

# *Type 093B Assessment*



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# Type 093B Key Judgments

- ◆ Since the lead hull was rolled out in 2002, there are six, possibly seven, units within three subclasses.
  - Two Type 093
  - One, perhaps two, Type 093A
  - Three Type 093B
- ◆ The Type 093B has a number of modifications from the earlier units, the most intriguing being a large protuberance aft of the sail.
- ◆ The primary theory for the purpose of the protuberance is that it houses a missile vertical launching system; a theory that cannot be supported by the physical evidence and known Chinese designs.
- ◆ Analysis of recent photographs, along with a review of other available images, strongly argues the protuberance, or hump, houses the handling equipment for a passive towed array system that was confirmed on the Type 093B.

# Type 093 Family

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## 093B

■ 09-III B型攻击型核潜艇，较标准型号的区别是围壳整体更加具有流线型（注2），取消围壳窗。背部加装导弹垂发系统（注8），艇首和艇身水线以上有明显的凸起（注9），尾部增设拖曳声纳释放口（注10）。



## 093A

■ 09-III A型攻击型核潜艇，较标准型号的区别是围壳前段和艇体连接处有喷釉处理（注6）。



## 093

■ 09-III型攻击型核潜艇，2001年首艇下水。外观上较之前09型的主要区别是采用类似美国洛杉矶级核潜艇的围壳和7叶低噪螺旋桨（注5），舷窗式排水口由普通式改为分布式（注4），艇体表面有消声瓦。

- ◆ The Type 093 family is composed of three subclasses with evolutionary improvements.

# Type 093



- ◆ There are two Type 093 nuclear-powered attack submarines.
- ◆ Hull 407 was rolled out in 2002 and accepted into service in 2006. Hull 408 was rolled out in 2003 and accepted into service in 2007.
- ◆ A multi-year hiatus in construction suggests the Chinese navy was not satisfied with some design elements of the first two hulls.

# Type 093A



- ◆ There is one confirmed Type 093A nuclear-powered attack submarine.
  - Some Internet sources suggest there is a second hull but this has been difficult to corroborate.
- ◆ Hull 413 is estimated to have begun construction in 2009, was rolled out in late 2012 and accepted into service in 2015.
- ◆ Visually discernable modifications include the elimination of the sail windows, a rounded sail top, and a fillet at the base of the sail.

# Type 093B



- ◆ There are currently three Type 093B nuclear-powered attack submarines.
- ◆ Hull 414 was rolled out in late 2014 and accepted into service in 2016.  
Hull 415 was rolled out in 2015 and accepted into service in 2017.  
Hull 416 was rolled out in 2016 and is finishing up acceptance trails.
- ◆ In addition to the rounded sail top and fillet, the Type 093B also has a large hump or protuberance aft of the sail and what appeared to be a possible towed array deployment tube on the upper rudder.

# Type 093B



- ◆ A June 2016 handheld photo provided excellent details on the rounded top of the sail and the base fillet. While the hump aft of the sail is shown, the only conclusions that can be made is that it isn't very tall and that the hump extends along the sides of the sail.

# Type 093B Surface Transit



- ◆ On 12 January 2018, a Type 093B was photographed while conducting a surface transit near the Senkaku Islands.
- ◆ The photograph provided an excellent view of the Type 093B's stern and confirmed the presence of a towed array deployment tube.
- ◆ The protuberance aft of the sail reveals that it is largely a curved hump with a possible short flat deck aft of the sail.



# Type 094 Jin Class SSBN



Type 094 SSBN stern tube



Type 093B SSN stern tube

- ◆ The towed array deployment tube on the Type 093B is very similar to the one seen earlier on the Type 094 Jin class SSBN.
- ◆ This configuration is consistent with that on Russian Project 667BDR/BDRM SSBNs, Project 949A SSGNs, Project 971M SSN, and Project 885/885M SSGNs.

# Project 667 BDR [DELTA III] Class SSBN



- ◆ China's stern tube position indicates their towed array design is heavily influenced by Russian experience and technology.
- ◆ Because of the deployment position, Russian towed arrays have positively buoyant cables to keep the array clear of the screw(s).
  - A drogue is attached to the end of the towed array to drag the array and tow cable down to the same depth as the submarine when underway.

