HOUSE OF COMMONS
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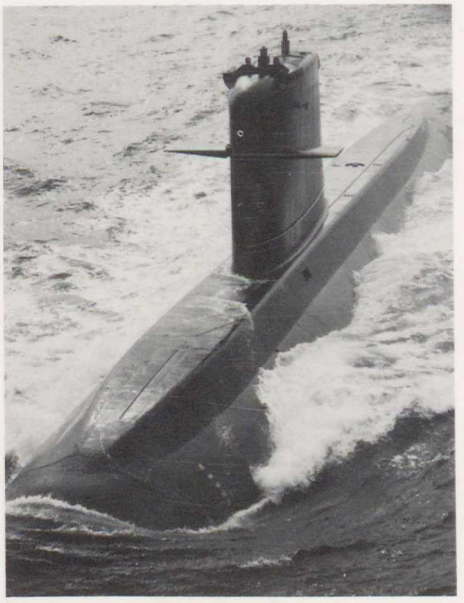
THE CANADIAN SUBMARINE ACQUISITION PROJECT



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A Report of the
Standing Committee
on National Defence

August 1988

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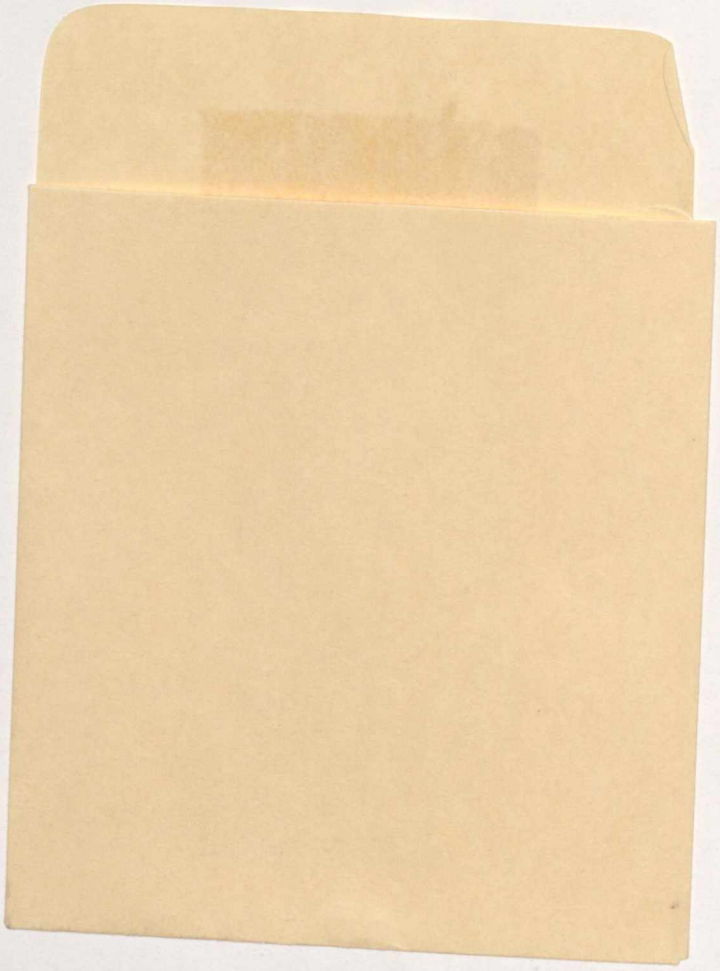

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Bottom: The British *HMS Turbulent* (courtesy of VSEL Defence Systems Canada Inc.)

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HOUSE OF COMMONS

Issue No. 41

Tuesday, August 16, 1988

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CHAMBRE DES COMMUNES

Fascicule nº 41

Le mardi 16 août 1988

Président: Patrick Crofton

Minutes of Proceedings and Evidence of the Standing Committee on

National Defence

Procès-verbaux et témoignages du Comité permanent de la

Défense nationale

RESPECTING:

Consideration of the White Paper on National Defence (The Canadian Submarine Acquisition Project), pursuant to Standing Order 96(2)

CONCERNANT:

L'étude du Livre blanc de la Défense nationale (Le Programme canadien d'acquisition de sous-marins), conformément à l'article 96(2) du Règlement

INCLUDING:

The Second Report to the House

Y COMPRIS:

Le deuxième rapport à la Chambre

Second Session of the Thirty-third Parliament, 1986-87-88

Deuxième session de la trente-troisième législature, 1986-1987-1988

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The Standing Committee on National Defence has the honour to present its

SECOND REPORT

Pursuant to Standing Order 96(2), your Committee has considered the White Paper on National Defence, more specifically the Canadian Submarine Acquisition Project.

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GLOSSARY OF TERMS

AECL	Atomic Energy of Canada Ltd.
ADCAP	advanced capability model of the Mark 48 torpedo
ACSAS	advanced conformal sonar acoustic system
AMÉTHYSTE	improved version of French Rubis-class of nuclear-powered attack submarines
ASROC	anti-submarine rocket
ASW	anti-submarine warfare
Cmdre	commodore
CF	Canadian Forces
COMCANLANT	Commander, Canadian Atlantic
CPF	Canadian patrol frigate
DDH-280	Canada's most modern destroyers. The four ships are referred to as the Tribals, or Tribal class
DELEX	destroyer life extension program
DND	Department of National Defence
ECM	electronic countermeasures
ELF	extremely low frequency (radio)
EMP	electromagnetic pulse
GIUK gap	the sea passages between Greenland, Iceland and the United Kingdom
HF	high frequency (HF)
HMCS	Her Majesty's Canadian Ship

LRPA	long-range patrol aircraft
MAD	magnetic anomaly detection
MARCOM	Maritime Command
MARPAC	Maritime Forces, Pacific
MRPA	medium-range patrol aircraft
NATO	North Atlantic Treaty Organization
NORAD	North American Aerospace Defence system
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
Oberon	British-built, diesel-electric class of submarines used by the Canadian, British, Australian, Chilean and Brazilian navies
PWR	pressurized water nuclear reactor
R&D	research and development
RAdm	rear-admiral
RFP	request for proposals
RCN	Royal Canadian Navy
RCNR	Royal Canadian Naval Reserve
RCNVR	Royal Canadian Naval Volunteer Reserve
RN	Royal Navy (UK)
Rubis	first class of French nuclear-powered attack submarines
SACLANT	Supreme Allied Commander, Atlantic (NATO)
SLBM	submarine-launched ballistic missile
SLCM	submarine- or sea-launched cruise missile

Snorkel	tube for drawing air from the surface to ventilate a submarine's diesel motors and provide fresh air for the crew
Snort	to use a snorkel
SOSUS	sound surveillance system
SSB	diesel-electric ballistic-missile submarine
SSBN	nuclear-powered ballistic missile submarine
SSG	diesel-electric guided-missile submarine
SSGN	nuclear-powered guided missile submarine
SSK	diesel-electric attack submarine
SSN	nuclear-powered attack submarine, also known as a "hunter-killer"
SSN 20	successor to the British Trafalgar class
STANAVFORLANT	Standing Naval Force, Atlantic (NATO)
SUBACS	submarine advanced combat system
SUBROC	submarine-launched rocket
SURTASS	surveillance towed-array sensor system
TACTAS	tactical towed-array system
Trafalgar	most recent class of British nulcear-powered attack submarines
TRUMP	Tribal-class update and modernization program
USN	United States Navy
USS	United States Ship
VAdm	vice-admiral
VLF	very low frequency (radio)

INTRODUCTION

The acquisition of 10 to 12 nuclear-powered submarines for Canada's navy has emerged as the most controversial and most publicized aspect of the government's White Paper on defence. Even though the first official announcement came in June 1987 with publication of *Challenge and Commitment: A Defence Policy for Canada*, the debate is far from over.

It is the largest single equipment purchase in the history of the Canadian Armed Forces. In military terms, it is bound to have a substantial impact on the way Canada's naval personnel see themselves, their roles and their capabilities. Canadian taxpayers and Parliamentarians will have to weigh the benefits and costs. Our allies and adversaries will also have to take stock of Canada's defence posture.

The acquisition is a long-term project that will stretch well into the next century and affect generations to come. At the time of writing of this report, the necessarily largely confidential process of ascertaining which country-of-origin will provide the design and technology for Canada's new submarine fleet was yet to be completed. As a number of witnesses told the Committee, cost data was not yet firm, nor had the specifics been made public of how the two contenders — the British Trafalgar class submarine and the French-built Rubis-Améthyste — would meet the safety, cost and operational requirements of the Department of National Defence.

Recognizing the importance of the submarine acquisition, but mindful of the limited information available at this stage in the process, the Standing Committee on National Defence has prepared an interim report on the program. The aim of the report is to provide some background on the history and evolution of submarine warfare, to summarize testimony and submissions to the Committee and to lay the foundation for further discussion and study.

The report includes sections drawn from published material and staff interviews dealing with submarine warfare, Canada's past involvement with the operation and construction of submarines and a brief description of developments in anti-submarine warfare. Testimony before the Committee has been summarized in sections on what have been seen to be the major

issues surrounding the submarine acquisition initiative: how the government came to the decision to acquire nuclear-powered submarines, the strategic rationale for the acquisition, Canadian maritime requirements, cost, safety and nuclear non-proliferation concerns, and the nature and impact to the acquisition process.

The Committee heard testimony from the Minister of National Defence, the Honourable Perrin Beatty, officials from government departments directly involved in the acquisition process, outside analysts, organizations and individuals. Submissions made during the course of the public hearings and published material have also been drawn on by the Committee's staff in preparation of this report.

Those who have followed the Committee's deliberations and the public debate surrounding the government's initiative are aware that the Official Opposition spokesmen and spokesmen for the New Democratic Party reject Canada's acquisition of nuclear-powered submarines, while Progressive Conservative Members of the Committee support the program.

It is the hope of all Members of the Committee that this interim report will contribute to an essential public debate, not only on the future of the Canadian navy's submarine fleet, but also Canada's overall security needs for the future.

1. SUBMARINE WARFARE

SOME HISTORY

The earliest known attack by a submarine on a surface ship occurred in the War of 1812, when David Bushnell, an American, used his own submersible to bore a hole in a British vessel anchored off New London, Connecticut. Fifty years later during the American Civil War, a Confederate submarine destroyed a Union warship in Charleston's harbour. By 1914, all major navies had submarines.

The capabilities of submarines and their roles in warfare have evolved dramatically since the early years of this century. During the World Wars, diesel-electric-powered submarines were used offensively against surface ships and defensively in support of surface ships. With the launching in 1955 of USS Nautilus, the world's first nuclear-powered ship, submarines began to be seen as both long-range and short-range weapons, particularly with the advent of submarine-launched ballistic missiles capable of destroying entire ports, inland cities and ships at sea. A submarine's most important mission in peacetime is information gathering or "marking" (trailing) enemy submarines.

As aircraft carrier battle groups became increasingly important to overall United States Navy strategy in the late 1970s, high-speed nuclear-powered attack submarines (SSNs) took on the added role of directly supporting surface fleets, being less vulnerable than ships to detection and destruction. Submarines also added to a navy's flexibility by being able to operate effectively as single units. Nuclear-powered ballistic missile submarines (SSBNs) or "boomers", for example, operate independently in their deterrent role. Submarines can also be used for minelaying and limited troop deployment.

The 1982 Falklands War between the United Kingdom and Argentina has been seized upon by many military analyts as an important case study of the realities of modern naval capabilities and tactics. The war provided persuasive evidence of how effective submarines, diesel-electic powered or nuclear propelled, can be. After a Royal Navy nuclear-powered attack submarine sank the Argentinian cruiser General Belgrano, British submarines were seen as a sufficient threat to keep Argentina's surface fleet

within its territorial waters for the remainder of the war. Equally, the inability of the Royal Navy to locate and destroy the diesel-powered Argentinian submarine San Luis, despite a 36-day search and the use of a large number of anti-submarine warfare (ASW) weapons, demonstrated the vulnerability of surface fleets and the technological limits of anti-submarine operations.

MAJOR NAVIES AND FLEET MIXES

The so-called Club of Five nuclear-powered submarine navies is made up of the United States, the Soviet Union, the United Kingdom, France and China. Each has a combination of nuclear-powered ballistic missile and attack submarines, along with diesel-electric powered submarines (SSKs). (see Table 1) The American, Soviet, British and French nuclear-powered submarine fleets all have the capability to launch cruise missiles. Sixteen Soviet and three Chinese conventional boats reportedly can fire these sea-skimming missiles against surface ships and land targets. India has recently acquired a Soviet-built nuclear-powered submarine through a leasing arrangement and Brazil is reportedly attempting to develop and acquire nuclear-propulsion technology.

