Un sous-marin français construit aux antipodes

(A French Submarine built in the Antipodes) ©Bob Trotter 2017

By Commodore Bob Trotter OAM RAN (Ret'd)[1]

> *The year 1866 was signalised by a remarkable incident, a mysterious and puzzling phenomenon, which doubtless no one has yet forgotten. Not to mention rumours which agitated the maritime population and excited the public mind, even in the interior of continents, seafaring men were particularly excited. Merchants, common sailors, captains of vessels, skippers, both of Europe and America, naval officers of all countries, and the Governments of several States on the two continents, were deeply interested in the matter. For some time past vessels had been met by 'an enormous thing,' a long object, spindle-shaped, occasionally phosphorescent, and infinitely larger and more rapid in its movements than a whale.*
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> *Upon this imaginary creature rested the responsibility of all these shipwrecks, which unfortunately were considerable; for of three thousand ships whose loss was annually recorded at Lloyd's, the number of sailing and steam-ships supposed to be totally lost, from the absence of all news, amounted to not less than two hundred!*
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> *Now, it was the 'monster' who, justly or unjustly, was accused of their disappearance, and, thanks to it, communication between the different continents became more and more dangerous. The public demanded sharply that the seas should at any price be relieved from this formidable cetacean.*[2]

Not long after the French novelist Jules Verne wrote those prophetic words in 1870, France's Navy, *La Marine*, began serious experimental work on underwater craft. *Gymnote*, one of the first all-electric submarines and the first functional submarine equipped with torpedoes was launched in 1888, the effective start of Forces sous-marines. But, before getting down to a brief look at *La Marine's* submarine pedigree, it is useful to look at our own.

Whilst the Royal Australian Navy is very much younger than many of those of the major powers, its submarine history is almost as long and as enduring.

> On 24th May 1914 His Majesty's Australian Submarines *AE1* and *AE2* entered Sydney Harbour for the first time, having completed the longest ocean passage ever taken by any submarine — sailing from Barrow-in-Furness in the United Kingdom. In their very short lives they exerted significant and very long-lasting influence out of proportion for their size (800 tonnes dived) and numbers in their crew (35). *AE1* and her entire crew were to be Australia's first casualty in World War I while *AE2* was the first submarine to penetrate the Dardanelles during the Gallipoli Campaign showing the way for all other Allied submarines.
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> Very few Australians know the stories of *AE1* and *AE2*. Nor would they know about the 'Peace Boats'[3], six Australian J Class boats (1919-1926), nor the two Odin Class boats HMAS *Oxley* and *Otway* (1927-1931). Even fewer know that the operations of US, British and Netherlands submarines based in Brisbane and Fremantle played a major role in the defence of Australia from 1942 to 1945. Only a handful or people know that Fremantle was the second largest submarine base in the World, and that the 160 or so submarines operating from North Wharf conducted the most successful and cost-effective operation in the history of submarine warfare.

> Australia was a very early entrant to the business of submarine ownership. It started when Alfred Deakin selected two submarines against the recommendations of his Chief of Naval Staff in what might have been a courageous act for a country of less than 6 million people. Australian Government efforts to maintain its submarine capability during the first 50 years were intermittent and difficult, but it never quite gave up.
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> The trend established by Deakin, where the politician must persuade the naval officers that submarines are useful for Australia continued when John Gorton could see the benefit in purchasing the RAN Oberon Class submarines while the Naval Staff of the day were not so convinced. Kim Beazley found himself in a similar situation when discussing the requirement and build location for the submarine capability that ultimately became the Collins Class submarine. Because of the foresight of Gorton and Beazley, the second 50 years of Australia's submarines has been a great success.
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> The Oberon submarines quickly moved out of their 'clockwork mouse' anti-submarine warfare training role and developed an impressive reputation for very long-range intelligence, surveillance and reconnaissance operations. Australia's Oberon update program also established a very clever technology capability in Australian industry.
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> Despite early challenges for the Australian-built Collins Class submarines, they regularly surpass world class standards of performance while operating in the most demanding environment ever required of conventionally powered submarines
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> So, Australia has had good cause to celebrate a centenary of silent service with a robust heritage of submarine operations and industrial capability and, it is well placed for success with the next generation of Australian submarines which will establish the submarine capability for the next 100 years.[4]