# Type 093B Hump



Jianggezhuang Naval Base (Jun 2015)

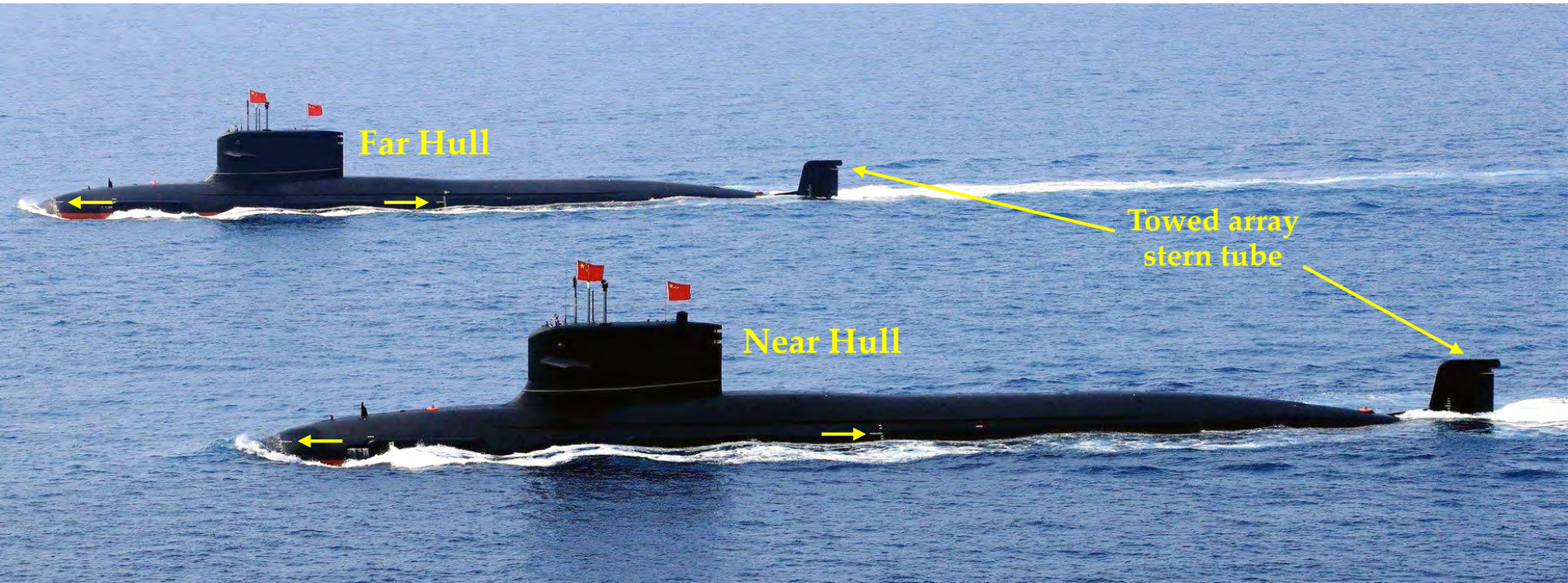
- ◆ There are few good imagery shots of the Type 093B protuberance, but analysis of those images shows the hump projects  $\approx 11.5$  meters aft of the sail and appears to be not very wide. The full length of the hump is about 18 meters.
- ◆ The overall shape of the structure appears to be quite curved, with a small deck area just aft of the sail that could be flat.

# Type 093B - April 2018 Naval Review



- ◆ Two Type 093B submarines participated in the April 2018 Naval Review for President Xi. Photos from that event provide a much clearer view of the hump's shape and size.
- ◆ The hump appears to have a short flat deck aft of the sail that is about 5.0 - 5.5 meters in length (red arrow). The rest of the structure is a shallow sloped section that fairs in with the the outer hull. The hump's height is very short.