TABLE 1

PRINCIPAL NUCLEAR-POWERED SUBMARINE FLEETS

	NUCLEAR-POWERED			DIESEL-POWERED		
COUNTRY	**SSBN**	**SSGN**	**SSN**	**SSB**	**SSG**	**SSK**
U.S.A.	37+5	0*	97+48**	0	0	4
U.S.S.R.	62	52+1	76+2	15	16	135+2***
U.K.	4+1+(3)	0*	15+3	0	0	13+1+(3)
France	6+(1)	0*	6+1+(3)	0	0	14
China	4+(2)	0	3+2	1	3	102+3

(Figures include all submarines in operation and at various stages of production. For example, the Table shows the U.K. to have 4+1+(3) SSBNs. That includes 4 in commission, 1 in production, and 3 in the planning stage.)

* 4 Los Angeles class and 4 Sturgeon class SSNs are fitted with Tomahawk submarine launched cruise missiles, as well as Sub-Harpoon sub-surface-to-surface cruise missiles (SSMs). The British Trafalgar class submarine is equipped with the Sub-Harpoon. The French Rubis class submarine is fitted with SM 39 cruise missiles, an adaptation of the MM 38 Exocet missile.

** The 48 U.S. SSNs that are listed as currently being built include 30 SSN-21 Seawolf class submarines now in the planning stage

*** The Soviets are said to have an additional 65 SSKs in reserve

Source: *Jane's Fighting Ships 1987-88*

The 1983 report on Canada's Maritime Defence by the Sub-committee on National Defence of the Standing Senate Committee on Foreign Affairs argued that a competent navy is one which has a well-balanced, mixed fleet:

> Operating together, air, surface and sub-surface units do more than simply compensate for each other's weaknesses: they take on a strength greater than the sum of their parts. For this reason balance should always be sought among the various elements when equipment purchases are being considered. Further, it is simply unwise to place all or most of one's eggs in one basket, because it is always possible that new developments or conflicts of some unforeseen kind might render one or another weapons platform permanently or temporarily ineffective. There must always be something to fall back upon. (p. 47)

The statistics on the mix of surface ships, submarines and naval aviation in the U.S., Soviet, British and French fleets indicate that each country's navy is quantitatively and qualitatively different in many respects. (See Table 2) As well, fleet mixes are always being altered. For example, the Soviets are currently attempting to improve their naval aviation capability and are introducing a new class of aircraft carrier. The United States has begun development of the new nuclear-powered attack submarine, the Seawolf.

TABLE 2

FLEET MIXES

	U.S.A.	U.S.S.R.	FRANCE	U.K.	CANADA
PRINCIPAL COMBATANTS:					
Submarines	138	356	26	32	3
SURFACE SHIPS:					
Aircraft carriers	15	6	3	3	0
Battleships	3	0	0	0	0
Cruisers	36	37	1	0	0
Destroyers	68	63	16	14	4
Frigates	115	168	25	35	16
TOTAL:	237	274	45	52	20
NAVAL AVIATION:					
Combat aircraft*	1701	984	122	37	33
Helicopters	313	335	24	160	32

* Includes aircraft carrier fighter, land-based bomber/fighter, ASW and reconnaissance aircraft.

Source: *Jane's Fighting Ships 1987-88*

OTHER NAVIES

The submarine component of the other navies in the North Atlantic Treaty Organization (NATO) countries varies from no submarines in the Belgian navy to 24 conventional boats in the West German fleet. Except for nine of Turkey's submarines, which were built in the late 1940s, most of NATO's conventional boats were commissioned during the 1960s and early 1970s. Italy, the Netherlands, Norway and West Germany are in the process of adding to their conventional submarine fleet. Of the non-NATO West European navies, Sweden has 12 conventional-powered vessels, four are currently in production and four more are proposed; Finland has no submarines.

Among Warsaw Pact countries, Poland has three conventional submarines, Romania one, and Bulgaria four. All are Soviet-built. Of the non-Warsaw Pact East European countries, Yugoslavia has five domestically-made diesel-powered boats, with a new class currently in production; Albania has three Soviet-built conventional vessels.

Apart from Canada, Brazil is the only country currently seeking the appropriate technology transfers to build its own nuclear-powered submarine. If the plan goes ahead, Brazil's nuclear-powered vessels will add to its current submarine fleet of eight conventional boats, with another one under construction and four more in the planning stages. In February 1988, India took delivery from the Soviet Union of a leased nuclear-powered submarine with cruise missile capability. It is not yet clear whether India intends to use it as a cruise-missile boat. India's current fleet of submarines includes 11 diesel-electric boats, six more under construction and three more planned.

2. TECHNOLOGICAL CHANGE

AN OVERVIEW

During the First World War, the average submarine weighed 675 tonnes, was equipped with four torpedo tubes and had a range of 5,560 kilometres. Its maximum speed was 14 knots surfaced and 10 knots for one hour submerged. By the end of the war, a few submarines were up to 798 tonnes in size, were equipped with six torpedo tubes and two deck-mounted guns, and had a range of 9,260 kilometres.

Critical technological advances made during the interwar period included improvements in submarine ranges (to 12,038 kilometres), diving depth (to 183 metres) and diving speed (a 50 per cent cut to 30 seconds). At the close of the Second World War, snorkels to "snort" air for a submarine's diesel engines and crew were becoming standard equipment. Improvements in anti-submarine warfare (ASW) technology resulted in a uneasy balance between submarine and ASW capabilities. According to Capt. John E. Moore, Royal Navy, retired, editor of *Jane's Fighting Ships, 1987-88*:

> Ever since the submarine was first acknowledged as a major threat to surface ships, the struggle to find an antidote has continued, only to lag behind for the majority of the last 75 years. (p. 113)

Diesel-powered submarines were originally designed for maximum surface speed and to submerge only to attack and to avoid detection. Nuclear power brought a qualitative change in capability, enabling submarines to remain submerged for indefinite periods of time because of their ability to replenish depleted oxygen and to outpace surface vessels at sonar operating speeds, (the speed at which the noise generated by a tracking vessel's engine, hull and other sources of sound is less than the noise produced by its target). While the average diesel-electric submarine has a range of 18,600 kilometres, nuclear power provides virtually limitless endurance, in some cases up to nine years without refuelling. The main limitations are food supplies for the crew and the boredom of long patrols. In contrast, an average diesel-powered frigate has a range of 9,300 kilometres, without refuelling.

SOUND

Sound travels almost five times as quickly in water as it does in air, depending on the water pressure and temperature. As well, sound does not dissipate as quickly in water. Consequently, a loud sound at a depth of 90 to 120 metres may be heard 23,000 kilometres away. There are two kinds of sound-detecting sonar: passive (listening); and active (echo-ranging). The earliest sonars were a submerged tube a sailor put his ear to. Later, the hydrophone was invented, which transformed sound waves into electrical waves. Signals could then be amplified and turned back into sound. Hydrophones could also be used in an active mode by sending out a sound, waiting for it to bounce off a target and listening for the echo. Submarines have been fitted with a number of different sonar systems, the latest being the Submarine Advanced Combat System. For the U.S. Seawolf class, an Advanced Conformal Sonar Acoustic System will be used to take advantage of improved sonar antenna placement on the newly-designed hull.

OCEAN SURVEILLANCE

The shortest route into the North Atlantic for Soviet submarines of the Northern Fleet is through the sea passages between Greenland, Iceland and the United Kingdom (the GIUK gap). Since the early 1950s, a network of listening devices called the Sound Surveillance System (SOSUS) has crisscrossed these chokepoints, transmitting data along cables to shore-based listening posts and other strategic command points around the world. Over 20 such command centres have since been built. Reportedly, if a submarine can in fact be heard, SOSUS can pinpoint it within a 130-square-kilometre area of ocean.

STEALTH

Improvements in sonar have accompanied advances in submarine stealth qualities, principally in the area of quietening. In his testimony before the Committee, RAdm John Anderson, Chief of the Submarine Acquisition Project at the Department of National Defence, argued that: "...Quietening is probably the single most important improvement they (the Soviets) can make to enhance the effectiveness of their nuclear attack boats." (February 2, 1988, Issue No. 24:9)

The Soviets have historically lagged behind the Americans in such technology but espionage activities and the illegal sale by Toshiba of propeller milling technology has helped their position considerably. Over a period of years, John Walker, who had access to U.S. Navy codes, provided the Soviets with the details of the encrypted messages American submarines exchanged. The messages included information on what Soviet submarines had been spotted and what noises gave them away, thereby indicating to the Soviets where their weaknesses lay. The propeller technology case involved the sale in 1984 to the Soviets of four advanced milling machines and four computerized numerical controllers to guide propeller cutting heads. At moderate speeds much of a submarine's noise originates from propeller turbulence, or cavitation, and Soviet propellers have been noisier than Western-built propellers. The sale violated the West's embargo on transfers of technology with military applications and enabled the Soviets to produce almost flawless propellers. Despite these two cases, RAdm Anderson testified that Soviet: "...quiet speeds will remain much lower and the maximum speed at which they can use passive sonar will probably remain lower than the speed in Western submarines." (February 2, 1988, Issue No. 24:9)

Other ways to improve the quietness of a submarine include: insulating the propulsion unit from the hull with resilient mountings and/or installing the unit on a large raft inside the hull; enveloping the outside of the submarine with anechoic (anti-echo) coating or tiling, which reduces the amount of energy reflected by an active searching sonar; rounding out the shape of the hull to reduce turbulence; and other hull improvements, such as the use of titanium to reduce the magnetic effect of a hull and to avoid triggering mines and detection by airborne magnetic anomaly detection (MAD) equipment. With improvements in these areas in the last 25 years, Soviet Mike, Sierra and Akula-class SSNs have become substantially more elusive.

DEPTH AND SPEED

Diving depth is another critical stealth quality. Depth capability depends on the circularity and the thickness of the hull, as well as the types of materials used in hull construction. The Soviets have developed a titanium-alloy hull that permits the Alfa class submarines to dive to 700 metres — 250 metres deeper than the reported diving depth of any Allied combat submarine.

Speed is also a defence as it allows for rapid deployment and permits a submarine to engage and disengage and, if necessary, to outrun an enemy submarine and its weapons. The Seawolf class will be able to travel at an estimated 45 knots submerged. The Soviet Alfa class is estimated to be able to attain 45 knots while submerged.

THE ROLE OF SATELLITES

Satellites are increasingly playing an important role in submarine detection. Satellites are able to spot submarines in port or on the surface at sea. Some success as well has been achieved in the monitoring by satellites of shallow sub-surface submarine movements. Synthetic aperture radar can detect slight movements on the ocean's surface caused by a submarine passing below. However, Eldon J. Healey, Assistant Deputy Minister (Materiel) for the Department of National Defence, told the Committee that while there may be "incremental improvements" in the ability to make oceans transparent in the future, no dramatic breakthroughs are expected in the next 10 to 20 years.

COMMUNICATIONS

Communication between submarines and surface ships is difficult. Long-range high radio frequencies (HF) are seldom used for transmission because they are relatively easy to detect by direction-finding shore or shipboard equipment. Submarines can receive Extremely Low, Ultra-Low and Very-Low frequencies (ELF, ULF and VLF, respectively), from surface ships and coastal stations, but cannot send messages because equipment for such transmission is too large to be fitted in submarines. The VLF system used by the United States Navy to communicate with its submarine fleet is reportedly invulnerable to the Electromagnetic Pulse Effect that would be caused by a nuclear air burst over sensitive communications equipment, is practically impossible to jam and is unaffected by abnormal propagation conditions. However, because of its slow data transmission rate VLF can only be used for short messages. Receiving depth can be increased significantly by streaming a buoyant wire antenna, or by towing a communications buoy at set times. Submarines can effectively transmit and receive Ultra-High (UHF) and Very-High (VHF) radio frequencies, but such transmissions require a boat to either extend an antenna above the surface or send an expendable buoy to the surface.

