SECRETS OF THE BOMARC:

RE-EXAMINING CANADA'S MISUNDERSTOOD MISSILE

PART 1

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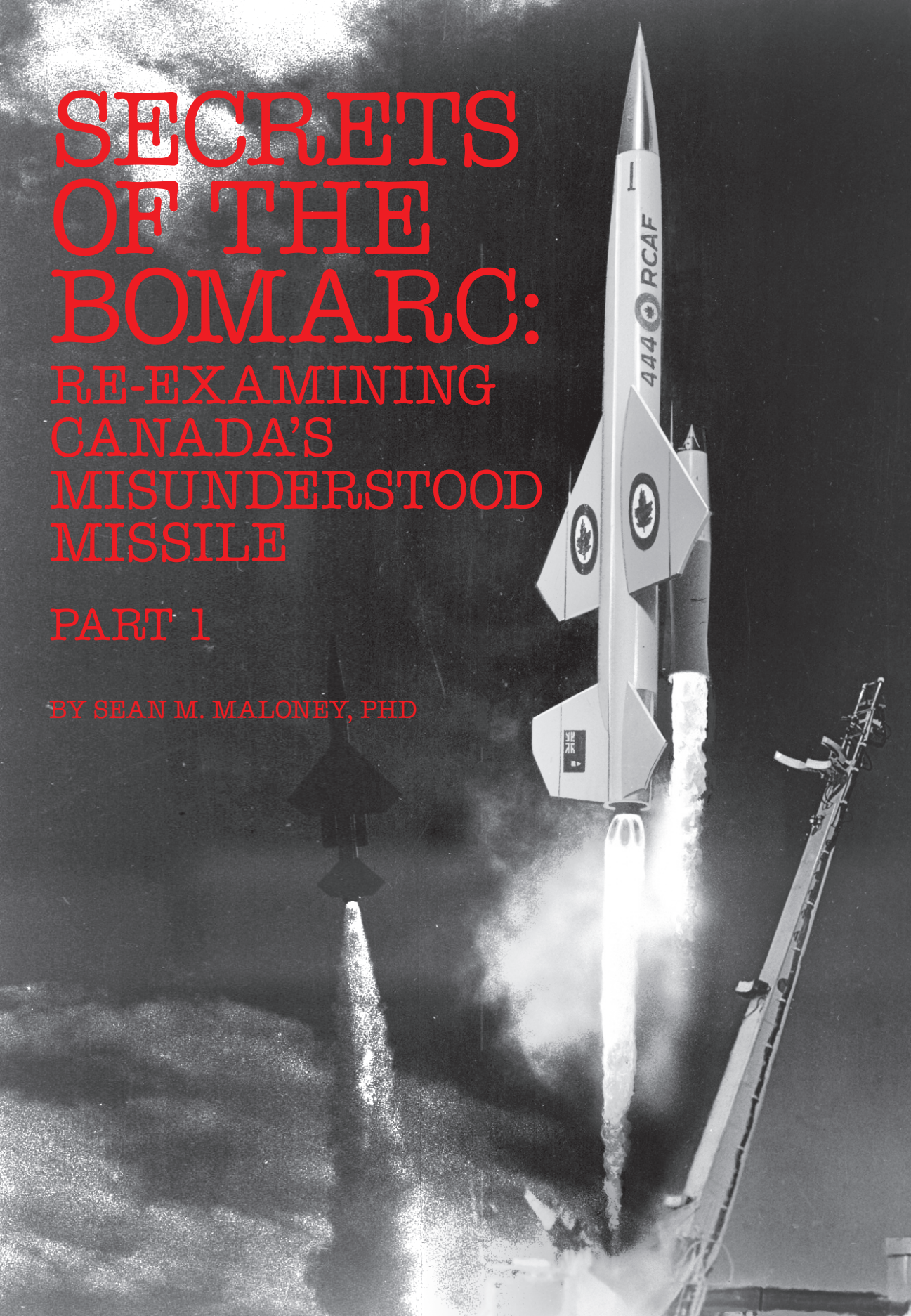