# Type 093B - April 2018 Naval Review



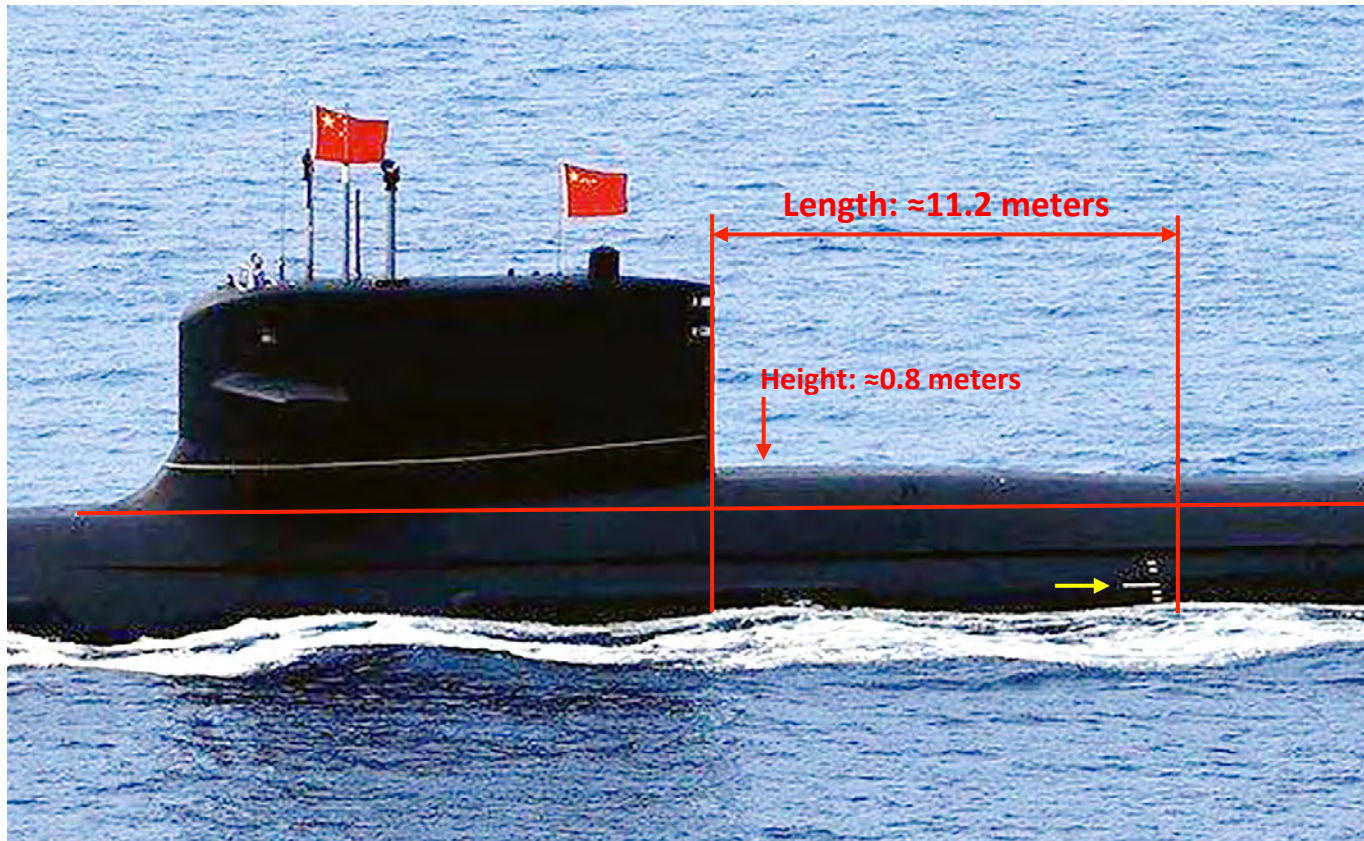
- ◆ This second photo from the April review shows two Type 093B SSNs with a near broadside port aspect. Both submarines are riding a bit high as the normal surface draft markings (indicated by the yellow arrows) are clearly above the water.