TORPEDOES

The U.S. Navy's Mark 48 torpedo is considered the West's most effective. The wire-guided Mark 48 has a range of 38-50 kilometres, depending on modifications, a speed of 40-55 knots, and carries a 267 kilogram explosive charge. The Mark 48 is currently being upgraded to the ADCAP (advanced capability) configuration to counter high-speed, deep-diving Soviet submarines. Its estimated diving depth is 900 metres. The Mark 48/ADCAP is also intended to minimize shipboard constraints such as warmup and reactivation time, and provide enhanced effectiveness against enemy surface ships. The comparable Soviet torpedoes are the Type 45, Type 53 and Type 65. The first has active and passive sonar guidance, a range of 10-15 kilometres, a speed of 35-40 knots and carries a 100-150 kilogram explosive charge. The Type 53 is fired with a preset course and then homes in with active and passive sonar. Its range is 4-20 kilometres at 28-45 knots and it can carry a 400 kilogram charge or low-yield nuclear warhead. The Type 65 is an anti-surface ship weapon with pattern guidance, active and passive sonar and wake-homing capabilities. Range is 50-100 kilometres at 30-50 knots. It can carry a 900 kilogram explosive charge or a low-yield nuclear warhead. The Type 53 reportedly has a diving depth of 800 metres.

CRUISE MISSILES

The Soviets pioneered the submarine-launched ballistic missile (SLBM) in 1957 when three missiles were fired from a Zulu-class conventional boat. The United States caught up and surpassed the Soviet technology first with its Polaris and then Poseidon and Trident missiles. SLBMs are capable of inter-continental flight at great speed and have considerable accuracy. Ranges exceed 8,300 kilometres. Cruise missiles launched from guided-missile submarines, also pioneered by the Soviets, have shorter ranges but greater accuracy than submarine-launched ballistic missiles. Up until 1967, all cruise-missile submarines had to surface to launch their missiles, which can be equipped with nuclear, conventional, chemical, or biological/bacteriological warheads. Once considered as chiefly anti-ship weapons, sea-launched cruise missiles now have shore bombardment capability. The Soviets have developed submarines specifically designed around cruise missiles, whereas the Americans decided in the early 1970s to design their SLCMs to be compatible with existing torpedo and ballistic missile tubes.

The U.S. Sub-Harpoon and Tomahawk cruise missiles have a range of 120 kilometres and 2,500 kilometres, respectively. In his testimony before the Committee, the Hon. Perrin Beatty said it is not the government's intention at the present time to purchase the Sub-Harpoon cruise missile. VAdm Charles Thomas added:

> ...At the moment the anti-ship capability that is the result of a weapon like the Harpoon is not at the top of our priority list. When I have to make that trade-off between choices, I would rather have the more capable submarine and the more capable torpedo, and that is the direction in which our requirement has been written.
>
> (March 7, 1988, Issue No. 29:23)

The Soviet counterparts to the Tomahawk, the SS-NX-21 and the SS-NX-24, reportedly have ranges of 3,000 kilometres and 1,600 kilometres, respectively.

3. CANADIAN SUBMARINES: 1914-1988

THE FIRST WORLD WAR

Canadian operation of submarines dates back to 1914, when British Columbia, alarmed by the existence of a German Pacific Fleet, purchased two American boats originally built for the Chilean Navy in Seattle, Washington. The deal was closed by the Premier of the province, Sir Richard McBride, for $1.15 million and the boats were transferred to the command of a retired Royal Navy officer, before eventually being turned over to the four-year-old Royal Canadian Navy. Although the German fleet never approached British Columbia and was ultimately defeated off the Falkland Islands, Canadian crews operated CC-1 and CC-2 on the West Coast until 1917, when they travelled through the Panama Canal to Halifax to be used in defensive patrols and anti-submarine warfare training. During the First World War, Canadian Vickers in Montreal built 18 American-designed, Holland-class submarines for the Royal Navy and the Italian navy, under the supervision of experts from the Electric Boat Company in Groton, Connecticut. Another 17 prefabricated hulls were assembled at Vancouver and Montreal for the Russian navy.

At sea, German U-boats ravaged transatlantic shipping after unrestricted attacks were authorized in 1917. U-boats sank 800 ships between February and April of that year. However, the introduction of the convoy system, with combined surface and air escort, cut losses dramatically. In the latter months of the war, only five ships in convoys were lost to U-boats. In all, over 5,000 Allied ships, totalling 11 million tonnes, were sunk. U-boat losses were also high. Of the 345 built during the war, Allied navies and air forces sank 178, killing 5,364 crew members.

BETWEEN THE WARS

After the Armistice, the United Kingdom transferred two newer Holland-class boats to Canada to replace CC-1 and CC-2, but cuts in navy spending in the early 1920s forced the retirement of the two submarines. With the rise of Adolph Hitler and the rebuilding of the German navy, the main threat to Canada was seen as air or raider ship attacks on shore facilities and merchant and naval shipping. The effectiveness of First World War convoys and the development of an early type of sonar, known as

ASDIC, were believed by the British Admiralty to have rendered the submarine largely ineffective.

THE BATTLE OF THE ATLANTIC

By the outbreak of the Second World War, Germany had built 57 U-boats and had published a submarine warfare doctrine incorporating night-time, surface attacks on convoys by "Wolf Packs" of boats. The German U-boats were of two types: a 500-tonne class with a cruising range of 17,700 kilometers, and 700-tonne boats with a range of 24,000 kilometers. They carried 14-21 torpedoes with a maximum range of 14,000 metres and a speed of 40 knots. The torpedoes could be surface-launched or fired from a depth of 60 metres. Under attack, the quick and sturdily-built German boats were difficult to hit and even harder to destroy. A 136-kilogram depth charge had to explode within seven metres to be lethal. The Battle of the Atlantic centred on the effort to resupply the United Kingdom and, eventually the Soviet Union, with equipment, strategic goods, and, in the case of Britain, manpower. For the German navy, the object was to choke off the flow of supplies from "Fortress America" and sap the British will to resist.

In the early war years, Canadian-escorted convoys suffered huge losses, the result of manning by inexperienced, ineffectively trained crews, poorly equipped with submarine detection equipment. In 1942, over 6 million tonnes of Allied shipping were lost, when 80 per cent of all ships torpedoed in the Atlantic were under Canadian escort. With better training, equipment and tactics, as well as the entry into the war of the United States, the Allies drastically cut shipping losses. Throughout the war, 25,343 Canadian-escorted ships carried 182 million tonnes of cargo from North America to the United Kingdom. Canadian warships sank, captured or destroyed 42 enemy surface ships, and sank 27 U-boats. The material and human cost was 24 Canadian warships sunk, 1,797 Canadian seamen dead, 319 wounded and 95 captured. Of the 1,162 U-boats built during the war, 632 were sunk and 28,000 German submariners killed. Canada built no submarines during the war, although the Navy and Air Force pleaded for training boats to practice anti-submarine tactics. The lack of shipyard space, absence of available ship designs and the overall cost mitigated against construction.

The United Kingdom borrowed nine First World War-vintage R- and S-class submarines from the United States and based four of them at Halifax and St. John's for training purposes. Twenty-four members of the Royal Canadian Naval Voluntary Reserve served in the Royal Navy and two Canadians eventually commanded British boats. Individual British and

French submarines on convoy duty operated out of Halifax and the Royal Navy's Second Submarine Flotilla operated out of Halifax for a short period.

THE POST-WAR PERIOD

During the early 1950s, the Soviet Union rapidly increased its fleet of conventional-powered submarines. Late in the decade it began installing ballistic missiles with a 480-km range in its Zulu-class diesel-electric boats. Meanwhile, the United States Navy was pressing ahead with nuclear propulsion development. In January 1955, the USS Nautilus became the first submarine to get underway on nuclear power. Three and a half years later, Nautilus made the first under-ice transit of the Arctic, passing under the North Pole from the Pacific to the Atlantic. In the Soviet Union, the first nuclear attack boat, a November-class, went into service in 1958, followed closely by the Hotel-class, nuclear-powered ballistic missile sub. By 1963, the Soviets had built about 50 nuclear-powered boats, including attack submarines, cruise-missile launching boats and ballistic missile subs. Meanwhile, the United States commissioned about 30 ballistic missile and attack subs, including the ill-fated Thresher, which was crushed in a deep dive in April 1963 with 127 men on board.

In the 1950s, a British conventionally-powered submarine detachment exercised with Canadian anti-submarines forces based in Halifax. The Grilse, a large, fast American-built Tench-class diesel-electric boat, was acquired, in 1961 and based at Esquimalt for West Coast training. Both the Grilse and its later replacement, the Rainbow, were commanded and crewed by Canadians.

In the late 1950s, Canada began studying the possibility of acquiring nuclear-powered submarines. In June 1959, Department of National Defence planners recommended Canada state its intention to acquire one or more nuclear-powered boats, based on a proven United States design. The estimated average cost of each vessel was expected to be $50-55 million, operating and maintenance costs were estimated at $2.2 million for each submarine, and indirect costs for base development, shore training and submarine rescue facilities were estimated at a total of $15.5 million. Most of each vessel's plant and equipment was to be of United States origin, with a gradual changeover to Canadian content. The final target for Canadian content was to be about 60 per cent of production costs. The nuclear option was scuttled largely because there was little hope Cabinet would increase the Navy's budget to cover the cost.

The Government opted, instead, for three British-built Oberon-class diesel-electric patrol submarines at a cost of $16.4 million for each boat. Ojibwa, the first Canadian "O-boat", was commissioned in September 1965, followed by Onondaga in June 1967 and Okanagan in June 1968. The Oberons in the First Canadian Submarine Squadron based at Halifax have a complement of 65 officers and men, and house eight, 533-millimetre torpedo tubes, six in the bow and two in the stern. The 90 metre long by 8.1 metres in diameter vessels have a maximum speed of 12 knots surfaced and 17 knots submerged, with a maximum range of 16,665 kilometers surfaced at cruising speed. Maximum diving depth is 275 metres. Although the Oberons were originally purchased for anti-submarine warfare training purposes, their roles now include area and choke-point surveillance in the Greenland-Iceland-United Kingdom gap between the North Atlantic and the Norwegian Sea. In the early 1980s, all three underwent upgrades — the Submarine Operational Upgrading Program — to provide them with more modern sonar and fire control systems. The total cost of the SOUP project was estimated at $42.4 million in 1985. They are also being rearmed with the Mark 48 torpedo, which costs about $2 million each.

4. NUCLEAR-POWERED SUBMARINES FOR THE CANADIAN NAVY

THE WHITE PAPER

The Government's June 1987 White Paper on defence, *Challenge and Commitment: A Defence Policy for Canada*, set out several basic defence and foreign policy premises related to the decision to acquire nuclear-powered submarines. It described the Soviet Union as an expansionist military power which has devoted massive resources to attaining rough parity with the United States in strategic weapons, sustaining numerical superiority in weapons and manpower in Central Europe and extending the global reach of its navy. The main threat to North America was seen as a nuclear attack by the Soviet Union's land- and sea-based long-range weapons, while the "centre of gravity" of East-West confrontation remained Central Europe. The White Paper stressed as well that Canada must take into account the growing economic and strategic importance of the Asia-Pacific region and the Arctic Ocean.

As for the threat at sea, the White Paper stated that the Soviet Union is likely to increase its nuclear capabilities by deploying cruise missiles.

> ...Launched from offshore as far north in the Atlantic as the Labrador Sea, or in the Pacific, Soviet sea-launched cruise missiles could strike any military or industrial target in either Canada or the United States.
>
> ...Canadian Arctic waters could well provide an alternate route for Soviet submarines to move from the Artic Ocean to the Atlantic to reach cruise missile firing positions further south or to operate in more traditional roles against vital Allied shipping.
>
> (White Paper, p. 11)

The White Paper noted that one of the co-operative defence arrangements between Canada and the United States involves the surveillance of Soviet submarines, a mission which is aimed at deterring a long-range nuclear attack on North America by helping to protect the North Atlantic Treaty Organization's strategic nuclear forces based in the United States.

On the issue of sovereignty, the government's policy statement indicated that nationhood is predicated on "the ability to exercise effective

national sovereignty'' and noted that discussions have been undertaken to seek a solution to the dispute with the United States on the status of the Northwest Passage through the Arctic Archipelago. The United States does not recognize the Canadian assertion that the channels through the Arctic Islands are internal Canadian waters, not an international strait. According to the White Paper, a solution should be based on, "mutual respect for sovereignty and our common security and other interests.'' While noting that civilian authorities are reponsible for the enforcement of Canadian law throughout Canadian territory, it adds that:

> ...An important manifestation of sovereignty is the ability to monitor effectively what is happening within areas of Canadian jurisdiction, be it on land, in the air or at sea, including under the ice. But monitoring alone is not sufficient. To exercise effective control, there must also be a capability to respond with force against incursions.
>
> (White Paper, p. 24)

THE CASE FOR NUCLEAR-POWERED SUBMARINES

The White Paper argued the case for the acquisition of nuclear-powered submarines by stating that, "Canada's areas of maritime interest are vast and our resources limited.'' The Atlantic is seen to be of primary strategic importance to Canada and the NATO Allies because it would be the major lifeline from North America to Europe if a conventional war erupted. The Pacific has seen a significant increase in trade and military activity. The Arctic has become an operating area for nuclear-powered submarines. Deep channels through the Canadian Archipelago could be used for transit from the Arctic Basin to the Atlantic, or vice versa. According to the policy statement, insufficient numbers of obsolete naval forces are inadequate to meet the country's maritime requirements. The White Paper solution is a combination of upgraded and new surface ships, maritime aircraft and submarines.