The Government has decided to develop a twelve boat Future Submarine capability with Direction des Constructions Navales Services (now renamed Naval Group) based on its offered Shortfin *Barracuda* design. Two questions often arise concerning this decision and the size of the capability. Why French and why twelve submarines? In answering, this author makes no attempt to replicate the exhaustive work of Rear Admiral Greg Sammut's fine men and women of the Future Submarine Program Project Office but it worth repeating the words expressed in the Australian newspaper by Peter Jennings, Executive Director of the Australian Strategic Policy Institute shortly after the decision. He said

> *'The truth about the submarine program is that a careful evaluation process conducted by experienced submariners led to a sensible outcome based on delivering what the navy actually needs. How boring is that?'*

La Marine

Throughout her modern history France has always considered herself special among the world's nations, with an important historic and civilising role, a view expressed by Charles de Gaulle as '*France cannot be France without greatness*'. This ideal called for a navy that could figure on the world stage, but which had varied very greatly under the Third and Fourth Republics, 1879 to 1945 and 1947 to 1958 respectively, and again in the first forty years of the Fifth Republic of 1958[5].

The official title of France's navy is *La Marine*, and its motto is 'Honneur, Patrie, Valeur, Discipline'. It is a proud service with a history stretching back to the 17th Century, the time of its formation by Cardinal Richelieu in the reign of Louis XIII. Splendid periods of glory followed its expansion by the

statesman Jean Baptiste Colbert in the reign of Louis XIV and in the last period of outstanding success before the Revolution in the reigns of Louis XV and Louis XVI. Linked to this tradition is pride in the achievements of explorers and navigators in the age of sail[6].

Modern French maritime strategy evolved around the possession of warships that could defend France's coast or when international relations required, working with allied fleets; she used seapower to acquire and later defend colonies and key transport routes and; to influence other powers to ensure French interests were well served. However, throughout her modern history it was a navy that was second in national defence priorities but one that played a lead role in 1940, a time of national misfortune and crisis.[7]

Post-World War Two, Great Britain and France drew different conclusions from their loss of empire and their decline in military power in relative to the United States and the Soviet Union. Whereas Britain tacitly accepted that the political, military and diplomatic hegemony lay elsewhere, France under President de Gaulle drew strength from the worldwide criticism of the Algerian war and at Suez and reversed the loss of power and prestige. In France, naval policy was very clearly to be that power must be independent and based on nuclear powered aircraft carrier capabilities, modern missile-firing strike aircraft, submarines and destroyers. It worked, as world power status and a permanent seat on the United Nations Security Council was secured on its inception by the Fifth Republic's developing an intercontinental ballistic missile nuclear submarine force[8].

The Shortfin Barracuda Pedigree – why a French submarine for Australia?

For the first time in the 136-year history of France's National Day Parade, the Australian Defence Force led the march down the Champs-Élysées on 14th July 2016 with the Royal Australian Navy contingent leading. Such recognition by France is of course a matter of the history of Australia's World War One involvement on the battlefields of France but it also recognises over a century of defence cooperation which has included the purchase of aircraft, a replenishment ship, submarine propulsion machinery, sonars and many other items in our defence inventory.

Showing typical flair, France was an enthusiastic and early starter in experimenting with submarines. Early discussions were about a preference for submersibles or for submarines; submersibles being faster, steam-driven surface warships which, over a period of some ten minutes or more could prepare and dive to close and attack; submarines being a fully submerged albeit slower boat that could dive very quickly and become hidden for longer periods.

A small 30 ton electrically driven submarine, *Gymnote* was built in 1888. Designed by Gustave Zédé, it exploited the success of Arthur Krebs' electric motor technology on the airship La France in 1884. It was operated by a crew of five men, and the electric motor of 52 hp was powered by a battery of 564 cells and could make 8 knots on the surface and 4 knots dived.

Figure 1 Gymnote 1888

Many other designs followed which included the larger boat *Gustav Zede* in 1893; the 120-ton steam-driven submersible *Narval* capable of 11 knots on the surface and 15 knots dived; the 185-ton steam-driven *Farfardet* in 1899 carrying four 15-inch torpedoes externally; followed by four *Sirene* class submersibles of 157 tons powered by steam-petrol engines on the surface and motors submerged. Following many successful and not so successful designs two small experimental petrol driven boats, *Circe* and *Calypso*, were armed with six improved torpedoes but all these boats had seriously limited range of action and none could stay submerged for very long. An old cruiser, *Foudre*, was fitted with deck cranes to be used as a transport for small submarines but the practical difficulties and delays in dropping the boats in the midst of a battle became obvious.

Prior to, during and after World War One, French submarine preferences began to move towards the British pattern of larger and faster boats designed for offensive operations. During that conflict a total of fourteen submarine classes were developed and operated. They were a mix of coastal and ocean-going sizes of steam, petrol and diesel-powered designs and, finally, fitted with torpedo tubes.