Publicly derided and quietly phased out in 1972, the "Coffin"[1] Interceptor Missile 99B/W40 Weapons System Mod 0, better known as the BOMARC,[2] has faded into near obscurity in Canadian history. Of the 56 BOMARC airframes deployed to Canada in the early 1960s, three remain on public display in Canada. The bronze plaque on one of them stationed outside the airport states: "In 1971 the BOMARC missile was abandoned. Although the BOMARC was nuclear warhead capable, it was a great disappointment for Canadian Forces to fulfill Canada's role in the North American Air Defence Command (NORAD)." Similarly, the data supplied at the Canadian Aviation and Space Museum in Ottawa states: "While on paper the missile looked impressive, the BOMARC was not able to intercept long range nuclear-armed missiles that began to be deployed at the beginning of the 1960s."

Any perusal of political cartoons from the period readily uncovers numerous caustic sketches usually depicting an unflattering caricature of Prime Minister John Diefenbaker juxtaposed with the missile in some fashion. Then there were the professional critics, comprising members of the nascent antinuclear movement in Canada, who wanted Canadian neutrality in the Cold War. There were opposition politicians looking for any angle from which to attack the government. There were armed forces personnel engaged in interservice politics. Less publicly, there was a serious personnel failure at 447 Squadron—the BOMARC unit at La Macaza, Quebec—which almost resulted in the removal of the warheads in 1964.[3]

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Historiographically, the BOMARC becomes the easily targeted scapegoat for the closeout of the now mythic CF105 Arrow programme. No book dealing with the Arrow programme gives the BOMARC system any positive ink in any way, shape, or form. Arrow is Canadian, BOMARC is American. Arrow good, BOMARC bad. There is no quarter. The BOMARC had to be bad so that the Arrow can be so good.[4]

Yet, despite the odds, Canada's two BOMARC squadrons quietly remained on guard for a decade, ready to engage Soviet bomber aircraft in the event of an attack on North America. This begs the question: If the system was so flawed, why did it stay in service so long? Was it simply a matter of bureaucratic or political inertia? Was it really as technologically flawed or as strategically obsolete as asserted at the time in the public domain?

There were aspects of the BOMARC system itself, and in particular the warhead that it carried, that suggest there may have been other factors in play. Given the levels of secrecy that existed at the time, and possibly remain even today, those aspects have not emerged in any coherent form. This article will examine the hypothesis that the BOMARC missile system could have had applications as an interim or expedient antiballistic missile (ABM) system. The evidence is not definitive, but circumstantial, and makes for an intriguing hypothesis. Indeed, this potential capability remained in the American domain because of the closehold aspects of nuclear-weapon design and employment. In the current policy climate regarding Canada and

ballistic-missile defence, lack of knowledge on Canada's part attenuates our ability to participate in and influence decisions made by our closest ally, the United States (US), very similar to the situation in the 1960s.

The origins of nuclear air defence systems

The nature of the air defence problem that emerged in 1949 and 1950 during the Berlin Crisis and the advent of the Korean War led to development of nuclear air defence weapons. The United States Air Force's (USAF's) Strategic Air Command (SAC) constituted the primary deterrent to global war and was seen to be increasingly vulnerable to Soviet bombers and their nuclear bombs as the opposing force grew in capability. The need for an air defence system was paramount and an unprecedented technological effort was implemented in the US.[5] The Canadian government, after careful consideration and consultations, accepted this view, and both partners embarked on the road that led to the NORAD agreement in 1958. The Canada-US Emergency Defence Plan Military Cooperation Committee (MCC) 300/9 was based on this concept: "To protect as much of the warmaking capability of Canada and the United States against air attack as is possible with the forces available … . The object … is the protection of Strategic Air Command bases."[6]

The pressing need for improved air defences because of the perceived vulnerabilities of SAC in 1950[7] led to a variety of American projects. One of these was the 1951 concept of adding a nuclear warhead to Boeing's planned BOMARC missile. That was dependent on reducing the size of the existing nuclear weapons to the point they could be inserted into a smaller-diameter airframe, and that technology did not yet exist. The other project was codenamed HEAVENBOUND and looked at the requirements for a lightweight warhead with low yield. In 1953, the feasibility of both projects was established, and by 1954, the Joint Chiefs of Staff gave approval to proceed on these and other tracks.[8]