> ...The goal will be greater flexibility, a more appropriate balance among air, surface, and underwater assets and the reorientation of Canadian naval forces toward effective operations in the Atlantic, the Pacific and the Arctic oceans.
>
> (Ibid, p. 51)

Tribal-class destroyers are being upgraded, a total of 12 frigates have been approved, Sea King helicopters will be replaced with a new anti-submarine helicopter, mine countermeasure vessels will be procured, new sonar systems will be developed, vessels to tow sonar arrays will be acquired and fixed sensors will be deployed in the Arctic. Completing the

new naval mix will be nuclear-powered submarines. The White Paper stresses that: "...submarines are essential to meet current and evolving long-range ocean surveillance and control requirements" in all three oceans, because of their capability to maintain higher sustained speeds than conventional submarines and their greater endurance.

> Through their mere presence, nuclear-powered submarines can deny an opponent the use of sea areas. They are the only proven vehicle, today or for the foreseeable future, capable of sustained operation under the ice. A program of 10 to 12 will permit submarines to be on station on a continuing basis in the Canadian areas of responsibility in the northeast Pacific, the North Atlantic and the Canadian Arctic. There they will be employed in essentially the same role now assigned to our diesel submarines. A fleet of nuclear-powered submarines is the best way to achieve the required operational capabilities in the vast Pacific and Atlantic oceans. In addition, the SSN (nuclear-powered attack submarine) is the only vessel able to exercise surveillance and control in northern Canadian ice-covered waters. SSNs will complement aircraft, destroyers and frigates in a vivid demonstration of Canadian determination to meet challenges in all three oceans. Such a highly capable, significant and versatile force will help to restore the effectiveness of the Canadian navy and prepare it to meet Canada's naval requirements well into the next century.
>
> (White Paper, pp. 52-54)

The White Paper states that a nuclear-powered submarine would be more expensive than a conventional submarine, but roughly the same cost as an air defence frigate. Acquisition of conventional submarines, plus a third batch of frigates, would be as costly as acquiring 10 to 12 nuclear-powered submarines over a 20-year period.

> ...Consequently, since the SSN is a more capable anti-submarine platform for all three oceans, it is deemed to be the best investment for the navy. Thus, although the number of surface ships will be allowed to decrease slightly, the resulting naval force will be more balanced.
>
> (Ibid, p. 54)

The submarines will not be nuclear armed and the White Paper stated that the acquisition is "compatible" with Canada's position on the non-proliferation of nuclear weapons and with Canadian environmental regulations.

5. THE STRATEGIC RATIONALE

THE THREAT

In the past 25 years, the Soviet navy has been transformed from "a small coastal defence force to a large, general-purpose, ocean-going navy, which is second only to the United States Navy in its range of activities and apparent power," Harriet Critchley, Director of the Strategic Studies Program at the University of Calgary, told the Committee. Of its four fleets, the Northern Fleet, based in the Soviet Arctic, has the highest proportion of submarines — about 60 per cent of all Soviet ballistic missile submarines, and 46 per cent of all other Soviet underwater craft. From the late 1960s to the present day, the Soviets have been steadily increasing the range of their sea-launched ballistic missiles, while the JWestern Allies have been establishing an intricate technological and operational network to monitor the comings and goings of Soviet vessels between their northern ports and the open North Atlantic.

As Dr. Critchley told the Committee:

> ...Over the last two and a half decades, as the Soviet Navy's submarine force grew and as a significant portion of that force was deployed in the Northern Fleet, NATO countries increasingly concentrated their efforts on monitoring Soviet submarine activity in and through the North Atlantic. By the late 1970s and early 1980s, the monitoring methods included satellites, sea-bottomed-mounted acoustical devices, sonar arrays towed by ships and aircraft, long-range patrols by sonar-equipped aircraft, patrols by sonar-equipped destroyers (with) sonar-equipped helicopters on board and by attack submarines and mining. The general area monitored describes a large arc in the North Atlantic from northern Norway (to) Bear Island to the waters between Greenland, Iceland and the northern United Kingdom (the GIUK gap). Other (similarly monitored) ocean areas include the Atlantic coast of the United States and the Pacific coast of the United States, incorporating Alaska and the Aleutians.
>
> (April 26, 1988, Issue No. 35:32)

THE "BASTION" STRATEGY

According to Dr. Critchley, the effect of a strategic chokepoint in areas of once open sea routes, coupled with the extended ranges of Soviet sea-based missiles (up to 9,100 kilometres in the case of the SS-N-8 Mod 2, from an original range of 1,400 kilometres for the SS-N-5 ballistic missile),

has led to the elaboration of what has become known as the "bastion" strategy. Relatively close to home ports in the Arctic, Soviet ballistic missile submarines now largely remain shielded by attack submarines, surface vessels, land-based aircraft, and, when the needed arises, the Polar ice cap and the ice-infested seas on the cap's fringes. While the Soviets concentrate operations in the Arctic, Allied navies with a responsibility to protect NATO's Northern Flank have continued operating in the Norwegian Sea.

In recent years, elements within the United States Navy have been promoting a "Forward Maritime Strategy" that, in part, calls for an onslaught into the Soviet bastions by carrier battle groups and attack submarines in the event of a conventional war in Europe. The ultimate goal is to neutralize the Soviets' sea-based strategic nuclear missiles and tip the balance of a conventional war in Europe in favour of NATO.

THE PACIFIC

Since the 1970s, the Soviet naval presence in the Pacific Ocean has increased by 80 per cent. About 40 per cent of all Soviet ballistic missile submarines and 30 per cent of all other types of Soviet submarines are based in the region. Along with the increase in numbers, has come more Soviet naval activity, including long-range patrols by ballistic missile submarines and an increase in operations of Soviet attack submarines and intelligence gathering ships off Canada's West Coast, particularly since United States Navy ballistic-missile subs, equipped with the Trident C-4 missile, began using the base at Bremerton, Washington, on Puget Sound. To gain access to the Pacific, the United States warships pass through the Straits of Juan de Fuca, which Canada shares responsibility for with the United States.

ARCTIC ACTIVITY

The Soviet bastion strategy and routine peacetime forward operations by NATO have caused a significant increase in activity in the Arctic Ocean and adjacent seas. With the establishment of the Greenland-Iceland-United Kingdom chokepoints, some naval strategists have pointed out that the channels through Canada's Arctic islands could serve as alternate routes for submarines heading north or south between the Atlantic and the Arctic. Although American and Royal Navy subs have publicized surfacings at the North Pole, Canada has no firm evidence of Soviet activity in Canadian Arctic waters.

A CANADIAN ASSESSMENT

The Chief of the Submarine Acquisition Project, RAdm John Anderson, gave the following general assessment of the Soviet threat before the Committee:

> The threat to Canada and our NATO Allies for the next 20 years is based on the hypothesis that relations between the superpowers will remain relatively the same. Neither will make such technological breakthroughs (that) would change its capacity to detect submarines at sea.
>
> ...Two of the Soviet navy's assessed five basic missions are strategic offence, which involves the use of submarine-launched ballistic and sea-launched land attack cruise missiles, and the protection of those launch vehicles or submarines, and secondly, the interdiction of sea lines of communication.
>
> (February 2, 1988, Issue No. 24:7)

The direct threats to Canada stemming from those two missions are perceived to be ballistic missile or cruise missile attacks on North America. A third threat is from attack submarines protecting the Soviet long-range missile boats. A fourth is based on the assessment that all Soviet submarines — ballistic-missile and cruise-missile carriers and attack submarines — have the capacity to use torpedoes or anti-ship missiles against warships and commercial vessels.

> Therefore, if there is a war with the Warsaw Pact countries, there will be Soviet nuclear-powered attack submarines in all three oceans. They will have the capacity to launch ballistic missiles, cruise missiles and torpedoes as well as surface-to-surface missiles. It is also possible, but less likely, that mines will be placed by these units in our waters.
>
> (Ibid, 24:8)

SOVIET CAPABILITIES

While the number of Soviet ballistic-missile submarines, currently 62, is expected to decline somewhat by the year 2008, and the fleet of attack submarines to remain stable between 100 and 120 boats, significant qualitative improvements are foreseen, including the introduction of cruise-missile capability for all Soviet submarines, greater weapons capacity and accuracy, introduction of a surface-to-air missile, enhanced under-ice capability, higher submerged speeds, better quietening, deeper diving depths, stronger hulls and improved navigation, communications and decoy

equipment. By 2008, only about 60 per cent of the Soviet submarine fleet will be less than 20 years old, compared with the current level of 80 per cent. The newer boats are expected to have the improved capabilities of the current top-of-the-line Soviet nuclear-powered attack boats — the Victor III, Sierra and Akula classes.

CANADIAN ROLES, OBJECTIVES AND TASKS

A statement of Department of National Defence roles, objectives and tasks, published in 1983, lists Canada's military roles as sovereignty protection, defence of North America, the fulfilment of agreed North Atlantic Treaty Organization commitments, and international peacekeeping.

SOVEREIGNTY

Under sovereignty protection, DND's stated objectives pertinent to Canadian submarine operations are:

* To ensure adequate overall capability for surveillance of Canadian territory, airspace and sea approaches,
* To reinforce, through military involvement, respect for and compliance with Canadian territorial and jurisdictional authority,
* To promote Canadian unity and identity,
* And to support search and rescue.

Specific sovereignty tasks include detecting, deterring and countering challenges to territorial sovereignty; providing surveillance in conjunction with other government departments over Canadian waters; providing surveillance of land and sea areas north of 60 degrees N latitude to reinforce the Canadian presence and to detect and identify unauthorized activities; to assist in ice surveillance; to support other departments in the exercise of their maritime regulatory responsibilites over surface and sub-surface vessels and if necessary to exercise military control over these vessels; to provide a national presence in conjunction with other departments in remote areas; and to provide a Canadian presence abroad through visits.

DEFENCE OF NORTH AMERICA

Under defence of North America in co-operation with United States forces, the 1983 statement indicated the pertinent objectives are:

* To deny the advantage of surprise attack on North America,

* To contribute to the protection of the land-based United States nuclear retaliatory capability, and

* To provide responses to other military threats against North America.

Specific North American defence tasks are to conduct sub-surface surveillance in conjunction with U.S. forces of shallow and deep-water areas of the seaward approaches to North America, including the Canadian Arctic and the Denmark Strait; to provide a continuing intelligence picture of potentially hostile submarine activities; in the event of hostilities, to carry out operations to detect and counter attacks on shipping in North American waters; to provide sea forces to deter military threats to North America waters; and to counter small incursions in isolated areas.

NATO COMMITMENTS

Under fulfilment of agreed on NATO commitments, the applicable objectives are:

* To prevent or contain an attack on the NATO area, which includes Europe, the North Atlantic and North America,

* To sustain the confidence of the U.S. and other Allies

* To ensure that Allied policies include provision for Canada's security interests.

Specific tasks are to provide distant and close protection for military and merchant convoys in transit across the North Atlantic, off the east and west coasts of North America and in northern European waters; to contribute to deterrence on NATO's Northern Flank; and to provide operational training for all environments.

CANADIAN OPERATIONS

Testifying before the Committee, RAdm Anderson stated that under current commitments to NATO Canada's conventionally-powered Oberons would be used "in barrier operations as part of NATO's layered defence in-depth concept for protecting the trans-Atlantic sea routes." Nuclear-powered attack submarines would function in the same role.

> ...They (nuclear-powered submarines) will operate under Canadian rules and according to doctrine established by the Canadian government. They will not be assigned to the command of other nations. The assumption of wartime operational control by NATO commanders would, as at present, be subject to Canadian agreement. The limits to the roles, tasks and missions we would undertake will be set by Canadian authorities on the basis of agreed Alliance guidelines.
>
> (February 2, 1988, Issue No. 24:12)

VAdm Charles Thomas, Commander of Maritime Command, told the Committee that Canada now provides 50 per cent of the committed escorts in NATO's Western Atlantic area that would be used to protect the sea lines of communication to Europe during a crisis or war. Canadian surface ships and submarines are committed to move right across the Atlantic. Tactically, a commander has the choice of keeping a protective shield of submarines close to a given convoy or "1,000 miles from that which you are escorting... and deal with the submarine before he can get in a position to fire."

