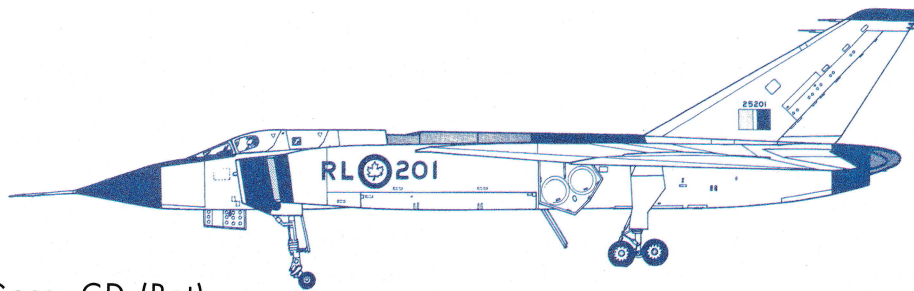


The Arrow Revisited

by Major General William Goss, CD (Ret)



In the 46 years that have elapsed since the cancellation of the Avro Arrow interceptor, many treatises have been written and many opinions expressed as to the wisdom of the Arrow itself, and especially its ultimate cancellation. Most of these opinions have been slanted one way or another.

As one of the principal military project managers for the Arrow and later for the Bomarc surface-to-air missile and CF-104 Starfighter strike aircraft, I have resisted commenting on these projects until now. Now, however, I would like to try to put all of these projects into their proper perspective, thereby, perhaps, to allow the Arrow to seek its proper place in the scheme of things.

First of all, it is necessary to remember that the RCAF definition of the operational characteristics (OCH) that had to be fulfilled by the Arrow were being developed at the height of the Cold War and, once completed, there was to be inherently a huge time lag to the production of the first aircraft which would be designed to meet the OCH. During this period, very profound advances had also been made in respect to the inter-continental ballistic missiles (ICBMs), on the one hand, and orbiting satellites, on the other, when the Russians put their *Sputnik* into orbit, all of which compounded the perceived threats to North America and the scope of defensive weapons needed to address these threats.

That being said, there appeared to be just cause to continue to address the bomber threat, and therefore to continue to pursue the Arrow weapon system as the best means of addressing this threat. In this regard, let it be understood that every effort was made not only to assure that the Arrow met the requirements of the OCH but also to compress the time schedule involved between the statement of requirement,

through production and flight testing, to the ultimate introduction of the aircraft to RCAF squadron service.

Many treatises on the Arrow tend to denigrate the RCAF competence and realism in its pursuit of the Arrow. In this regard, let it be said that the development of the OCH for the Arrow was driven by the parameters of the threat that it was to counter. It would have been incompetent to develop an OCH which did not, in fact, address the threat.

Let it be said also that as the principal interface between the RCAF and the ultimate designers and manufacturers of the Arrow, I had been personally groomed over several years to take an active part in the project. I was as highly qualified academically as anyone on the project, bar none, and had been given, in addition, a comprehensive exposure to all facets that would ultimately relate to the project.

To begin with, I had been a long-time flying instructor and had been trained as a Mosquito fighter pilot. I had two Masters degrees in engineering, one in high-speed aerodynamics and one in instrumentation and data collection and collation as it was to apply to flight testing. I had been given in-depth training in the U.S. on guided missiles which included launching V-2 rockets from White Sands, New Mexico, and an in-depth knowledge of the design and operation of the Sparrow air-to-air missile which was to be the designated weapon for the Arrow. I had been seconded to the Defence Research Board (DRB) as a research scientist to assist in the successful development and testing of the Velvet Glove air-to-air missile for NATO. And, finally, I had made a comprehensive tour of all of the aerospace firms and test facilities in California so as to have a first-hand knowledge of production and testing. In

sum, the RCAF in its wisdom, was well prepared to take on the design and development of the Arrow which, when it manifested, achieved and exceeded all of the requirements of the OCH.

As one means of foreshortening the time required to design, build, test, and put the Arrow into the service, the RCAF, along with the contractor, Avro, decided to use the Cook-Craigie concept of production wherein, instead of designing the aircraft and then producing a few prototypes for testing and modifying the design before going to production, considerable attention was put into progressively confirming the design by simulation and, once completed, to go immediately into production. This concept compressed the schedule by many months, proved hugely successful and resulted in only minimal design changes to be retrofitted to the first few production aircraft.

A second means of foreshortening the elapsed time between design and squadron use was the integrated approach that was taken in respect to flight testing wherein the contractor and the RCAF, together, defined the flight test program, each test aircraft was instrumented to monitor and capture all the flight test data required, and this data was progressively telemetered to a computer on the ground for collection and collation. The test flights were jointly shared by the test pilots of the contractor and the RCAF, with F/L Jack Woodman capably representing the RCAF.

With all the success that was achieved and all the innovation that was the hallmark of the Arrow, the question always devolves down to why was it cancelled. Most commentators blame Prime Minister John Diefenbaker as the principal culprit, which is totally inaccurate and unfair.