The HEAVENBOUND project spawned the W25 warhead that was mated by the Douglas Aircraft Company with their aircraft-launched rocket and called the MB1 Genie. The construction of the MB1/W-25 weapon system was authorized in 1955–56, and on 19 July 1957, with Canadian observers present, Operation PLUMBBOB's Shot JOHN detonated over the Nevada desert after the rocket was fired from an F89J interceptor. Accounts noted that the "explosion pulverized anything caught within a one mile [1.6 kilometre (km)] radius" of the detonation.[9] Of note here was that the observer group comprised almost all senior officers involved in the future nuclearization of the RCAF: Air Marshal Roy Slemon, Air Vice Marshal Larry Dunlap, Air Commodore Clare Annis, Air Vice Marshal Larry Wray, Air Commodore Douglas Bradshaw, and others.[10] Air Vice Marshal John Easton observed Shot JOHN:

> The first MB-1 bursts I saw, and I was about 60 miles [96.5 km] away from it across the desert, and I thought I would manage with an ordinary pair of sun glasses …. I spent the next 24 hours with two black spots, one in the middle of each eye and it was impossible to read anything.[11]

The MB1 Genie entered USAF squadron service and stood alert for the first time in 1958.

The development of the BOMARC and its warhead was much slower, given the advanced but immature technologies that Boeing was dealing with and the need to incorporate the missile

into a complete air defence system that included radars, computers, and direction centres (later called the semiautomated ground environment [SAGE], the predecessor of today's internet).[12] USAF's Air Defense Command accepted the concept of a nuclear warhead for BOMARC in 1952, and HEAVENBOUND confirmed its feasibility. In 1953, the Atomic Energy Commission and USAF looked at a number of possibilities, with the specifications that the warhead be 18 inches [45.7 centimetres (cm)] in diameter, 30 inches [76.2 cm] long, and weigh 250 pounds [113.4 kilograms (kg)]. At some point, thought was given to using the Genie's existing W25 warhead in the BOMARC but increasing its yield.[13]

However, there was some breakthrough during the 1954–1955 testing series that "revealed the advisability of 'pocketing' greater nuclear yields" and "technological changes that led to smaller and lighter containers." These both led to the initial design of the W40 warhead in 1956.[14] Whatever developments took place at this time had some bearing on the future parameters of the W40: its final dimensions were 17.9 inches [45.4 cm] in diameter, 31.64 inches [80.36 cm] long, but it weighed 350 pounds [158.7 kg]. It was 100 pounds [45.3 kg] heavier than specified.[15] There were a variety of delays but the first W40s were available for the BOMARC missiles in September 1959, though a debate over safety rules delayed "mating" until May 1960.[16] Unlike the W25, the W40 remained untested when fired with its BOMARC airframe because of President Eisenhower's decision to implement a nuclear-test moratorium in October 1958. That said, the BOMARCs were still deployed to their sites throughout the US in 1959–60. The Canadian sites remained under consideration during the turbulent debate over the CF105 Avro Arrow and where it fit into the air defence system.

Canadian interest in nuclear air defence weapons

An extensive web of personal relationships developed between the scientists of Canada's Defence Research Board (DRB) and their American and British colleagues; they were coupled with strong military linkages through the planning groups in the Canada–US Permanent Joint Board on Defence and the MCC. These connections enabled Canada to be well aware of American developments in the continental defence field in spite of the strictures of the American Atomic Energy Act that prohibited the transfer of nuclear weapons' design information.[17]

The DRB, when queried by the Joint Special Weapons Policy Committee in 1954, anticipated a possible Canadian requirement for a high-altitude anti-aircraft missile and an "antimissile missile system to defeat tactical ballistic missiles with speeds from Mach 3 to Mach 20 and ranges of 50 to 600 nautical miles [92.6 to 1111.2 km]." Similarly, "It is considered that a nuclear warhead should be provided only for the weapon system designed to defeat enemy aircraft and missiles at high altitudes … ."[18]