Canadian escort operations could take place on the southern transatlantic route that passes by the Azores island group and along the Iberian Peninsula, or further north — the route that passes off Nova Scotia, south of Iceland and then to the United Kingdom.

As for the defence of North America, the Hon. Perrin Beatty stated that the government intends to hold new discussions with the United States "with regard to an integrated naval command, if you like, similar to the integrated air command we have."

> ...What is clear is that under our obligations with NATO and simply from the point of view of the importance of co-operating in the naval defence of North America, it would be essential for us to co-ordinate our activities and to work very closely with one another.
>
> The difficulty we have had to date is that we would come to the table to discuss dividing it up with very few assets to bring to bear. As we in the future talk about the defence of North America, and particularly the strategic importance of the Arctic, Canada will be in a position to bring some assets to the table, and for the first time be able to discharge more fully the responsibility given to us by NATO of protecting the waters in those Arctic areas. Of longstanding it has been Canada's responsibility, and yet Canada has not been able to discharge it.
>
> (March 7, 1988, Issue No. 29:27)

VAdm Thomas explained that one type of co-operation that is necessary is "water space management", in which moving blocks of ocean

are reserved for individual submarines through NATO North Atlantic Command headquarters in Norfolk, Virginia. In the words of VAdm Thomas:

> We have three submarines, we have a need to know where our submarines are going to go. When we have submarines of the force that we are talking about, we will be a full participant in that system. I suspect that anybody operating in waters of interest to Canada will make sure Canada knows about it, because the prospect of blue bumping into blue in the night at 600 feet is not entertaining.
>
> (March 7, 1988, Issue No. 29:26-27)

CANADA AND THE U.S. FORWARD MARITIME STRATEGY

The U.S. Maritime Strategy or Forward Maritime Strategy was first made public in January 1986 by Adm James D. Watkins, then the U.S. Navy's Chief of Naval Operations. One aspect of the strategy advocates closing the Greenland-Iceland-United Kingdom gap and then attacking into the Soviet sea bastions using aircraft carrier battle groups and attack submarines to ferret out and destroy Soviet ballistic missile submarines, nuclear-powered attack submarines and surface ships, as well as to strike at Soviet shore facilities. One facet of the strategy is to come to the defence of northern Norway. The strategy, which has not been formally endorsed by NATO, calls for U.S. and allied naval forces "to sieze the initiative as far forward as possible. Naval forces will, destroy Soviet forces in the Mediterranean, Indian Ocean and other forward areas, neutralize Soviet clients if required, and fight our way toward Soviet home waters," Adm Watkins wrote in the Proceedings of the U.S. Naval Institute.

Critics of the strategy say it would trigger a nuclear exchange between the superpowers if the Soviets felt that the U.S. offensive was significantly tilting the nuclear balance in favour of the West, or that the sea leg of their strategic nuclear forces was in danger of being wiped out entirely. A successful Allied offensive in the Norwegian Sea could also leave northern Soviet forces decimated and the Russian heartland exposed — a scenario in which critics fear Moscow could feel compelled to launch land-based ballistic missiles against North American and other targets.

Gen Paul Manson, Chief of the Defence Staff, gave the following assessment of the U.S. Maritime Strategy:

> ...The fact is that it is an American strategy and I do not think anyone would deny the right of the Americans in a sovereign way to establish their own strategy, just as Canada does.

Canada, as a member of the NATO alliance, subscribes to NATO maritime strategy, and it is a very well articulated strategy being developed extensively over a long period of time. Canada itself has had an important part in the development of that strategy.

The U.S. maritime strategy has been criticized on the grounds that it is a forward strategy. In some respects it might be destabilizing, particularly in the sense that some people maintain that the United States Navy would enter the so-called bastions to attack missile-launching submarines. This raises the question as to whether or not that would be destabilizing or stabilizing. That debate continues. There is no definitive answer to it.

Of course, that is true of many aspects of the debate about deterrence in general. The uncertainty itself, I might add, is stabilizing in that a part of deterrence is uncertainty. As long as there is uncertainty in the mind of one side or the other, he does not have a clear path ahead of him if he has aggressive intent. So NATO, in its strategy, does build in an element of uncertainty.

The fact remains that the U.S. maritime strategy, as we in Canada see it, is an extension of the strategy that they have followed in respect of the maritime forces since the days of World War II. It calls for the employment of American naval forces, on essentially a global scale, concentrating in those oceans of the world where trouble spots may occur, in peacetime or in wartime. Thus, you will find maritime forces in the Pacific Ocean, Indian Ocean, in the area of the Persian Gulf, in the Mediterranean, in the North Atlantic and, perhaps in the future, in the Arctic as well.

I do not think anyone would deny the fact that it is a reasonable component of that strategy, which is shared completely with NATO in its maritime strategy, to bottle up the Soviet north fleet in the area of the Greenland-Iceland-U.K. gap. Because if in a conventional conflict the Soviet fleet were permitted to break through that gap into the North Atlantic Ocean, it would present great risk to the resupply of the European theatre of war by resources from the North American continent. That would be a very dangerous situation indeed for the ability of NATO to sustain a defence and to keep the nuclear threshold at a reasonable level.

So all these things considered, the important fact is that Canada is not obliged in any way to follow American strategy, whether it is good or bad. We do have our own maritime strategy, and we would follow the direction of the Canadian government in any conflict.

(February 3, 1988, Issue No. 25:12-13)

Asked whether Canadian nuclear-powered submarines under the command of NATO's Supreme Allied Commander Atlantic (SACLANT) would be drawn into the American strategy, Gen Manson told the Committee:

That is a decision that would be made by the government of the day; and, as I said, we would not by any means be compelled to follow any American strategy that the government of Canada felt was not proper in the circumstances. There is no compulsion in the fact that Canada belongs to NATO to follow any strategy that Canada does not agree with.

...Because these vessels are not in service and will not be for another nine years, we have not, of course, as is well known, come to any arrangements with NATO or with the United States regarding the command, control and employment of nuclear submarines when they finally arrive on the scene.

(February 3, 1988, Issue No. 25:14)

RAdm Anderson testified that while some Canadian forces are committed to barrier duty operations under NATO that are aimed at "attriting" submarines as they try to enter the North Atlantic:

...The important thing is that even though that is in place today, the acceptance of that sort of mission was one that was agreed to by the Canadian government, and it would be only in terms of committing forces that the government would agree to that occurring with the escalation of tension. So you always have, regardless of what your submarine is doing, the control being excercised by the Government of Canada.

Now, at a certain stage of alert, we have committed certain forces to the Supreme Allied Commander, Atlantic. He would then exercise operational control over our units. But the command of the submarine is still handled by a Canadian — in fact, working to very specific Canadian guidelines. In terms of the use of the submarines, there would be an allied effort that we would be contributing to, but only with the concurrence of the Canadian government.

(Ibid, 25:11-12)

OUTSIDE VIEWS

Ray Creery, Chairman of the Research Committee of Veterans Against Nuclear Arms, an organization critical of the nuclear-powered submarine acquisition, contended that Canadian submarines would be inexorably drawn into the U.S. maritime strategy.

If we acquire nuclear-powered submarines, then we should realize that their capabilities, plus the indivisible nature of the operations envisaged, will almost inevitably draw these submarines into execution of the U.S. maritime strategy — defensively at first, thereby freeing U.S submarines for their offensive tasks, but possibly offensively later.

> The possibility that acquiring nuclear submarines will draw Canada into a strategy that makes a first nuclear strike the preferred option in certain circumstances is reinforced by the necessity of engaging in joint operations. Canadian submarine operations would be co-ordinated with those of other NATO navies exercised by the Supreme Allied Commander, Atlantic, because of the necessity of making sure that friendly submarines do not operate in the same area.
>
> Under operational conditions, communications would have to pass through the U.S. Navy's Very-Low-Frequency radio system, because only VLF signals can reach a submerged submarine and the Canadian navy has no VLF station. With joint operations going forward in a crisis, it might not seem reasonable or technically acceptable to separate the U.S. and Canadian components.
>
> (May 3, 1988, Issue No. 36:27)

Joel Sokolsky, assistant professor in the Department of Political and Economic Science at the Royal Military College of Canada, stated in his testimony before the Committee that "the last thing in the world the U.S. Navy appears to want at this time," would be Allied help in going into the Soviet ballistic-missile submarine bastions.

> It is argued that Canada would become a silent partner in this counter-SSBN strategy. If we had SSNs (nuclear-powered attack submarines), we would know the U.S. was in our Arctic. We would not say anything and we would become accomplices. I think that has to be worked out in our arms control negotiations and within the alliance. I would only like to say that not having SSNs in the Arctic is not going to persuade the United States to abandon elements of the forward maritime strategy any more than it is going to persuade either the Americans or the Soviets to scale down their sea-launched cruise missiles.
>
> (May 10, 1988, Issue No. 38:6)

John Lamb, executive director of the Canadian Centre for Arms Control and Disarmament, while expressing his organization's opposition to the nuclear-powered submarine acquisition for a number of reasons, including the possibility of Canada becoming integrated "as a junior partner in U.S. naval operations in the North", also testified that:

> There are limits to how far Canada could be drawn into some of the nastier scenarios you can draw. The SSNs that are being considered... I do not think we would be all that welcome in the Norwegian Sea to take part in the most agrressive parts of the maritime strategy...
>
> (Ibid, 38:35)

On the communications issue, RAdm Anderson told the Committee that under current Allied arrangements there is a world-wide sharing of

communications facilities. National communications are encoded to "protect your information while it is travelling through other nations' communciation centres..." (February 3, 1988, Issue No. 25:11)

Asked if with the acquisition of nuclear-powered submarines there was a danger of loss of military or political control of submarines operating under the Arctic ice cap, RAdm Anderson denied such an eventuality.

6. CANADIAN REQUIREMENTS

OBERON-CLASS SUBMARINES

Canada originally purchased three Oberon-class diesel-electric submarines for anti-submarine training of its surface fleet and anti-submarine aircraft, but since the early 1970s has realized that the Oberons could carry out effective operational roles by providing on-the-spot surveillance of other submarines. However, according to navy officials who testified before the Committee, the Oberons are limited by their propulsion system to a "fixed patrol mode." In the words of RAdm Anderson:

> ...It (an Oberon) needs to be assigned a piece of the ocean over which it can be, so to speak, the landlord. The less it moves, the more effective it is in terms of patrol. Obviously, adjoining pieces of the ocean assigned to other submarines become barriers, penetration of which can be very dangerous for an enemy.
>
> ...With SSNs we will be able to exercise surveillance and control over much larger areas in all three ocean approaches.
>
> (February 2, 1988, Issue No. 24:11-12)

DIESEL-ELECTRIC ADVANTAGES AND DISADVANTAGES

In certain areas and depending on which specific types of submarine are being compared, conventional submarines do offer some advantages over nuclear-powered boats. As listed by the Honourable Doug Frith during the Committee hearings, advantages may include:

* Lower initial cost;
* Lower operating and crew costs;
* Less susceptibility to detection by non-acoustic and sonar techniques;
* Their small size makes them a smaller target in close-in engagements with other submarines;
* Their size makes them less attractive to magnetic mines;
* They have less rotating machinery and are, therefore, quieter;
* They are better suited for operations in shallow coastal waters because of their shallower draft and greater control at low speeds;

* And their simpler design makes for less time-consuming and complex overhauls.

VAdm Thomas responded:

...Diesel submarines do cost less (than nuclear-powered boats). We think the ratio is about 1.7:1. They may have a lower operating cost. It depends on which diesel submarine and how intensively you operate it. They are less susceptible to detection because they have a lower thermal and magnetic signature. They have a lower thermal signature when they are running their diesels; they do not necessarily have a lower magnetic signature. There is a relationship between the size of the submarine and the size of the magnetic signature, and you would observe that one of the two contenders is about the order of magnitude in tonnage that most of the conventional submarines are; the other is larger.

The difficulty with the words "nuclear submarine" is that it goes all the way from a *Rubis-Améthyste modifié*, at about 2,700 tonnes, to something the size of the Typhoon, (which) is twice the size of the Queen Mary submerged. So it is like our Arctic; it is not a constant thing...

Magnetic signatures, by the way, can be designed out of the submarine or compensated for, depending on how much money you want to spend on that. If you think you are going to have your submarine operating in his minefields and where it is subject to attack by his air, you had better be pretty quiet magnetically. If you are going to be using it defensively where it is your air that is overhead and you do not have minefields, you have a little more margin. You get into those kinds of trade-offs between how much you are prepared to pay and what you want to get.