At the commencement of World War Two, *La Marine* submarine strength was eighty-five boats, mostly of 1500 tons and larger. Illustrative of the sometimes innovative, indeed imaginative approach by French designers was the large *Surcouf*, a mammoth attack submarine which at the time of her completion, was the largest submarine ever put to sea. A triumph of French naval engineering she was unique in being armed with a twin 8” gun turret as well as 12 torpedo tubes, 6 anti-aircraft guns in two mountings and a Besson floatplane for over-the-horizon reconnaissance, scouting and gunnery spotting. Following the neutralizing of the French fleet in 1940, she was handed over to the Free French Navy and used to escort Atlantic convoys before being ordered to French Polynesia in the Pacific Ocean. She disappeared after resupply at Bermuda in February 1942 and has never been found.

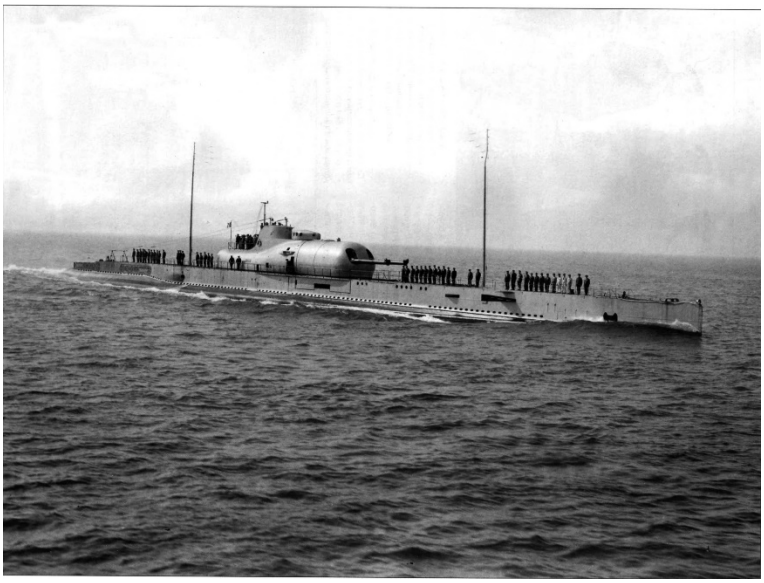

Figure 2 Surcouf

Post-World War Two, France developed three successful conventionally powered submarine classes for *La Marine* and for export. The *Daphne* class, from 1958 to 1970; the *Agosta* and improved export *Agosta* classes during the 1970s and 1990s were exported to countries including South Africa, Pakistan, Portugal, Malaysia and Spain. The four *Agostas* operated by sous-marin français were decommissioned from 1997 to 2001 and were the last conventional submarines operated by France.

The latest conventionally powered class, *Scorpene*, is a new generation submarine developed and manufactured in France by DCNS in cooperation with the Spanish company Navantia for export to Chile, Malaysia, India and Brazil.

A nuclear-powered submarine was proposed in the late 1950s and laid down as Hull No Q244, based on a heavy water reactor power plant which could utilize natural uranium, France having no uranium enrichment facilities at the time. Regrettably, the designers were unable to produce such a reactor small enough to fit into the submarine and the project was cancelled in 1959.

In the early 1960s the French government decided to develop an independent nuclear deterrent based on Submarine Launched Ballistic Missiles (SLBM) and Hull Q244 was redesigned as a conventionally powered SLBM trials submarine and renamed *Gymnote 2* in honour of the original all-electric submarine of 1888.

In parallel with these events, France was delivered several political blows to its nuclear aspirations. The United States did not offer to supply a complete US-designed submarine nuclear propulsion system as it had agreed with the UK in 1958. Moreover, the US Congress had refused to grant access to submarine reactor design information nor the supply the enriched uranium needed for a submarine-sized reactor. Consequently, France decided to develop an independent naval nuclear program under its Commissariat à l'Energie Atomique (CEA) and proceeded to develop a uranium enrichment plant at Pierrelatte. A long-term naval shipbuilding plan was approved that saw for four SSBNs[9] and one SSN[10] built between 1959 and 1969.

The rest is history and at mid-2015 forces sous-marines operates an all-nuclear fleet of submarines comprising six, second generation *Rubis*-class SSNs (to be replaced by new design *Barracuda* SSNs from 2017) and; four second generation *Le Triomphant* class SSBNs which will remain operational beyond 2030 when they too will be replaced.