Another entity keeping track of nuclear air defence developments was the Canadian Army's Anti-Aircraft Command (AAC). In 1955, Canadian personnel, likely through the DRB, were aware that the US Army was going to add a nuclear weapon to the Nike missile and that "Aweapons" were also in progress for BOMARC. Furthermore, the AAC was made aware by the RCAF that there was a growing belief in the US Continental Air Defense Command that "it is now too late to develop an interceptor to defeat the Type 37 and B 58 bomber (B 58 = M[ach] 1.8 and height 60,000 [feet] (18,288 metres [m]). Next development must be to defeat NAVAHOtype missile (M[ach] 4.0 and height 100,000 feet [30,480 m])."[19]

In August 1956, after Shot JOHN and other PLUMBBOB tests, the DRB noted internally that:

> an atomic weapon can be rendered inoperative as an atomic weapon by one of the effects from another atomic weapon. A defensive atomic weapon intended to render inoperative an atomic weapon carried by a conventional aircraft might be quite large yield, possibly in the order of hundreds of kilotons. Canada has no firm information on the effect mentioned, but from basic physical principles the defensive weapon would have to be very accurate if the yield were not very large.[20] [emphasis in original]

Of note:

> The real problem, however, will be the intercontinental ballistic missile carrying an atomic warhead. As a missile it will be difficult to destroy; the hope will lie in "neutralizing" the atomic warhead … . The interception would be planned at great heights, possibly in the order of 20 miles [32.2 km].[21]

The DRB even started looking at the "A/ICBM [anti-intercontinental ballistic missile] problem" in 1957, as it concerned "the protection of Strategic Air Command."[22]

Canadian industry was also engaged, and DeHavilland Canada, in a joint project with the US Convair company, approached the RCAF "on an antiICBM missile or detection system." DeHavilland representatives believed that "there were many things which were in Canada's capability to do, both to discover and to fabricate."[23] Some believed that BOMARC launchers "are perfectly capable of Canadian manufacture," as were the airframes which were "a simpler aircraft than the F86."[24]

> "In Canada, the RCAF had stolen the march on the Army and pushed ahead with BOMARC while the Army was still thinking in terms of anti-aircraft artillery."

Canadian defence personnel were, between 1954 and 1957, already looking towards not only nuclear defence against manned bombers but also at future use of nuclear weapons against intercontinental ballistic missiles (ICBMs) with something that "neutralized" the incoming warhead, not just the carrier system. That was speculative theory. The realities of politics now intruded.

From 1954 to 1959, an extremely complex web of technology-driven issues dominated Canadian defence policy. These included the Distant Early Warning Line, the MidCanada Line, interceptor aircraft including the CF105 Arrow, and the possible acquisition of BOMARC and Nike missile systems. The complexity revolved around the perceived need to integrate Canadian and American defence and how this played out in the political realm. That story is beyond the scope of this study. Where it becomes important in the runup to the acceptance by the Canadian government of the BOMARC system is in the debate over what constituted "point defence" and what system was best suited to it (and what service would command it).

In June 1956, Cabinet recognized that some form of long-range missile might replace some RCAF Air Defence Command (ADC) squadrons in the future. The target type that the missile was supposed to engage was unspecified but was implied to be bombers. In 1957, after the Sputnik launch, the MCC looked more and more at the growing ballistic-missile defence problem. These were not contradictory issues. Ballistic missiles did not replace bombers, they supplemented them and, over time, bombers would supplement the missiles.[25]

The RCAF was already looking at a combination of fighter and missile systems but by mid1956 was concerned that information on ICBM systems and how to counter them was being held back by the DRB.[26] However, at this time, the RCAF was already debating the merits of "the unguided atomic weapon" (MB1 Genie), and a nuclear-capable guided missile based on the Sparrow III, for its future manned interceptor, the CF105.[27]

The Canadian Army, however, was struggling to find its role in air defence. Their American counterparts had been granted responsibility for the missile defence of the US after a bout of interservice wrangling, but BOMARC remained a USAF weapon. In Canada, the RCAF had stolen the march on the Army and pushed ahead with BOMARC while the Army was still thinking in terms of anti-aircraft artillery. The Army was desperately trying to catch up, and the American developments with nuclearizing some form of a Nike missile held promise.

