

required. At a minimum, this means point-defence missiles and a close-in weapons system. Sophisticated radars are also needed to make these systems effective, as are electronic countermeasures to blind or confuse attacking aircraft or missiles. Because such ships would be employed on escort duties, they should also have missiles and radars with which to protect other vessels against air attack, and so provide a form of area air defence. (These missiles would be of longer range than point-defence missiles.) At the moment, such a weapons system can only be accommodated in a hull much larger than that contemplated for the CPF. However, efforts being made to develop more compact area air defence systems may bear fruit before a CPF follow-on goes into production or the DDH-280s receive their mid-life update. Data-link communications systems are also essential and infra-red detection devices would be extremely useful. Such vessels should, in addition, be fitted with a gun for sovereignty protection duties and to give them a shore-bombardment capability.

*(b) The LRPA and its weapons systems.*

As noted before, Canada's LRPA, the Aurora, is highly effective in detecting and tracking submarines. It is equipped with a data-link system. Those in service require a more effective ASW torpedo, however, and some means of protecting themselves against aircraft and missiles. In addition to their ECM equipment they probably need an air-to-air missile. They also should have an air-to-surface missile. In point of fact, they are currently equipped for, but not with the Harpoon missile. Should additional Auroras be purchased, they should be ordered fully equipped and the missiles for them should be acquired.

*(c) The submarine and its weapons systems.*

The modern diesel electric submarine is a weapons-platform of remarkable flexibility and efficiency. In part this is because it is not vulnerable, when submerged, to long-range attacks by aircraft and ships. Thus, it does not require the same variety of sophisticated weapons and sensor systems for its own protection as do surface vessels. It is much less expensive to build a conventional submarine than a surface vessel of frigate size. Because of automation, and because there are fewer functions to perform on board, it requires only thirty to forty personnel as opposed to the surface vessel's two hundred or more. Its diesel electric engines consume far less fuel than do the diesels and turbines of modern surface vessels. Its passive sonar systems can detect targets at ranges beyond 100 km, and it can be fitted with a passive towed-array sonar to further extend its detection range. The diesel electric submarine has a very high weapons-per-ton ratio. It can carry torpedoes, submarine-to-surface missiles, or a combination — two dozen or more. The submarine-to-surface missiles currently available to NATO navies have ranges of up to 180 km, and there are prospects, with the development of a submarine version of the Tomahawk, of achieving ranges of up to 500 km. Modern torpedoes of the guided or homing variety can be used at distances of 35 to 50 km.

Modern conventional ocean-going submarines have an endurance of from seventy to ninety days at sea. They can operate as independent units or as part of a team. With their snorkles they are rarely required to surface. They can descend to depths of up to 300 m. They are capable of submerged speeds of up to 25 knots for short bursts, although their efficient transiting speed submerged is in the order of 11 knots. When operating at very low speeds (up to 4.5 knots), they are so quiet