A complete submarine power is one that can safely design, build, operate and sustain any class of submarine on an enduring basis. France is a complete submarine power and has national policies to remain so[11]. Therefore, it can be claimed with some confidence that the *Shortfin Barracuda* Block 1A, designed specifically for the RAN, will be the recipient of France's most sensitive and protected submarine technology and will be the most lethal conventional submarine ever contemplated.

Figure 3 The Shortfin Barracuda (Picture courtesy of DCNS)

Earlier in this piece, the Author noted that it was not the intention to replicate the capability decision process so, nor is it the intention of providing a design description the details of which will evolve in the next phase of the Future Submarine Program. Sufficient to say that what is being offered is leading edge.

Pump jet propulsion means the *Shortfin Barracuda* will move more quietly than submarines with propeller technology. The sonar suite performance promised will be the best available ever for a submarine this size. This coupling of excellent acoustic discretion, leading edge detection capabilities and pathways for technology development will grant Australia a sovereign and regionally superior submarine capability and the capacity to remain ahead of any regional adversaries now and well into the future.

A future submarine enterprise will also evolve the submarine knowledge base which will spread into a network of Australian educational, research and development and industrial bodies. It will become sovereign, enduring, autonomous, regionally superior and interoperable. The Australian build program will build dedicated measures to transfer technology, expertise, knowledge and a supply chain for the future operation and sustainment of the submarines, including a crucial upgrade program that will span over 30 years.

But why twelve submarines?

There is nothing new about a required Australian submarine force of this order of magnitude. Early numbers studies for what is now the Collins Class featured most of the arguments below and came up with ten. The author recalls that that number was reduced within the Department to a palatable eight and Government eventually reduced it six with an option for two more. As we know, the

option was not taken up and the experience of the early years of the class demonstrated that, equipment and logistics problems encountered aside, in many respects the consequences of reduced availability and training space proved that the original requirement was about right.

The arguments following below are like those put by the Submarine Institute of Australia's submissions to submarine capability studies in papers by Rear Admiral Peter Briggs AO CSC and later published by the Australian Strategic Policy Institute. They are a brief venture into a very complex problem that the author hopes will provide some confidence that the figure twelve is sustainable.

The answer to the question of how many submarines Australia needs starts with what is required to provide sufficient 'strategic impact' and have a potential aggressor avoid a military confrontation with Australia. It flows from consideration of the criticality of the maritime environment for Australia's prosperity, the impact of growing regional maritime power, and the need to look for capabilities that will give future Australian Governments' options to cope in this emerging situation. Hence a requirement for long range, long endurance, survivable submarines.

To be able to exploit the initiative gained from their stealth, Australia's submarines must be able to covertly reach sensitive areas throughout our region with sufficient mobility, endurance and payload for the long duration missions involved, frequently in or through demanding tropical waters. Given the unfolding strategic landscape, another starting assumption is that Australia's submarine force must be capable of operating and surviving north of the archipelago and throughout the South China Sea; able to observe, report and if necessary strike.

Against this setting two points based on practical observation over many yours of operating and sustaining a submarine force must be made.

The first is the 'rule of three'. Like aircraft, submarines operate under a strict maintenance regime, and are designed to provide a high level of serviceability at sea and to avoid catastrophic failure of a key system and in the worst case, loss of the submarine. Given sufficient qualified personnel, this regime determines submarine availability; from three submarines, typically one will be in maintenance/refit, one will be training/preparing for a deployment and one will be available for deployment or deployed. Despite the many improvements in design for maintenance efficiencies and effectiveness brought about by technological change, there is little evidence that these parameters will change in the foreseeable future. Submarines come in threes.

The second observation borne of experience is that a force of six submarines, i.e. typically with three or four available or at sea under the rule of three the force will struggle to achieve sufficient sea days to generate enough of the highly skilled and long development time personnel such as commanding officers, engineers and senior technicians to man the four to five crews and provide the essential shore staff in the Submarine Squadron, training and policy areas.

Modelling of these training pipelines demonstrates that a force of at least nine submarines, i.e. typically six at sea is the minimum to achieve a sustainable critical mass of specialist/experienced personnel. The RAN has survived hitherto by lateral recruiting qualified personnel from other navies—not a reliable basis for manning a core capability.

Geography is a major factor; it is 2,900–3,000 nautical miles from HMAS *Stirling* in Perth to the southern end of the South China Sea via the three to five choke points on a typical transit route for a conventional submarine. Without being specific about the scenario, it's therefore likely that Australia will wish to be capable of maintaining a deterrent submarine presence at very long ranges, say 3,500 nm.