# Type 093B – Far Hull



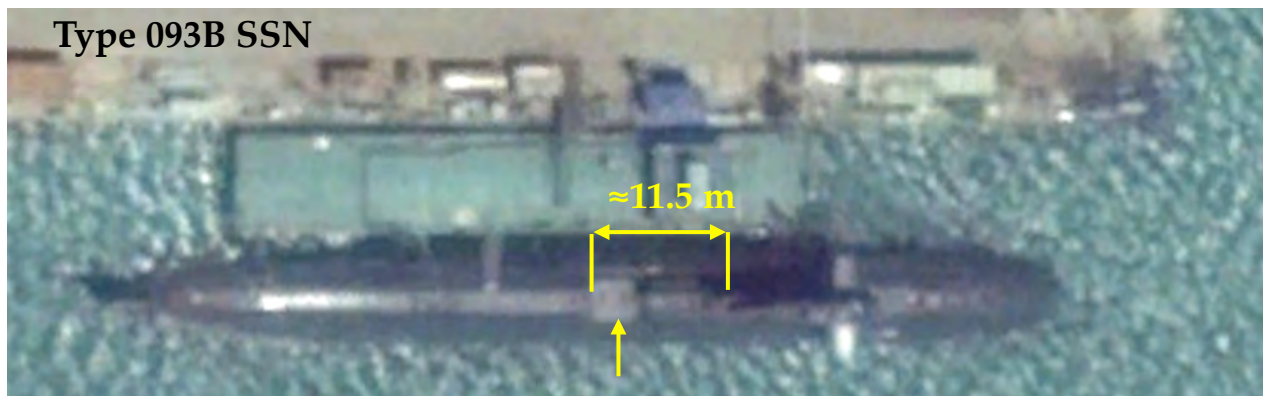
- ◆ Using the draft markings as a guide (yellow arrow), it is possible to get a more refined estimated of the hump's length and height.
  - The length of the hump aft of the sail is about 11.2 meters, in good agreement with estimates from satellite imagery.
  - The height is very slight, only 0.8 meters.

# Type 093B – Near Hull



- ◆ Measurements for the closer Type 093B yield similar results.
  - Hump length aft of the sail is about 11.2 meters.
  - Height is 0.8 meters.

# Towed Array Handling Equipment Location



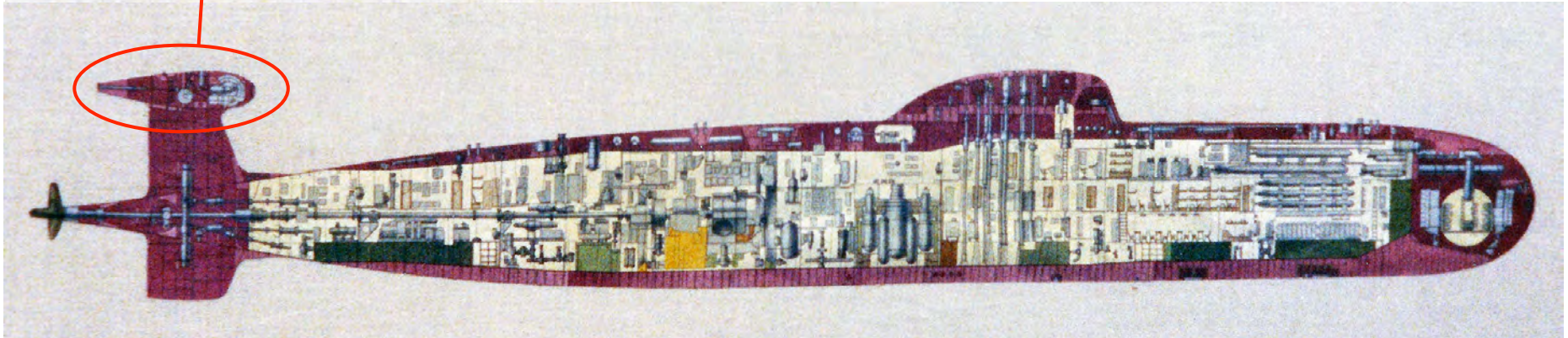
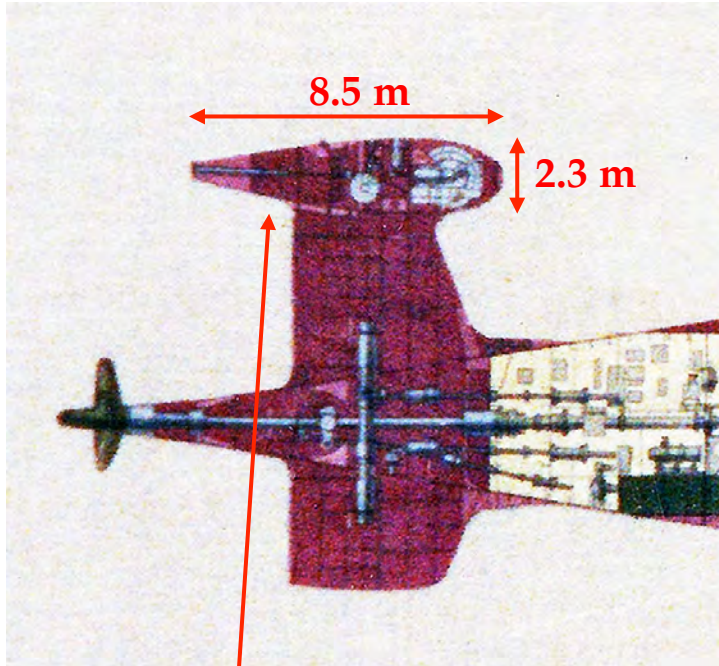
Huludao Shipyard