In the debate over BOMARC, the Army noted that in the Canadian context, "The objective of the BOMARC program is to develop an interceptor missile defence system 'to give an effective area defence against high-performance aircraft and missiles.'"[28] The Army argued that ICBM defence would "be of a local nature" not area, that "perimeter" defence weapons would be overwhelmed, and "thus by 1960 or shortly after Canada must have in existence an antimissile capability." The Canadian Army already had, it claimed, 225 personnel trained in the use of the Nike Ajax missile (non-nuclear) and, they were in a position to train 7 personnel for Nike Hercules.[29] Taking their cues from the US Army, the Canadian Army developed arguments against area defence and focused on point defence. The Army changed its approach and attacked BOMARC because it "had no capability against ballistic missiles."[30]

By this time, the Cabinet Defence Committee agreed that the SAGE and BOMARC system should be seriously examined and that the Chief of the Air Staff brief them on "the introduction of nuclear weapons into the system."[31] The Army fought back: "the introduction of BOMARC should be strenuously resisted until its cost effectiveness has been weighted against other weapons systems … and until the policy on an A/ICBM has been decided."[32]

Furthermore:

> It is fundamentally wrong to plan only to defeat the manned bomber. By 1963, our air defence arsenal in Canada would presumably be the CF 105 and BOMARC, neither of which has any capability against the "sharply increasing" threat of the ICBM. Thus just about the time that the peak costs for BOMARC are being reached we may have to consider the equally costly installation of the ZEUS A/ICBM.[33]

In June 1958, Chairman of the Canadian Chiefs of Staff Committee General Charles Foulkes shut down the Army on this issue. The scale of the blast of thermonuclear weapons delivered by supersonic missile or bomber meant that point defence was useless. Nike Ajax

and Nike Hercules sites would be consumed by megaton-yield weapons directed at the targets they were protecting.[34]

What is significant is that Foulkes did not introduce the need for an ABM system into the debate when dealing with the Army or the RCAF. He had good reasons. First, he was likely aware from his former Second World War command that there were political problems with US Army antiballistic missile systems. President Eisenhower decided against the system's deployment in early 1959.[35]

More importantly, Foulkes was invited to attend the HARDTACK nuclear test series in 1958, where he was given preferential treatment in observing particular tests and in collecting information on them.[36] The purpose of the HARDTACK test shots at the Pacific islands proving grounds was to focus on the following:[37]

a. small, low yield highly mobile weapons for tactical and antisubmarine warfare uses;

b. modern, lightweight and instantly ready weapons of sophisticated design for use against hostile aircraft;

c. warheads for antimissile use;

d. deterrent and retaliatory weapons, including warheads for second-generation intermediate-range ballistic missiles, ICBMs, and fleet ballistic missiles; and

e. a family of "clean" weapons.

The HARDTACK test series (there were 35 of them) was comprehensive. One of these was Shot TOBACCO, which involved a test shot of a Nike Zeus with a W50 nuclear warhead in May 1958, one month before Foulkes shut down the Army on Nike systems. The second stage of the warhead failed to ignite and the test was a failure.[38] The next shot of interest was YUCCA. This is believed to have involved a W25 warhead, the same as the MB1 Genie's warhead, elevated by balloon to 26 km and then successfully detonated with a 1.7 kiloton yield. This test simulated the use of the W25 against an incoming ballistic missile. Then, finally, there were Shots TEAK and ORANGE. These spectacular events involved Redstone ballistic missiles with W39 thermonuclear warheads yielding 1.9 megatons detonated at altitudes of 77 and 43 km respectively. The shots generated a variety of interesting electromagnetic disturbances in the stratosphere and mesosphere that had serious implications for antiballistic missile systems.[39]

Foulkes would have been unable to pass on the specifics of Shot HARDTACK to Canadian policy makers and military personnel because of the extremely high level of secrecy associated with the tests. By late 1958, nuclear weapons, their design and employment had gone far, far beyond the relatively crude gravity bomb weapons of the 1940s that Canadian military leaders were familiar with. Fortunately, Foulkes's access permitted him to gently influence Canadian policy.

Finally, on 24 September 1958, a USAF BOMARC missile successfully intercepted a Navaho missile flying at Mach 1.5 at 50,000 feet [15,240 m] off Cape Canaveral.[40] The unarmed BOMARC A, tracked by radar, "came close enough … to destroy the [Navaho]."[41] This distance was unspecified in "secret-level" reportage. With Nike Zeus in suspended animation for the

Observers view atmospheric testing during operation Hardtack.
Source: National Nuclear Security Administration Nevada

time being and the British having no comparable system available yet, BOMARC was the only game in town for Canada.