...As for fewer rotating parts, there are a lot fewer rotating parts in a battery-driven submarine on battery and a lot more when it is on diesel. What the diesel submarine does is this. For about 17 per cent of the time it sticks up a big noise flag and says: here I am, here I am. You know where he is at least once every 24 hours, and you know what he is doing, and you can count between battery charges and estimate how much battery he has left, therefore, how much combat capability he has left. When he is quiet, he is as quiet as a good, very quiet nuclear submarine, and when (he) is noisy he is very noisy indeed.

On being better suited for the dogfight environment, the conventional submarine that is in a combat exchange of weapons situation with a nuclear submarine had better get his (firing) solution right the first time; he will not get a second time. He cannot run away and he runs out of sensors because he runs out of electricity if he tries. He has one hour at 20 knots or running his sensors or some combination thereof.

(February 2, 1988, Issue No. 24:37-38)

NUCLEAR-POWERED SUBMARINES

RAdm Anderson told the Committee that a major thrust of the defence White Paper is to equip the navy to respond to threats in Canada's three oceans. Protection of the Atlantic sea lines of communication to Europe must be improved, maritime traffic through areas of Canadian responsibility in the Pacific Ocean is increasing, and Canada's northern maritime approaches are gaining in strategic importance because of increased military and economic activity in and around the Arctic Ocean.

With vast ocean expanses to patrol, the advantages of nuclear-powered submarines over diesel-electric boats lie in their speed, endurance and flexibility, according to RAdm Anderson.

> ...It (a nuclear-powered submarine) can do the work of, we believe, three diesel submarines, depending on the scenario you want to put that calculation into, and is the only vehicle that can conduct prolonged under-ice operations. Nuclear-propelled submarines are ideally suited, we believe, to our naval requirements.
>
> (February 2, 1988, Issue No. 24:11)

In the general performance criteria set for Canadian nuclear-powered submarines the emphasis has been on safety and reliability, anti-submarine warfare capability and the ability to operate in the Arctic, RAdm Anderson testified.

> ...Less emphasis has been (accorded) to anti-surface capabilities, hydrodynamic performance and inshore operations.
>
> (Ibid, 24:13)

The emphasis on safety is the government's "foremost commitment". In the other areas, a Canadian nuclear-powered submarine will have to be stealthier than Soviet submarines, carry a highly effective torpedo, and be able to surface through Arctic ice. The stealth advantage is meant to compensate for the deeper diving abilities and higher speeds of some Soviet submarines. An effective torpedo is necessary to penetrate robust Soviet hulls.

THE TRAFALGAR- AND RUBIS-AMÉTHYSTE-CLASS SUBMARINES

The contenders for the Canadian submarine program are the British-designed and built Trafalgar and the French-designed and built Canadian AMÉTHYSTE. The AMÉTHYSTE is the fifth boat of the Rubis class, in which a number of design changes have been incorporated. The original Rubis is 72 metres long and has a dived displacement of 2,670 tonnes. The Canadian AMÉTHYSTE will be 79.65 metres in length and have a dived displacement of 2,890 tonnes. Trafalgar-class boats are 85 metres long and have a dived displacement of 5,208 tonnes. The French submarine has a reported speed of 25 knots submerged, compared with Trafalgar's reported top speed of 32 knots. The published diving depth of the Trafalgar class is 300 metres, compared with 350 metres for the Canadian AMÉTHYSTE. As for propulsion equipment, the Trafalgar is powered by a nuclear reactor that drives two geared steam turbines through a gear box attached to the propeller. The AMÉTHYSTE'S nuclear reactor produces steam that powers turbo alternators, which produce electrical power for an electric drive motor. The French boat is crewed by two alternating teams of 66, while the British boats are designed for a normal complement of 97 or 98, but are currently operating with embarked complements of over 120 men for training purposes. The British manning system calls for about four-fifths of the crew to be on board for a given patrol, while a "fifth watch" is ashore, pending rotation on board. The British boat is fitted with five torpedo tubes and carries a torpedo load of 25. The French boat will have six tubes and a load of 22 torpedoes. Both can fire sub-surface-to-surface cruise missiles: the French vessel is equipped to handle the SM 39 sea version of the Exocet; the British boat the Sub-Harpoon. Published reports on the endurance of both boats indicate that they can patrol without replenishment for 60 to 85 days.

EXAMINING ALTERNATIVES

Prior to the decision to acquire nuclear-powered submarines, the Department of National Defence ruled out the possible use of so-called "hybrid" submarines — classic diesel-electric models with an air-independent power module added. Technology studied within the Department and through submissions from industry included miniaturized nuclear reactors, closed-cycle internal combustion engines and fuel cells.

According to testmony before the Commiteee, the problems encountered were that various technologies were too "immature", bulky, or incapable of adequate speeds. In the words of RAdm Anderson:

> ...In terms of wartime situations, we did not see an air-independent system that was not a full nuclear power plant as being very much of an advantage over a diesel-powered submarine. Under the ice, the submarine's performance in this regard would still be unacceptably low.
>
> (February 3, 1988, Issue No. 25:5-6)

Eldon Healey, Assistant Deputy Minister (Materiel), described the shift in options this way:

> ...That program... was started because we believed the air-independent systems — the hybrid-type concept, if it were available, if someone could develop one — would give us a measure of capability in the Arctic, particularly in the Arctic ice edge, because they would not be able to sustain continued operations under the Arctic ice for a very lengthy period of time.
>
> However, the move from being a little bit pregnant to fully pregnant, if I can use the analogy, was not very great. Mr. Nielsen made the decision that we should... look at the feasibility of acquiring fully capable nuclear submarines, which is what we did.
>
> (Ibid, 25:32)

In a written submission to the Committee, the ECS Group of Companies argued that the Department of National Defence "may find cause" to re-examine alternative propulsion technologies as the project continues and that:

> The full potential of the (nuclear-hybrid submarine), now suggested by a more advanced level of technical understanding of the AMPS (Autonomous Marine Power Source) concept, was not understood at the time of the decision to proceed with the SSN procurement.

The ECS submission contended that an individual hybrid submarine would cost half as much as a nuclear-powered submarine, be less expensive to maintain, have unlimited submerged endurance and an adequate submerged sprint speed. Developing a Canadian hybrid would also provide Canadian-owned designs and equipment and provide substantial industrial, scientific and technical benefits, according to the ECS submission.

However, Peter Cameron, past chairman of the Business Council on National Issues' Task Force on Foreign Policy and Defence, stated that after discussions with Defence Department officials and others:

> ...We came to the conclusion that there were really no hybrid systems that were on the horizon in the timeframe we are talking about that really gave you the military advantage this plan does.
>
> (May 3, 1988, Issue No. 36:17)

The Council specifically examined the Slowpoke reactor developed by Atomic Energy of Canada Ltd. and concluded that it could not yield enough speed, while providing the necessary power for air conditioning, and electronic and other systems.

Department of National Defence officials testified that the option of implanting underwater mines in Arctic chokepoints had been examined and rejected on the grounds of cost, and the fact that Canada does not have any nuclear-powered vessels to go under the ice to lay mines or tend a minefield once it is in place. Gen Manson pointed out that mines torn from their moorings by ice or rough seas would be "totally non-discriminatory" and could damage friendly vessels, just as well as Soviet submarines. He also indicated that under international law, Canada would be obliged to have the capacity to remove mines before they could be sown in international waterways.

To complement the introduction of Canadian nuclear-powered submarines, the government intends to install an underwater network of sonar hydrophones at chokepoints in the Arctic. The network of listening devices, communications links to shore and processing facilities would provide an indication of submarine activity. However, RAdm Anderson told the Committee: "...You would still need to move a unit in to respond to it." (February 2, 1988, Issue No. 24:48)

7. COSTS

GOVERNMENT ESTIMATES

Government officials have estimated the cost of acquiring 10 to 12 nuclear-powered submarines at about $7.5-$8 billion in 1986 dollars. That cost includes $4.5-$5 billion in what is known as the "sail-away" cost of the 10-12 boats, and $3 billion for infrastructure. The Department of National Defence has not put forward its own estimate of operations and maintenance costs for the submarines over their life-span. The Minister of National Defence told the Committee that studies on operations and maintenance costs will be completed in 1990.

Eldon Healey, Assistant Deputy Minister (Materiel), stated that the Department received confidential costing information from the countries of origin of the two contending designs, and where possible, cross-checked it with publicly available figures. In the case of the Trafalgar, the British figures were compared with those appearing in the United Kingdom's defence spending estimates published in May 1987. Using the dollar-to-pounds-sterling exchange rate on December 16, 1986, the 222 million pound average price for each of six Trafalgar class boats was $453 million.

> ...The exchange rate, of course, continues to move and has moved both up and down since that time... We added some additional cost to that and said it would round out to about $500 million. The number of 10 to 12 was a number that indicated our uncertainty in terms of the total price (of) the program, viewed from where we were at (at) that stage. It indicated that yes, there could be some difference in the overall price between the two types of submarines.
>
> (February 3, 1988, Issue No. 25:36)

As for the French-designed Canadian AMETHYSTE, Mr. Healey said that because the submarine is under development:

> ...We have yet to confirm the exact costs. We will not know precise costs until we go through the definition stage in terms of what it is going to cost us to produce here in Canada. Our belief at this stage, however, and we have done a great deal of work on this, is that within the figures we have presented, we could get between 10 and 12 submarines of one type or another of the two that are being offered.
>
> (Ibid, 25:36)

THE FLEET MIX

At the time of publication of the White Paper on defence, it was stated that the nuclear-powered submarines would be purchased instead of a third batch of air defence frigates and four conventionally-powered submarines. The latter were to replace the three Oberon class boats now in operation. The government has decided to acquire a total of 12 frigates, new shipborne helicopters, and mine countermeasure vessels. The expected fleet would number between 20-22 warships, including 12 frigates and the submarines. A document produced by the Department of National Defence indicates that the pre-White Paper planned fleet mix of four conventionally-powered submarines, and three batches of six, six and eight frigates had an estimated cost of $16.4 billion in 1986-87 dollars. The White Paper mix of 10-12 nuclear-powered submarines and 12 frigates has a pricetag of $16 billion in 1986-87 dollars.

OVERALL COSTS

RAdm Anderson testified that at a rate of expenditure of approximately $300 million a year, the cost of the nuclear-powered submarine acquisition will be equivalent to 3 to 3.5 per cent of the total defence budget, amortized over 27 years. The Department's estimated budget for 1988-89 is $11.2 billion. The government has set a floor for increases in annual defence spending of 2 per cent, after inflation is taken into account. RAdm Anderson testified that:

> ...Due to the extension of submarine acquisition planning well beyond the White Paper's 15-year planning period, there is more money available for army and air force projects within the period than had been earmarked prior to the White Paper review.
>
> (February 25, 1988, Issue No. 28:5)

The "sail-away" cost of the submarines is to include a weapons set, all necessary sonar and on-board communications equipment, towed array sonar and spare parts, but not spare nuclear fuel. Infrastructure expenditures are to include costs for documentation, licences, project management, training facilities and simulators, what is known as a "heavy nuclear workshop", and changes to existing infrastructure for the current fleet. Published reports have indicated that a Very Low Frequency radio link for under-ice communications could cost an additional $100-200 million, unless Canada gains access to the existing network operated by the United States Navy.

Infrastructure costs do not include nuclear fuel fabrication and enrichment facilities, which the government estimates would be too costly to build for the amount of fuel needed.

The Canadian Centre for Arms Control and Disarmament forecast that operations and maintenance costs, plus costs associated with refits and refuelling, could add $4.5 to $6.8 billion to the total cost of the boats. The Centre's estimates were based on published accounts of the operating costs of the Trafalgar and Rubis. Robert Gillespie, Chief, Supply, with the Department of National Defence, stated that without having had the opportunity to analyse the Centre's figures in great detail:

> ...At first glance it appears to be a very good piece of work considering the lack of extensive data, which we of course do not have all of yet ourselves either. It is not a bad ballpark estimate. I think there are probably areas which will be found to be somewhat inaccurate in terms of assumptions or calculations, but it is not a bad ballpark piece of work.
>
> (February 25, 1988, Issue No. 28:13)

However, Gillespie would not endorse the suggestion that the total cost of the program might be as high as $14.8 billion.