The major problem with the Arrow was that neither the Canadian Government nor the contractor were successful in attracting

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other NATO countries, including the U.S., to participate in the programme, thereby to provide at least a break-even production order. A.V. Roe had two subsidiaries, Avro, which was the aircraft designer and manufacturer, and Orenda which was the Iroquois engine designer and manufacturer.

Avro, for whatever reason, had basically become the single-product company, to wit the Arrow, which, in itself, by itself, and without additional NATO orders, *was not economically viable*. It is true, that the cost-per-copy of the Arrow had ultimately exceeded the \$3.7 million mark, which at the time, was a frightening prospect financially, although some years later the Canadian government, in its wisdom, had no problem with the per-copy cost of 10 times this amount when it purchased the CF-18.

Perhaps the real tragedy of the Arrow cancellation was the Iroquois engine which was being designed, tested and manufactured by Orenda and which was at least 10 years ahead of its time. The technology developed by Orenda is currently employed in most of today's high performance engines of all types.

Orenda, unlike Avro, was itself economically viable in that it had other products to sustain the company. Had the Iroquois engine been continued to fruition, it would have been a force to be reckoned with in the world of aircraft engines. That it was cancelled along with the Arrow was, in my view, a significant mistake on the part of A.V. Roe, the Canadian Government, and the RCAF.

The Arrow was designed as a single-purpose, all-weather, high-altitude interceptor aircraft and, because of its design, could never have been adapted to other roles such as low-level bombing, close air support, etc, for which aircraft were also required by the RCAF. The decision was made, therefore, to acquire an existing high-altitude interceptor, albeit with lesser capability but also with a considerably lesser cost which would permit the follow-on development of CF-104 Starfighter as a low-level strike aircraft.

It is a red herring of the first order to

suggest that the RCAF cancelled the Arrow and, instead, purchased the Bomarc surface-to-air missile to take its place. NORAD and the USAF perceived that a hole existed in the high-altitude air defence system that was supposed to protect the heartland of the U.S. This gap was in the Northern Ontario/Northern Quebec regions and the USAF, not the RCAF, provided the Bomarc missile, the launching equipment, and nuclear warheads, while the RCAF's only contribution was to build the bases and the related infrastructure, an arrangement whereby the cost to the USAF was two-thirds and the RCAF one-third of the total cost of the Bomarc. Whether one likes it or not, the Bomarc was a significant technological achievement with its launching and control system, its ram-jet engine, and its nuclear warhead that would obliterate a whole squadron of enemy bombers. It served its purpose as a deterrent to the use of manned bombers.

When one is reflecting upon the Arrow, one would be well advised to remember that if, by some unknown means, the Arrow had been brought to fruition, the RCAF would have been relegated solely to the high altitude role, without the financial means of adding other capabilities. It would have been of little use to NATO or other undertakings such as the first Gulf War or the Balkans campaigns. In addition, the Canadian navy and the army would also have been greatly inhibited due to lack of close air support.

That said, it is clear that the cancellation could have been handled with greater finesse so as to take greater advantage of the technological gains that had been made. This is particularly true of the Iroquois engine, which could have continued on its own merits. While the USAF will rarely import aircraft from offshore for the defence of the USA, they would probably have been amenable to importing the Iroquois engine, as would the manufacturers of many commercial aircraft.

While the Arrow was in most respects a technological triumph, there were

inherently, because of the performance required, some frailties that would ultimately have to be addressed. For example, the landing gear was designed to retract into the wing, which was extremely thin because of the aerodynamic performance required. This fact required that the undercarriage be triple-articulating, and for landing it had to emerge from the wing, extend, and then the bogey had to rotate to the tracking position. One test aircraft was significantly damaged because the bogeys did not rotate as programmed. It is difficult to imagine how this complicated design could remain fully functional while on strenuous squadron service.

Despite this and other known design frailties, the Arrow is inevitably looked upon as a national tragedy without due recognition of the fact that, even though it was cancelled, it made a significant contribution to the national and international aerospace community, in the sense that all the advances in technology along with many of the principals involved in the Arrow, migrated to other programmes, thereby greatly enhancing progress in these areas. It is unfortunate that this piecemeal migration did not lend itself to crediting the authors of the Arrow program and the Arrow itself as the original or ultimate source.

Apart from the folklore that is associated with the Arrow, the fact that the spirit and courage existed whereby a small country like Canada could successfully undertake a project of the magnitude of the Arrow lives on in Canadians to the extent that we continue to excel in the innovative advancement and application of technology. Much of this confidence can be traced back to the Avro Arrow which is perhaps the most significant and lasting heritage of the project. ☺

(Ed note: MGen Bill Goss of Ottawa retired from the Canadian Forces in 1976 to pursue a successful career in business. He is currently an independent business consultant and is a member of the Air Force Association of Canada.)