Commentary

China's Polar Ships and Future Operations

Lawson W. Brigham

China significantly upgraded its polar marine operations capacity with the launch of a second polar research ship, the *Xuelong 2*, on 10 September 2018. Construction began on the new ship in December 2016 at the Jiangnan Shipyard in Shanghai and this vessel is China's first domestically-built polar research icebreaker; the ship is scheduled to come into service during 2019. The propulsion is diesel-electric and provides the ship with 15 megawatts of power (20,115 horsepower) to two Azipod propulsion units, or rotating, steerable pods. *Xuelong 2* is a Polar Class (PC) 3 ship (the highest class in the international classification system is PC1 and the lowest is PC7) and is designed to break 1.5-metre thick ice moving at continuous speeds of two to three knots (with icebreaking capability both moving ahead and astern). Owned by the Polar Research Institute of China, the new ship can operate comfortably in both polar regions as a logistics-supply vessel and a research ship conducting a full range of oceanographic and surveying operations. The total complement is 90 researchers and crew.

One of the keys to the design of *Xuelong 2* is the role of Finnish marine technology. China's Polar Institute awarded a contract to Aker Arctic in Finland for concept and basic design phases in 2012. Most would agree that Aker Arctic is among the world's leading icebreaker design firms and China has opted for the latest technological advances in polar ship design. Ice and open water model tests were conducted in Aker Arctic's Helsinki ice tank and laboratory. Due to the requirements for long, open water transits of modern polar research vessels, especially on voyages to the Southern Ocean, good seakeeping characteristics are essential for *Xuelong 2*. The ship is designed to carry two helicopters, has extensive wet and dry laboratories, multiple cranes, large cargo spaces, and spacious working decks for scientific operations. One special feature is a 'moon pool' ~ an opening through the ship's hull where scientific instruments can be lowered during operations with difficult ice conditions surrounding the ship. One icebreaking feature, unique to a number of Aker Arctic designs, is the ability of the ship to break ice effectively in both ahead and astern

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directions, dubbed by Aker Arctic a 'dual-acting icebreaker.' *Xuelong 2* is smaller in tonnage and physical size than *Xuelong 1*, but is more capable as an icebreaker due to higher propulsion power and a more efficient, icebreaking hull form.

Xuelong 1 (*Snow Dragon*) has been the principal polar research vessel for Chinese Arctic and Antarctic research expeditions since being acquired by China's government in 1993. *Xuelong I* was completed in March 1993 by the Kherson Shipyard in Ukraine as an icebreaking supply and cargo ship for the Russian maritime Arctic. Shanghai's Hudong-Zhonghua Shipbuilding firm converted the ship from a cargo vessel to polar research support ship by 1994. Extensive rebuilds of the ship were conducted in 2007 (with a new superstructure and pilothouse) and in 2013 (with new main engines). *Xuelong 1* is a physically large polar ship (21,025 tons displacement and 167 meters in length) and can accommodate 128 scientists and crew. However, the key limitation of this ship is that it is relatively under-powered (13.2 megawatts or 17,700 horsepower for propulsion) for the large size of the ship, and if it would be considered a fully capable icebreaker. Its original design as an ice class cargo ship with a single shaft and controllable pitch propeller limits its icebreaking capability. However, the ship has crossed the Arctic Ocean in summer on several research cruises and operated successfully in the Antarctic on numerous expeditions. *Xuelong 1* has been an impressive, Chinese national presence in both polar regions, and has been operated safely and effectively by highly competent polar mariners.

It is important to keep these ship developments in Chinese polar research in context. These two polar research ships, both government-owned and operated, provide China's research and sovereign presence at both ends of the world. They are excellent polar ships, and appropriate for the tasks at hand, but are far from being high end, large polar icebreakers with high propulsion and icebreaking capabilities. *Xuelong 1 & 2* are not naval vessels, nor do they have apparent security or law enforcement roles (as U.S. Coast Guard icebreakers have); both ships do have the endurance and capability to effectively carry Chinese officials on Antarctic Treaty inspections around the Continent. Neither ship has an envisioned role in the ice escort of commercial ships such as occurs along Russia's Northern Sea Route. They are purpose built and operated in support of China's expanding research efforts in Arctic and Antarctic waters. They have no commercial or escort function related to China's Polar Silk Road proposed in its January 2018 Arctic policy white paper. The only obvious link to a Polar Silk Road is the conduct of Arctic Ocean research to expand our knowledge of the profound changes underway in the region, and to support applied research related to potential Arctic marine transport routes. Tables in the media equating China's polar research ships to the large polar icebreakers of Russia, the United States and Canada, for example, are misleading and overstate China's current, national icebreaking capability.

The potential building of a Chinese nuclear icebreaker would be an intriguing game changer and wildcard factor from several strategic perspectives. The Chinese press in June 2018 reported that the China National Nuclear Corporation was welcoming bids from domestic shipyards to build a nuclear-powered icebreaker and comprehensive polar support ship. Such a nuclear icebreaker would provide China with an extraordinary maritime capacity with unlimited endurance, mobility and self-sufficiency to: potentially escort ships on Arctic waterways; conduct polar scientific operations in remote regions for extended periods; and, perform a broad range of complex logistics support in both polar regions, possibly in all seasons. Such a nuclear ship could conceivably provide support to naval operations. But a number of technologies would have to be harnessed

and meshed to construct a Chinese civilian, nuclear-powered ship. Russia operates the world's only nuclear icebreakers and they have pioneered their use since 1959, the year of completion and early operation of the icebreaker *Lenin* (the world's first nuclear-powered surface ship in service 1959-89). The Russian nuclear ships employ a steam turbine-electric power plant: the nuclear reactors produce hot water and steam which in turn drive turbine generators; the electricity produced by the generators power electric motors which rotate the ship's shafts and propellers. Rosatomflot, Russia's nuclear icebreaker operator, could provide China with a wealth of experience and Russian shipyards could export nuclear marine technology and expertise. Is it plausible the renewed era of Russia-China cooperation might extend to a collaboration in the design and construction of a Chinese nuclear icebreaker?

The potential construction and operation of a (civilian) nuclear icebreaker would provide a useful test platform for China's future development of nuclear-powered naval ships (such as an aircraft carrier and other surface warships), and possibly for future commercial cargo ships. However, construction, manning and operation of such a nuclear ship would require a lengthy and complex project requiring close cooperation among several industries and government agencies. The entire project would be a costly enterprise. Importantly, a nuclear icebreaker is realistically *not required* in the Antarctic for research or logistics. A Chinese nuclear icebreaker would be built for Arctic operations and roles supporting commercial ships that are unclear. China's ambition and call to build and operate a nuclear icebreaker leave many unanswered questions, including an abundance of strategic implications for the Arctic states and polar community.