For practical deterrence it is asserted that Australia should be able to sustain at least two submarines in this area, to offset the risk that a single submarine could be effectively neutralised as a deterrent by its mobility restrictions in the event of counter-detection. This would provide maximum strategic effect at lower risk. Concurrently, Australia would also wish to provide submarines closer to home in support of Task Force operations, for special force missions or training own ASW units.

The issue of concurrent roles and an allowance for attrition of own submarines employed on offensive operations are additional factors to the calculation of the force structure required to achieve the strategic effects. But, the characteristics of the submarines themselves are also important.

Speed of advance is the critical factor in determining how long it will take a submarine to complete the transit to and from a patrol area. This speed is determined not only by the submarine's own design, but also by external factors such as weather, ocean temperature and currents, the need to remain covert to achieve the mission and level of ASW surveillance/threat. Design features of the submarine, such as hull shape and the rate at which it can recharge its batteries (and their capacity) will determine how it performs in those environments. Not all designs are equal; these features are all critical attributes that need to be balanced and optimised in the design and it is easy to understate the challenge and complexities involved in achieving this in a short summary.

The external factors will vary during the course of a transit and the mission profile will be adapted 'on the fly' to accommodate these variations. Typically, the submarine will 'snort' (run its diesels to recharge the batteries) at a slow speed and for a limited time, exploiting local acoustic and environmental conditions where possible to reduce counter detection risks, before going deep to run at higher speed using power from the battery to cover the ground. To avoid snorting in a high threat/surveillance situation in the choke points enroute to the patrol area, an air independent propulsion system would be useful but that's generally a limited resource if using present technology.

Next, it is possible to model the time necessary for crew training and maintenance using assumptions based on typical performance figures of modern propulsion and battery technologies. Then, modelling the transit timing with an allowance for the practical and navigational obstacles indicates that a force of eight high capability submarines would have to be dedicated to the task to maintain one continuously on task at 3,500 nautical miles. Each mission would typically involve 35 days' transit to and from the patrol area, in a tactical posture responsive to the threat/surveillance environment, and 35 days on patrol—a total mission time of 70 days. Two such missions per year are probably the limit for crew effectiveness and retention. This regime would provide some relief from this cycle and time for other employment.

It would be prudent to be able to provide at least one additional, operational submarine for concurrent tasks such as Task Group support at closer ranges or for own ASW force training. Allowing for the rule of three, this would require a total force of at least 12 submarines.

This calculation illustrates the process of determining the number of submarines Australia might require to deal with a contingency. It's at the minimalist end of the spectrum, with little allowance for attrition or the unexpected. The cumulative requirement could sustain an argument for a total force of fifteen or eighteen submarines to provide for attrition and the flexibility to meet a range of circumstances.

Summing up, twelve submarines is the minimum force size to enable Australia to sustain one deployed at long range in a demanding but practical cycle, provide one operational submarine available for other tasking and have some capacity for ASW training or other contingencies. The deployment mix is one for the strategic judgment of the Government of the day and will depend on the circumstances it faces. As a minimum, for a sustainable manpower base we should have at least nine submarines

It's worth re-iterating that the submarine's most fundamental, key feature is its stealth. Given this attribute, a well-handled submarine is able to operate without causing fuss in areas where sea and air control isn't assured, and to gain access to areas denied to other platforms. Large submarines, such as Collins, and the Future Submarine, are able to operate at long range for weeks, carrying a flexible payload of sensors, weapons and specialist personnel. A capable submarine force is probably our most potent anti-submarine weapon system, perhaps their most demanding role. A potent submarine capability creates great uncertainty for an adversary: countering them is difficult, expensive and can't be guaranteed.

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[1] In preparing this article the author consulted widely within the Submarine Institute & Submarine Association of Australia, DCNS Australia (now Naval Group)..
[2] '*20,000 Leagues under the seas*' Jules Verne
[3] '*Century of Silent Service*' Graham Seal and Lloyd Blake, Boolarong Press, 2013
[4] The above paragraphs are from the Foreword by Vice Admiral Ian MacDougall, AC, AFSM, RAN (Ret'd) to '*Century of Silent Service*', edited and amended to fit the context of the article
[5] *'Three Republics One Navy; A Naval history of France 1870 – 1999'*, Anthony Clayton, Helion & Company 2014
[6] Ibid
[7] Ibid
[8] Ibid
[9] Nuclear-powered Ballistic Missile Submarine
[10] Nuclear-powered Attack Submarine
[11] DCNS Australia (now Naval Group)