From the policy standpoint, Minister of National Defence George Pearkes stated in retrospect that:

> The theory which the Americans were working upon, and so were we, was that if there was an attack by missiles or rocket-carrying aircraft, it would probably be followed up by a bomber attack on the cities and while they hadn't got an adequate defence against the missiles at the time, they felt they had to obtain the confidence of the people in the large cities in that area, they had to make a show at some defence and the BOMARC was something new or quite impressive to look at … . It was partly for show, but I think it was an effective weapon if there had been bombers … . Oh, there was opposition to the use of nuclear warheads … . I always maintained that we should have the best possible weapons which we could put into the hands of our service people. Nuclear warheads were the best.[42]

Editor's note: Part 2 of this article will appear in the fall issue of the *Royal Canadian Air Force Journal*.

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Abbreviations

AAC	Anti-Aircraft Command
ABM	antiballistic missile
A/ICBM	anti-intercontinental ballistic missile
ADC	Air Defence Command
ATI	Access to Information
cm	centimetres
DHH	Directorate of History and Heritage
DRB	Defence Research Board
ICBM	intercontinental ballistic missile
JCS	Joint Chief of Staff
JSWPC	Joint Special Weapons Policy Committee
kg	kilogram
km	kilometre
m	metre
MCC	Military Cooperation Committee
NORAD	North American Air Defence Command
RG	Record Group
SAC	Strategic Air Command
SAGE	semiautomated ground environment
US	United States
USAF	United States Air Force
USNARA	United States Naval Advanced Research Agency

Notes

1. The launch containers for the BOMARC missiles resembled coffins, hence the nickname.

2. BOMARC is derived from Boeing Michigan Aeronautical Research Center.

3. CANAIRDEF [Canadian Air Defence Command] to CANAIRHEAD [Canadian Air Headquarters], dated 11 March 1964, Access to Information [ATI] message. I quote, "Results of [Capability Inspection / Operational Readiness Inspection] at La Macaza were almost disastrous and if at USAF unit would have caused removal of the warheads."

4. Palmiro Campagna, on page 40 in the third edition of his *Storms of Controversy: The Secret Avro Arrow Files Revealed* (Toronto: Stoddart, 1992), explains that in a 1991 interview

with former Air Vice Marshal John Easton the CF105 was projected to have some form of antiballistic-missile capability. The details receive no elaboration in this or any other work.

5. USNARA [United States Naval Advanced Research Agency] documentation, "Commander's Conference April 24, 25, & 27, 1950 Ramey Air Force Base, Puerto Rico," National Security Archive holdings.

6. Director Military Operations and Plans (DMO&P) "Air Defence of North America," Directorate of History and Heritage [DHH], 19 December 1957, file 112.3M2.009 (D208).

7. The Soviets would not develop a potent intercontinental bomber force between 1952 and 1954. See Steven J. Zaloga, *The Kremlin's Nuclear Sword: The Rise and Fall of Russia's Strategic Nuclear Forces 1945–2000* (Washington, DC: Smithsonian Press, 2002).

8. United States Freedom of Information Act (FOIA), Air Defence Command (ADC) Historical Study No. 21, "BOMARC and Nuclear Armament 1951–1963"; and ADC Historical Study No. 20, "Nuclear Armament: Its Acquisition, Control and Application to Manned Interceptors 1951–1963."

9. ADC Historical Study No. 20.

10. "JOHN Shot-Operation PLUMBBOB: Information for RCAF Observers," 20 June 1957, Records Group (RG) 24, vol. 21444 file 1894-2.

11. Shorthand Transcript of 1961 Air Officers Command Conference, 21 March 1961, DHH, Raymont Collection, File 2008.

12. BOMARC-SAGE integration is discussed in some detail in Kent C. Redmond and Thomas M. Smith's *From Whirlwind to MITRE: The R&D Story of the SAGE Air Defense Computer* (Cambridge: MIT Press, 2000).