- ◆ Both the Type 094 and 093B submarines have a 4.5 m x 4.5 m area aft that is likely where the towed array handling equipment will be located. On the Type 093B this area occupies about 40% of the hump's length aft of the sail.
- ◆ As the Type 093 SSN was initially designed without a towed array, there is insufficient space between the two hulls to accommodate the gear needed to deploy, retrieve and store a towed array – the hump provides the needed space.

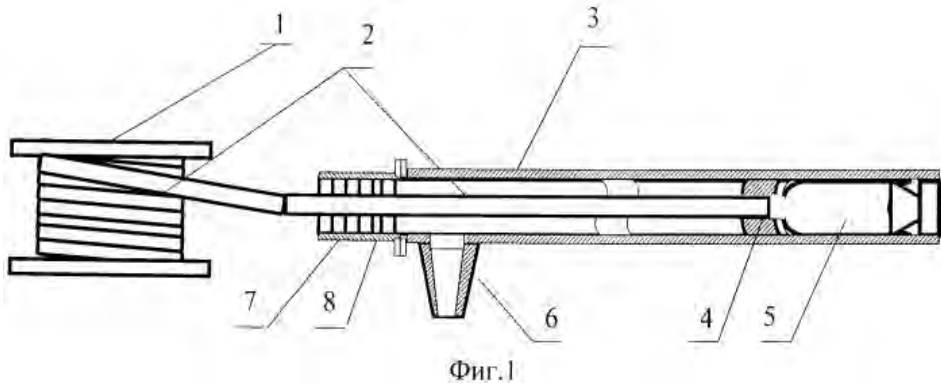


# Russian Historical Precedence

- ◆ The Russian Project 671RTM SSN is very similar in size to the Type 093B and required the addition of a large stern pod on the upper rudder to handle and store the MGK-500 SKAT system towed array. There just wasn't enough space between the hulls to house the winch, storage reel and other equipment.
- ◆ The much larger submarines, including the Project 971M SSN and Project 885/885M SSGNs, had the necessary space to store the equipment between the outer hull and pressure hull or in the sail.



# Chinese Submarine Towed Array



Russian towed array handling schematic with drogue



Project 667BDR SSBN towed array with drogue

- ◆ Based on Russian submarine towed array designs, one can roughly estimate the basic characteristics of the Chinese system.
  - Diameter: 40mm or 55mm (the latter size has been associated more with SSNs).
  - Total Length: 80m, 120m, or 350m (vibration isolation modules, acoustic aperture, tail & drogue).
  - Tow Cable Length: 500 to 700m (cabling is positively buoyant).
    - A drogue is used to help deploy the towed array and then maintain depth when underway – the drag on the drogue pulls the array into position.
- ◆ The addition of a towed array to the Type 093B is a significant improvement to the submarine's sensor suite, providing a very low frequency narrowband search capability that has been lacking in previous Chinese SSNs.