> ...Our traditional way of acquiring equipment is to define acquisition costs as including all things associated with the acquisition of the submarines, including the equipment itself, a certain amount of initial spares, the infrastructure, and so on. It is a fairly complete list of all costs associated with acquisition. As just a conventional way of doing things, we do not include in those initial project costs the cost of operating the equipment over the life of the equipment. But we by no means ignore that. We certainly pay very close attention to it and we make sure the government is aware of it. Indeed, it is a standard part of our approval process. As it is going to Cabinet or going to Treasury Board we identify the impact on operating costs of a program. We just do not define that as part of the acquisition...
>
> (Ibid, 28:13)

RAdm Anderson added:

> ...We are not being any different in this project than in any other major capital project the government undertakes. Certainly in the fullness of time, as the information goes forward for government to consider and make decisions upon, there is a full exposure of the cost of the acquisition and the expected through-life costs of any particular piece of capital equipment. So this project is being entirely consistent with the practices of the federal government today.

> I might also add that one could draw the analogy of buying an automobile. One goes out and purchases it, perhaps has to get a loan and looks at the cost of doing that, but in fact the actual cost of the fuel, insurance, the repair and upkeep is probably something very few people take into account at the beginning of their acquisition process.
>
> (February 25, 1988, Issue No. 28:14)

During his appearance before the Committee to discuss the acquisition, the Hon. Perrin Beatty underlined that the government is following the standard practice of specifying acquisition costs only and that studies on operating and maintenace costs will be completed in 1990. However, he noted that operations and maintenance costs are a major factor in the competition between the two contenders and in future will be a key ingredient in the letting of contracts involving operations and maintenance. He also stated that the Canadian Centre for Arms Control and Disarmament's calculations indicated that the estimated operations and maintenance costs of a Trafalgar-class submarine were about the same as those costs for one of Canada's DDH-280 destroyers, while the Centre's figures for a Rubis-Améthyste were several million dollars less than the operations and maintenance cost for a DDH-280. The Minister said that the Centre's figures represented, "...a very strong argument in favour of the cost effectiveness of the nuclear-propelled submarine." (March 7, 1988, Issue No. 29:13)

At a later appearance by representatives of the Centre, its director, John Lamb, argued that because the submarine acquisition program is the largest military purchase in Canadian history:

> ...Taxpayers have a right to know more than they have been told so far about how much the submarines will realistically cost.
>
> (May 10, 1988, Issue No. 38:25)

He suggested that building 65 per cent of the boats in Canada would increase costs over those of British-built Trafalgars or French-built Rubis-Améthystes. At the same time, Canadian inexperience in submarine construction and technological change are likely to lead to cost overruns. Mr. Lamb suggested that some of the risks involved are Canada ending up "with a rump fleet of just a few nuclear submarines, an expensive, under-utilized nuclear support infrastructure, and no funds left over to round out the fleet with conventional boats or surface ships." He also speculated that other elements of the armed forces could be squeezed by escalating submarine costs:

While I think there is backing for refurbishing the navy, there is no evidence that the SSN program enjoys the kind of national support I mentioned. In fact, the SSN program stands a very good chance of undermining the public support, fracturing the consensus that exists, for re-equipping Canada's armed forces generally.

(May 10, 1988, Issue No. 38:26)

8. SAFETY AND NUCLEAR NON-PROLIFERATION CONCERNS

SAFETY

Quoting Adm Hyman Rickover, considered the father of the United States' nuclear navy, RAdm Anderson told the Committee: "Our first nuclear accident will be our last."

According to RAdm Anderson, the nuclear technology challenge is twofold: moving into a new set of disciplines associated with the construction, maintenance, operation and eventual disposal of nuclear-powered submarines, and the elaboration of a comprehensive safety apparatus governing the entire project.

While conventional vessels have historically proven more accident-prone and to be greater polluters than nuclear-powered vessels, the possibility of mishaps involving nuclear-powered boats must be recognized. Regular monitoring of Canadian ports for radiological contamination is already carried out and rigid rules for submarines manoeuvring in and out of ports will be imposed, similar to those used to regulate vessels carrying hazardous liquefied natural gas.

RAdm Anderson told the Committee:

> ...The navy must plan for worst-case eventualities, even though they may have probabilities of virtually zero. Such planning will be based on continuing extensive analyses, safety studies and rigorous reviews of operations and perceived problems. Safety systems and procedures, along with quality control measures, will be established, and continuously and aggressively verified.
>
> (February 23, 1988, Issue No. 26:6-7)

SETTING STANDARDS

Submarines must meet rigorous standards to be able to withstand battle damage. Safety standards will also be applied to training and evaluation of operating methods, as well as to quality control of all construction materials. Crews will not be exposed to dangerous radiation levels.

Within the Department of National Defence, a director general for nuclear safety, "...will be completely independent of both operational and technical departmental authorities, reporting only to the highest levels in the Department." (February 23, 1988, Issue No. 26:8) The first director general is Dr. Allan Brown, a nuclear physicist, who was previously a senior departmental manager with Ontario Hydro.

According to RAdm Anderson:

> ...Among other roles, the director general will have inviolate stop-work or stop-operation authority, if there is a perception the required safety standards will not be met.
>
> (Ibid, 26:8)

REQUIRED INFRASTRUCTURE

Cmdre E.G.A. Bowkett, Director, Submarine Engineering with the Department of National Defence, told the Committee infrastructure for the handling and storage of irradiated materials — fuel, spent reactor cores and other materials — will be developed in collaboration with experts from the Canadian nuclear industry:

> With the assistance of Atomic Energy of Canada (Ltd.) and other (experts in) nuclear activities in the country, we believe we will be able to produce an infrastructure which will entirely allow for the safe handling, transportation, storage and disposal of those materials.
>
> ...The security and safety norms we would adopt for the submarine program would be equivalent to, or better than, the norms currently obtained in the Canadian civil program.
>
> (February 25, 1988, Issue No. 28:25)

NUCLEAR NON-PROLIFERATION CONCERNS

The 1968 Treaty on the Non-Proliferation of Nuclear Weapons, commonly referred to as the NPT, divides countries into two categories. The first are "nuclear weapons states" which had exploded a nuclear weapon prior to 1967 — the United States, the Soviet Union, the United Kingdom, France and China. The second group, "non-nuclear-weapon states", had not exploded a nuclear device by that time. Canada is one of the original 59 non-nuclear-weapon-state signatories of the Treaty. The United Kingdom, the United States and the Soviet Union signed the original treaty as weapon

states. France is not a signatory but has pledged to act as if it is. China is not a signatory. All countries accepting the treaty agree not to export any nuclear equipment or material to non-nuclear-weapon states, except under safeguards monitored by the International Atomic Energy Agency (IAEA).

Non-nuclear-weapon states party to the treaty pledge not to manufacture or receive nuclear weapons and peaceful nuclear explosives. The treaty itself is silent on the transfer by signatories of non-nuclear-explosive technology for military purposes. Article 14 of the standard IAEA agreement with individual countries leaves it up to the discretion of each country to determine whether IAEA safeguards should be applied to non-proscribed materials.

The Hon. Perrin Beatty testified that if the treaty had been designed "...to outlaw in some way the use of nuclear propulsion for military vessels, it would have said so..."

> What we will demonstrate is that a country that is nuclear — that is, that uses nuclear energy for both civil and military purposes — is capable of using them consistently with the spirit of the NPT and of specifically renouncing the acquisition of nuclear weapons despite our capacity to develop them here.
>
> ...We were once a nuclear power, but we have discontinued that role. We have no intention whatsoever of acquiring nuclear weapons.
>
> (March 7, 1988, Issue No. 29:15)

Armand Blum, Canadian Submarine Acquisition Co-ordinator with the Department of External Affairs, stated that the International Atomic Energy Agency is not authorized to provide safeguards for any military activity. In the case of nuclear-technology transfer from the United Kingdom or France, Canada anticipates establishing a bilateral safeguard regime with one of those "reputable guarantors", under which the supplier country would monitor Canadian use of nuclear materials.

> ...What we are hoping is that the way we are making our arrangements is such that if any other (country) follows our way, then there will be no fear of any material being diverted to contrary uses because the system of inspection and safeguards that we are trying to put into effect is as tight as possible.
>
> (February 23, 1988, Issue No. 26:11)

Jacques Simard, a Department of External Affairs policy advisor to RAdm Anderson, testified that when uranium is exempted from international

safeguards it will come under the bilateral arrangement between Canada and the supplier country and "probably" will be returned under international safeguards as spent fuel.

> ...The system we intend to put in place will reassure the international community that there was no possible diversion in the meantime.
>
> (February 23, 1988, Issue No. 26:13)

CRITICISMS

John Lamb, of the Canadian Centre for Arms Control and Disarmament, while rejecting the possibility that Canada would divert nuclear material to weapon production, contended that the government has chosen the "path of least resistance" in opting to set up a bilateral safeguard regime. Bilateral safeguards incorporate an "inherent conflict of interest" with the nuclear material supplier monitoring the user. In the past, the results of similar arrangements between the United States and India, Norway and Israel, and even Canada and India "hardly inspire confidence." Israel and India have reportedly acquired nuclear-weapon capabilities with the help of Western technology transfers.

> Given France's intent, moreover, to begin marketing its nuclear subs to other countries, including Brazil — which is another NPT non-signatory, as is France — for Canada to provide France with its first foreign nuclear submarine sale under a patently inadequate bilateral safeguard arrangement would make us an accessory to France's irresponsible and widely despised nuclear export policies.
>
> (May 10, 1988, Issue No. 38:28)

The alternative to a bilateral arrangement, according to Mr. Lamb, would be to ask the International Atomic Energy Agency to devise and obtain international support for a regime under which it would safeguard all the military nuclear-propulsion programs for non-nuclear-weapon states. Such a system would have to have the collaboration of the suppliers in working out the means to avoid compromising military security.

9. THE ACQUISITION PROCESS

THE PRE-WHITE PAPER PROCESS

Canada first began examining the possibility of acquiring nuclear-powered submarines in 1959, but opted instead to purchase three diesel-electric Oberon-class submarines from the United Kingdom, beginning in 1965. Witnesses from the Department of National Defence told the Committee that in the late 1950s nascent nuclear submarine development was considered too costly and technologically risky for Canada to become involved. However, in 1964, the Liberal government of the Right Honourable Lester B. Pearson produced a defence White Paper that indicated nuclear-powered submarines were being studied as a possible anti-submarine weapon for the Canadian navy.

In October 1980, approval was given to study the acquisition of four conventionally-powered boats to replace the Oberons, and in June 1983 a Project Management Office was set up. In August 1985, after a preliminary report on the conventional acquisition program was presented to then Defence Minister Erik Nielsen, the Minister ordered a nuclear-powered submarine feasibility study. Between December 1985 and February 1987, navy-to-navy discussions between Canadian, British, French and American officials were carried out. Meanwhile, in June 1986, Cabinet approval was granted to seek Canadian sources for the construction of four diesel-electric submarines. That source qualification process was completed by March 1987.

In June 1987, the new course toward acquisition of 10 to 12 nuclear-powered submarines emerged with publication of the government's White Paper.

THE POST-WHITE PAPER PROCESS

After publication of the White Paper, the first step has been selection of a country of origin for the Canadian submarines. That process has involved reciprocal visits by Canadian, British and French officials and the signing of Memoranda of Understanding (MOUs) between Canada and both the United Kingdom and France in February and March of this year, respectively. The MOUs outline the acquisition process in general terms.

Canada has also received some technical data to allow a preliminary interdepartmental review by National Defence, External Affairs, Supply and Services and Regional Industrial Expansion officials of the proposals from both countries to determine if they meet basic Canadian requirements.

At the time of writing, a memorandum to cabinet from the Minister of National Defence stemming from those twin interdepartmental reviews had not gone forward and no choice of the country of origin had been announced.

REQUESTS FOR PROPOSALS

Once the country of origin is chosen, the acquisition program planners are to draw up a request for proposals package for industry, outlining the specifications of the chosen submarine design and the infrastructure needed to support the fleet. Licencing agreements will have to be negotiated with the suppliers to acquire more design information needed to draw up the detailed requests for proposals. At the same time, government-funded project definition studies are to be carried out with two Canadian prime contractors over a 10-month period. Early this year there were five Canadian consortia which had expressed an interest in becoming prime contractors for the project. However, the government was encouraging the five to regroup into two.

Interested Canadian prime contractors would have about eight months to respond to the request for proposals. Once those responses are completed, another interdepartmental review would take place to determine which of the two contenders as prime contractors would receive the implementation contract.

Part of the project definition stage will determine how many of the boats will be built in Canada and how many, if any, will be built offshore.

National Defence planners have tentatively set December 1990 as the target date to begin industrial implementation of the project, with the first boat being completed in 1996, the second in 1998, and the remainder at 18-month intervals.