13. Chuck Hansen, *US Nuclear Weapons: The Secret History* (New York: Orion Books, 1987), 187.

14. ADC Historical Study No. 20.

15. Hansen, *US Nuclear Weapons*, 187.

16. ADC Historical Study No. 20.

17. As described in some detail in Chapter 4 of the author's *Learning to Love The Bomb: Canadian Nuclear Weapons and the Cold War 1951–1970* (Dulles: Potomac Press, 2007).

18. DRB to Joint Special Weapons Policy Committee (JSWPC), "Possible Canadian Requirements for Nuclear Warheads," 2 November 1954, ATI.

19. See DHH, file 423.009 (D14), letter Stearne to Rothschild and attachment, 1 Februrary 1955; and "File Memo on PROJECT COMBINE," 12 April 1955.

20. "Control of Tests of Atomic Weapons," ATI DRB memo, 31 August 1955.

21. Ibid.

22. "Some Factor Affecting Defence Research Policy: A Short Report to Board Member, October 1957," Library and Archives Canada (LAC), RG 24 acc 83-84/167 vol. 7407 file 173-1 pt. 1.

23. Hendrick Diary, 5 March 1958, DHH.

24. Ibid., 17 February 1958.

25. "Air Defence of North America," 19 December 1957, DHH.

26. Hendrick Diary, 24 May 1956, DHH.

27. Ibid., 6 April 1957.

28. "BOMARC IM99 Interceptor Weapons System: Its Capabilities and Limitations," 17 February 1958, DHH, file 112.3m2.009 (D208) DMO&P.

29. "Air Defence of Canada," 24 February 1958, DHH.

30. "Army Comments on the Proposed BOMARC," 23 April 1958, DHH file 112.3m2.009 (D208).

31. Extract from the Minutes of the 620th Meeting of the Chiefs of Staff Committee, 18 April 1958, DHH, file 112.3m2.009 (D208).

32. D Arty [Director of Artillery] to DMO&P, "Review of Air Defence Against the Manned Bomber," 5 June 1958.

33. Ibid.

34. Chiefs of Staff Committee Meeting, "Review of Air Defence Against the Manned Bomber," 10 June 1958, DHH, file 112.3M2.009 (D260).

35. The details are in the US Army's Center for Military History's *History of Strategic Air and Ballistic Missile Defense, Volume II (1956-1972)*, accessed June 18, 2014, http://www.history.army.mil/catalog/pubs/40/40-5.html.

36. USNARA, RG 218, box 79, Chairman, Chiefs of Staff 471.6 4-25-50 sec 20, "Invitation to Observe Atomic Weapon Test," 5 April 1958; and JSPC [Joint Strategic Plans Committee] to the JCS [Joint Chiefs of Staff], "HARDTACK Observers" 7 January 1958; RG 59 box 2878, memo to SECSTATE [Secretary of State], 10 February 1958.

37. Memo from JCS for Secretary of Defense, "Nuclear Testing," 30 April 1958, Declassified Document Reference System 1979, frame 37C.

38. "Operation HARDTACK I," www.nuclearweaponsarchive.org (site discontinued).

39. Ibid; William Robert Johnson, "High Altitude Nuclear Explosions," accessed June 18, 2014, http://www.johnstonsarchive.net/nuclear/hane.html; Defense Technical Information Center (DTIC) Defense Nuclear Agency, "Nuclear Weapons Tests Nuclear Test Personnel Review, Operation HARDTACK I 1958"; and Hansen, *US Nuclear Weapons*, 88–90. See also http://glasstone.blogspot.ca/2006/03/emp-radiation-from-nuclear-space.html (accessed June 18, 2014), which suggests that Shot YUCCA was the first time electro-magnetic pulse was measured.

40. Dwight D. Eisenhower Library Anne Whitman Files, "First Intercept of a Supersonic Target with an IM-99A (BOMARC)," Declassified Document Reference System, box 77 98B, frame 454.

41. James N. Gibson, *The Navaho Missile Project* (Atglen: Shiffer Publishing, 1996), 78. The Navaho was a hybrid rocket-guided missile combination.

42. University of Victoria Archive, The George Pearkes Papers, interview with George Pearkes, 7 March 1969.