# Missile VLS Theory

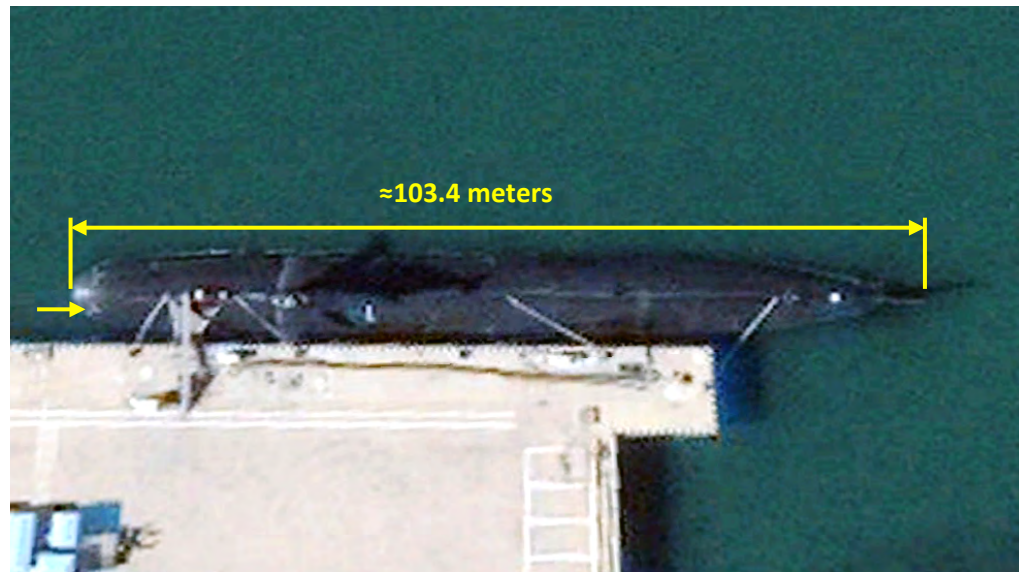


- ◆ The most popular theory promoted in Western journals and Chinese navy related websites is that the hump houses a vertical launch system for anti-ship and land attack cruise missiles.
- ◆ The physical characteristics of the Type 093B submarine, however, do not support this theory.

# Type 093 – Physical Evidence



- ◆ There is no difference in the length of the Type 093 variants.
  - A review of hand held and satellite imagery shows all three variants have a light ship, waterline length of 102 – 103 meters.
  - Beam width is harder to measure consistently, but the images that supported a good measurement indicated all Type 093 submarines have a beam of ≈11.0 meters.
  - All images used in this analysis are of Type 093 submarines that are riding high, as demonstrated by the yellow arrows that show the normal surface waterline marks.



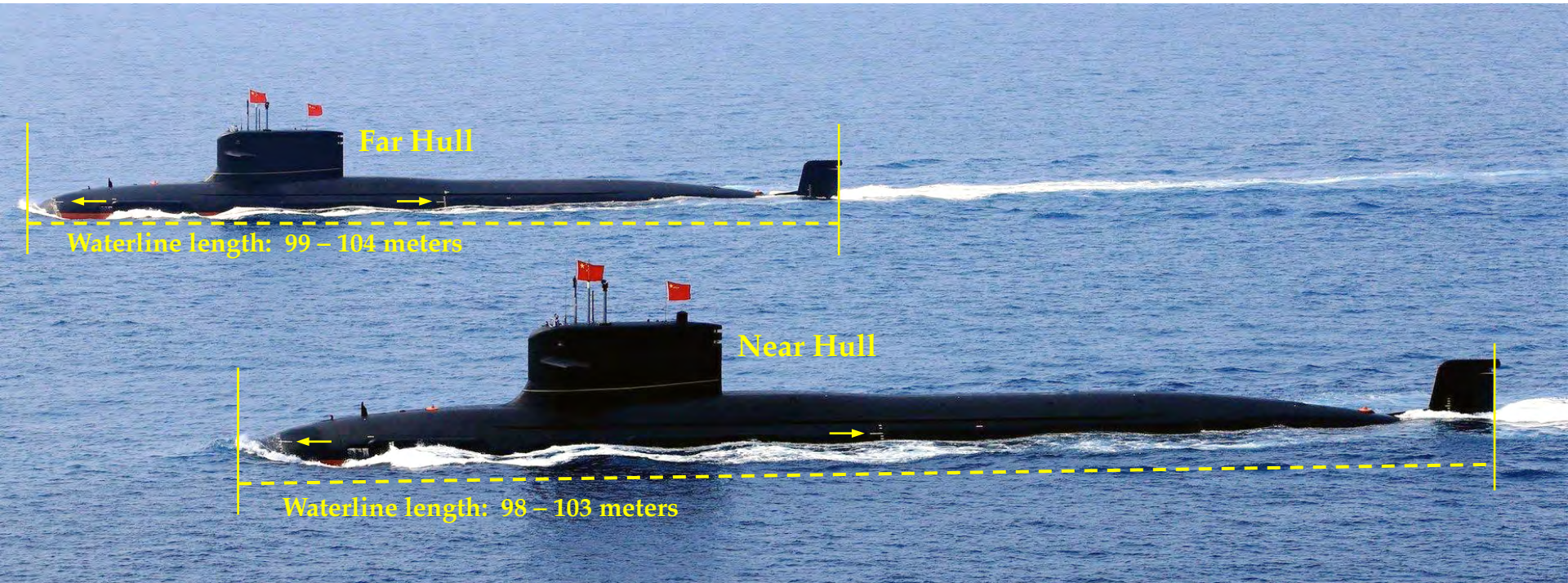
Jianggezhuang Naval Base (Nov 2017)