A PARALLEL PROCESS

Based on safety considerations and the experience of British and French submarine builders, National Defence officials have stated they would prefer a separate contractor handle the submarine nuclear-propulsion system. RAdm Anderson told the Committee that it was expected that a commercial entity would be set up to act as a design agent and manufacturer of the nuclear-propulsion plants for the submarines. James Clarke, President of the Canadian Maritime Industries Association, suggested that while the first one or two reactors could be provided to the government by offshore manufacturers, subsequent reactors would likely be built under licence by a firm such as Canatom Inc., operating in conjunction with Atomic Energy Canada Ltd.

CABINET APPROVAL

At at least four stages in the acquisition process, Cabinet approval has been or will be necessary to proceed. Those thresholds include, the original decision to opt for nuclear-powered submarines, the decision on the country of origin, the determination of which two potential prime contractors will be able to participate in the funded project definition stage, and the choice of a single prime contractor to implement the project.

Gen Paul Manson, Chief of the Defence Staff, also suggested that any such contracts would include "force majeure" clauses allowing the government to "change the terms of the contract unilaterally..." (February 3, 1988, Issue No. 25:33)

THE INDUSTRIAL IMPLICATIONS: JOB CREATION, TECHNOLOGICAL BENEFITS

The acquisition of 10 to 12 nuclear-powered submarines is expected to entail significant economic and technological benefits for industries directly or indirectly involved. Department of National Defence officials estimated that 65 per cent of the funds spent on the project will be spent in Canada, and new technologies will become available to the nuclear engineering, electronics and shipbuilding industries. The project could create an estimated 55,900 person/years of direct employment, with a major proportion of those jobs in high technology areas. The tentative breakdown of jobs by sector is 8,000 person/years in project management, 17,000 in electronics, 9,000 in

marine systems, 10,000 in shipbuilding and 11,000 in the engineering sector. Jobs in individual sectors should also help sustain a highly-skilled defence and shipbuilding industry.

THE NUCLEAR INDUSTRY

For Canada's declining nuclear industry, which is operating at about 20 to 25 per cent of capacity, the submarine project would provide "high-quality employment in the short term and a definite stabilizing influence in the medium to long term," RAdm Anderson stated. Although the nuclear technology to be acquired is "mature" and not likely to generate a great deal of new research, manufacturing parts could enable Canadian companies to extend their expertise.

RAdm Anderson also suggested that "20 or 30 years" from now, a Canadian-designed reactor could take the place of the initial imported design. The project is also expected to have a significant impact on research and development, small business, and give a boost to local construction industries on the east and west coasts that land infrastructure contracts.

CANADIAN INDUSTRIAL CAPABILITIES

James Clarke, President of the Canadian Maritime Industries Association, testified that Canadian industry is capable of manufacturing virtually all of the major components of the nuclear-powered submarines and assembling all the boats in Canada. However, in some instances, such as the manufacturing of special quality steel plating and government-supplied armaments, decoys and cryptographic equipment, it would be more cost effective to acquire the finished product outside Canada. At present, Canadian companies produce pressure hull components and other submarine equipment for United States nuclear-powered submarines.

The Maritime Industries Association estimated that Canadian content in the project could be as high as 70 per cent and would enhance the country's defence industrial base and defence preparedness.

> ...Another significant benefit stemming from maximum Canadian participation in this project would be the adoption by our shipyards and maritime industries concerned of highly sophisticated quality assurance, quality control, as well as nuclear and vessel safety processes. These will result in a major enhancement to Canadian maritime industrial technology.
>
> (May 5, 1988, Issue No. 37:9)

The Association forecast that with spinoffs to other industries, the submarine acquisition could represent a total of 100,000 person/years of work over a quarter of a century, shipyards will benefit from the transfer of specialized technologies, and support of the vessels could involve 40,000 person/years of work to the year 2035.

According to Mr. Clarke, the Canadian shipbuilding industry is "unalterably opposed" to building any of the new submarines offshore on the grounds that: (1) foreign shipyards may not be able to rearrange their schedules to accomodate the construction of the first Canadian boat by 1996; (2) it is unreasonable to expect the Canadian prime contractor and subcontractors to set up shop overseas to facilitate the transfer of technology; (3) technical risks will not be lessened by offshore construction; (4) Canadian content targets will be easier to attain if all the submarines are built in Canada; (5) and to overcome the "staggering" construction and maintenance challenges Canadian companies need the earliest possible start on the project.

THE TRANSFER OF TECHNOLOGY

Because French nuclear-powered submarines have been developed without the use of imported technology, France's proposal is "unencumbered" by any agreements with third parties. In the case of the British-built Trafalgar, the United Kingdom and the United States have had in place since 1958 an agreement which necessitates the approval of Congress of any transfer of American-originated nuclear-reactor equipment, technology or fuel used in the British submarine-building program to a third party such as Canada. Before the United Kingdom could proceed with a transfer, it is required under the U.S. Arms Export Control Act that an agreement be in place between Canada and the United States which would permit direct transfer of such items from the United States. This new Canada-U.S. agreement would necessitate amending the existing Canada-U.S. Agreement for Co-operation on the Uses of Atomic Energy for Mutual Defence Purposes, which was signed in 1959.

Under the United States' Atomic Energy Act of 1954, amending the 1959 Canada-U.S. treaty requires the approval of both the Senate and the House of Representatives during or, on completion of, a 90-day Congressional review process. The review process could take up to 90 legislative sitting days from the time the President submits the proposed treaty to Congress for amendment. Once an amendment comes into force, the President would then provide an executive determination approving the

British retransfer of the nuclear-propulsion equipment, technology and fuel to Canada. U.S. President Ronald Reagan has announced that his Administration will co-operate with Canada in seeking the technology transfer.

However, several members of Congress have questioned the Canadian program, raising concerns about project costs, the possible use of Canadian submarines to interfere with American operations in waters claimed by Canada, nuclear safety and security from espionage, nuclear non-proliferation and the adequacy of the British- and French-built submarines to meet the evolving Soviet threat.

RAdm Anderson told the Committee that discussions with British officials have indicated that the agreement between the United Kingdom and the United States, "...would in fact permit the eventual transfer of technology." (February 23, 1988, Issue No. 26:9)

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APPENDIX A

LIST OF WITNESSES

THURSDAY, JUNE 18, 1987 (Issue No. 13):

Appearing:

The Honourable Perrin Beatty,
Minister of National Defence.

From the Department of National Defence:

Eldon J. Healey,
Assistant Deputy Minister (Materiel);

Vice-Admiral Nigel D. Brodeur,
Deputy Chief of the Defence Staff;

General Paul D. Manson,
Chief of the Defence Staff;

Rear-Admiral Charles M. Thomas,
Chief, Maritime Doctrine and Operations.

THURSDAY, JUNE 25, 1987 (Issue No. 14):

Appearing:

The Honourable Perrin Beatty,
Minister of National Defence.

From the Department of National Defence:

General Paul D. Manson,
Chief of the Defence Staff;

Major-General Reginald W. Lewis,
Chief of Reserves;

Eldon J. Healey,
Assistant Deputy Minister (Materiel);

Robert W. Fowler,
Assistant Deputy Minister (Policy).

TUESDAY, FEBRUARY 2, 1988 (Issue No. 24):

From the Department of National Defence:

General Paul D. Manson,
Chief of the Defence Staff;

Rear-Admiral John R. Anderson,
Chief Submarine Acquisition;

Vice-Admiral Charles Thomas,
Commander,
Maritime Command.

WEDNESDAY, FEBRUARY 3, 1988 (Issue No. 25):

From the Department of National Defence:

General Paul D. Manson,
Chief of the Defence Staff;

Rear-Admiral John R. Anderson,
Chief Submarine Acquisition;

Eldon J. Healey,
Assistant Deputy Minister (Materiel);

Major-General Dave Huddleston,
Associate Assistant Deputy Minister (Policy).

TUESDAY, FEBRUARY 23, 1988 (Issue No. 26):

From the Department of National Defence:

Rear-Admiral John R. Anderson,
Chief Submarine Acquisition.

From the Department of External Affairs:

Armand Blum,
Canadian Submarine Acquisition Project Co-ordinator;

Jacques Simard,
Policy Advisor to Chief Submarine Acquisition.

THURSDAY, FEBRUARY 25, 1988 (Issue No. 28):

From the Department of National Defence:

Rear-Admiral John R. Anderson,
Chief Submarine Acquisition;

Robert Gillespie,
Chief, Supply;

Commodore E.G.A. Bowkett,
Director, Submarine Engineering.

MONDAY, MARCH 7, 1988 (Issue No. 29):

Appearing:

The Honourable Perrin Beatty,
Minister of National Defence.

From the Department of National Defence:

Eldon J. Healey,
Assistant Deputy Minister (Materiel);

Vice-Admiral Charles Thomas,
Commander,
Maritime Command.

TUESDAY, APRIL 26, 1988 (Issue No. 35):

Rear-Admiral (retired) Fred W. Crickard,
Halifax, Nova Scotia,
Private citizen.

Harriet Critchley,
Director,
Strategic Studies Program,
University of Calgary.

TUESDAY, MAY 3, 1988 (Issue No. 36):

From the Business Council on National Issues - Task Force on Foreign Policy and Defence:

Peter Cameron,
Past Chairman;

Brian Creamer,
Secretary;

George G. Bell,
Advisor;

Dudley Allan,
Member;

Alan Marchment,
Member.

From Veterans Against Nuclear Arms:

Ray Creery,
Chairman,
Research Committee;

Joseph Levitt,
President,
Ottawa Branch;

Robert Cocks,
President,
Defence Research and Education Centre.

THURSDAY, MAY 5, 1988 (Issue No. 37):

From the Canadian Maritime Industries Association:

James Clarke,
President.

Private citizen:

Rod Byers,
Director,
Centre for International and Strategic Studies,
York University.

TUESDAY, MAY 10, 1988 (Issue No. 38):

Joel Sokolsky,
Department of Political and Economic Science,
Royal Military College of Canada,
Kingston, Ontario.

From the Canadian Centre for Arms Control and Disarmament:

John Lamb,
Executive Director;

Dan Hayward,
Research Assistant;

Tariq Rauf,
Co-ordinator,
Non-Proliferation Project.

APPENDIX B

INDIVIDUALS AND ORGANIZATIONS WHO SUBMITTED BRIEFS AND LETTERS TO THE COMMITTEE, BUT WHO DID NOT APPEAR AS WITNESSES

The Drumheller Peacemaking Group,
Drumheller, Alberta.

ECS Group of Companies,
Ottawa, Ontario.

Frank J. Gaffney, Jr.,
Hudson Institute,
Alexandria, Virginia.

International Submarine Engineering Ltd.,
Port Moody, British Columbia.

Gayle Laird,
Calgary, Alberta.

Guy Savard,
Westmount, Quebec.

Transpolar Shipping Inc.,
Ottawa, Ontario.

A copy of the relevant Minutes of Proceedings and Evidence (*Issues Nos. 13, 14, 24 to 26, 28, 29, 35 to 38 and 41 which includes this Report*) is tabled.

Respectfully submitted,

PATRICK CROFTON
Chairman

MINUTES OF PROCEEDINGS

TUESDAY, AUGUST 16, 1988
(59)

[*Text*]

The Standing Committee on National Defence met, *in camera*, at 9:43 o'clock a.m., this day, in Room 209 West Block, the Chairman, Patrick Crofton, presiding.

Members of the Committee present: Patrick Crofton, Stan Darling.

Acting Members present: Barry Moore for W.R. (Bud) Jardine, Len Hopkins for Douglas Frith, Robert Wenman for Marc Ferland.

In attendance: *From the Parliamentary Centre for Foreign Affairs and Foreign Trade*: David Lord, Research Advisor.

Pursuant to Standing Order 96(2), the Committee resumed consideration of the White Paper on National Defence. (*See Minutes of Proceedings and Evidence dated Tuesday, June 16, 1987, Issue No. 13*).

The Committee commenced consideration of a draft report on the Canadian Submarine Acquisition Project.

It was agreed,—That the draft report be adopted as the Committee's Second Report to the House and that the Chairman present it to the House.

It was agreed,—That the Committee print an additional 3,000 copies of Issue No. 41 of the Committee's Minutes of Proceedings and Evidence, which will contain the Second Report to the House.

It was agreed,—That the Report be printed in tumble format.

It was agreed,—That all copies of Issue No. 41 which will contain the Second Report have a distinctive cover to be approved by the Chairman of the Committee.

At 10:43 o'clock a.m., the Committee adjourned to the call of the Chair.

Jean Michel Roy
Clerk of the Committee