

## 2.2 Submarine Tankers

Another marine technology that is being advocated to transport LNG from the Arctic is a submarine of 140,000 cubic metre (approximately 5 million cubic feet) capacity, driven either by nuclear or non-nuclear propulsion at submerged speeds of between 12 and 15 knots. Cargo transfer systems have been designed for cargo loading at an underwater terminal in the Arctic or at a conventional surface terminal. Under-ice conditions are generally less severe and a submerged terminal would eliminate the risk of exposure to surface ice conditions.

The nuclear submarine would be 387 metres long while the non-nuclear version would be 487 metres in length. The size of the submarine proposed represents a huge increase in scale compared to existing submarines, since the non-nuclear one proposed by General Dynamics Corporation to the Committee is almost three times longer than the Trident submarine. It is based on well-tested U.S. military submarine technology rather than commercial submarine technology.

Its size gives it limited maneuverability in maintaining the safety margin required between the ice and the seabed. It has been estimated that 150 metres is a safe operating depth but this does not exist, for instance, in Barrow Strait; consequently, the route taken would have to be longer to avoid shallow areas. The shallow waters of the Beaufort would necessitate subsea loading systems far offshore. This would require a more extended gathering system that would not be necessary for surface tankers.

The stopping distance of the proposed submarine is calculated to be approximately three times that of the maximum range of sonar operating to avoid bottom and under-ice reverberations. This limitation is compounded by the cold arctic conditions which tend to affect the accuracy of sonar devices.

The consequences of a problem such as a leak are much more serious aboard a submarine than in a surface vessel. The design must therefore allow for a much greater safety margin than is true of a surface vessel in considering such exigencies as emergency rescue or collisions.

LNG is a low-density cargo with a specific gravity less than half that of water. Since the buoyancy of a submarine must equal its total weight, a submerged craft carrying LNG must also carry large quantities of high-density ballast. The proponents of the submarine consider they have overcome this problem and that their proposal is economically and technically viable. There is less risk of hull damage during continuous journey through the ice. They claim more cargo can be delivered per unit of time by a submarine than by an icebreaking tanker system at uniform, predictable intervals, lowering the transportation cost.

The principal attraction to the Committee of this concept is the lack of surface disruption. The difficulty for the Committee in assessing this system is that most submarine operation in the Arctic has so far been for defence purposes and so data are unavailable. The Committee finds the concept of commercial submarine use in the Arctic interesting especially in those areas where surface conditions are particularly severe; however, this possibility would need to be further explored. This mode of transport could, in the Committee's opinion, be included in the Federal Government's consideration of alternative transport systems.