# Type 093A – Physical Evidence



- ◆ The Type 093A has the same light ship, waterline length of about 102 meters as measured independently by Open Source IMINT.

# Type 093B – Physical Evidence



- ◆ Both Type 093B submarines from the naval review are also riding high and have near broadside aspects. The long dashed yellow lines were first aligned with the normal surfaced draft markings to provide a proper perspective.
- ◆ With an average length of approximately 101 meters, both submarines have a waterline length that is consistent with other Type 093 variants.

# Type 093B – Physical Evidence



Huludao Shipyard (Jun 2015)



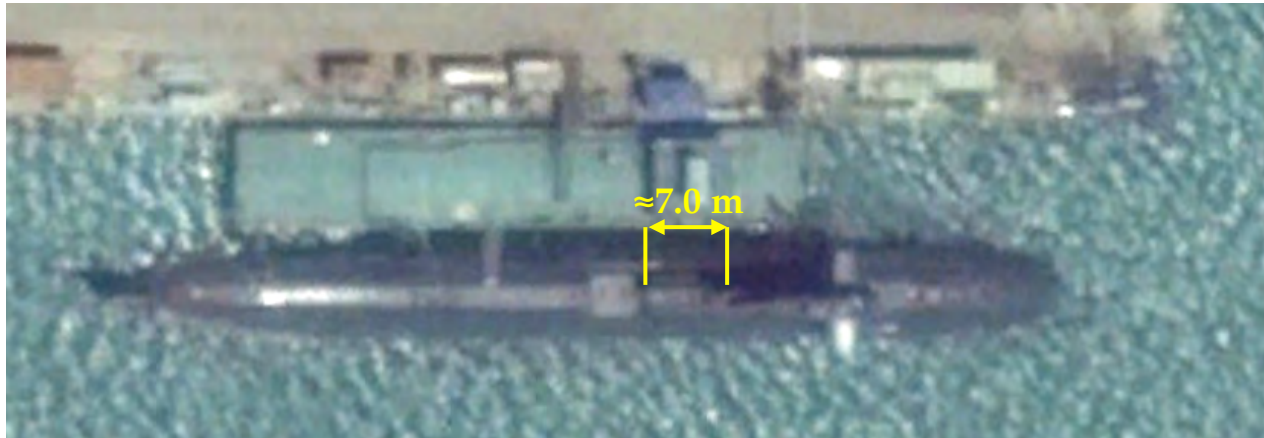
图3 仿真模型

Fig.3 Simulation model

Chinese submarine cruise missile tube design concept

- ◆ Satellite imagery of two Type 093B SSNs with the same waterline length of 102 – 103 meters.
- ◆ **Critical Point:** Without a significant addition in hull length, there is insufficient volume in the pressure hull for a set of multi-deck missile tubes as described in Chinese technical literature.
  - Submarines are inherently volume limited vessels and the use of every cubic meter is carefully considered in the design.

# Proximity to the Sail



Huludao Shipyard (Jun 2015)

- ◆ The space for the towed array handling gear takes up about 40% of the hump's length aft of the sail. This leaves, only about 7.0 meters (right up to the trailing edge of the sail) for a potential VLS.
  - This is insufficient length for any of the widely varying missile tube estimates put forth in various open source articles and blog postings. Even the lowest suggestion of eight missile tubes would require a minimum of 9 – 10 meters.
    - The very narrow deck width would also not allow multiple rows of launchers.
  - Placing launchers right next to the sail is also not practical as the sail generates a number of vortices that are strongest at the trailing edge.
    - Even SSBNs have a few meters from the trailing edge of the sail to the first tube.
    - Russia's Project 885/885M SSGNs have about a 10 meter distance between the sail and the missile tubes.



# Authoritative Chinese Designs



Type 032 model

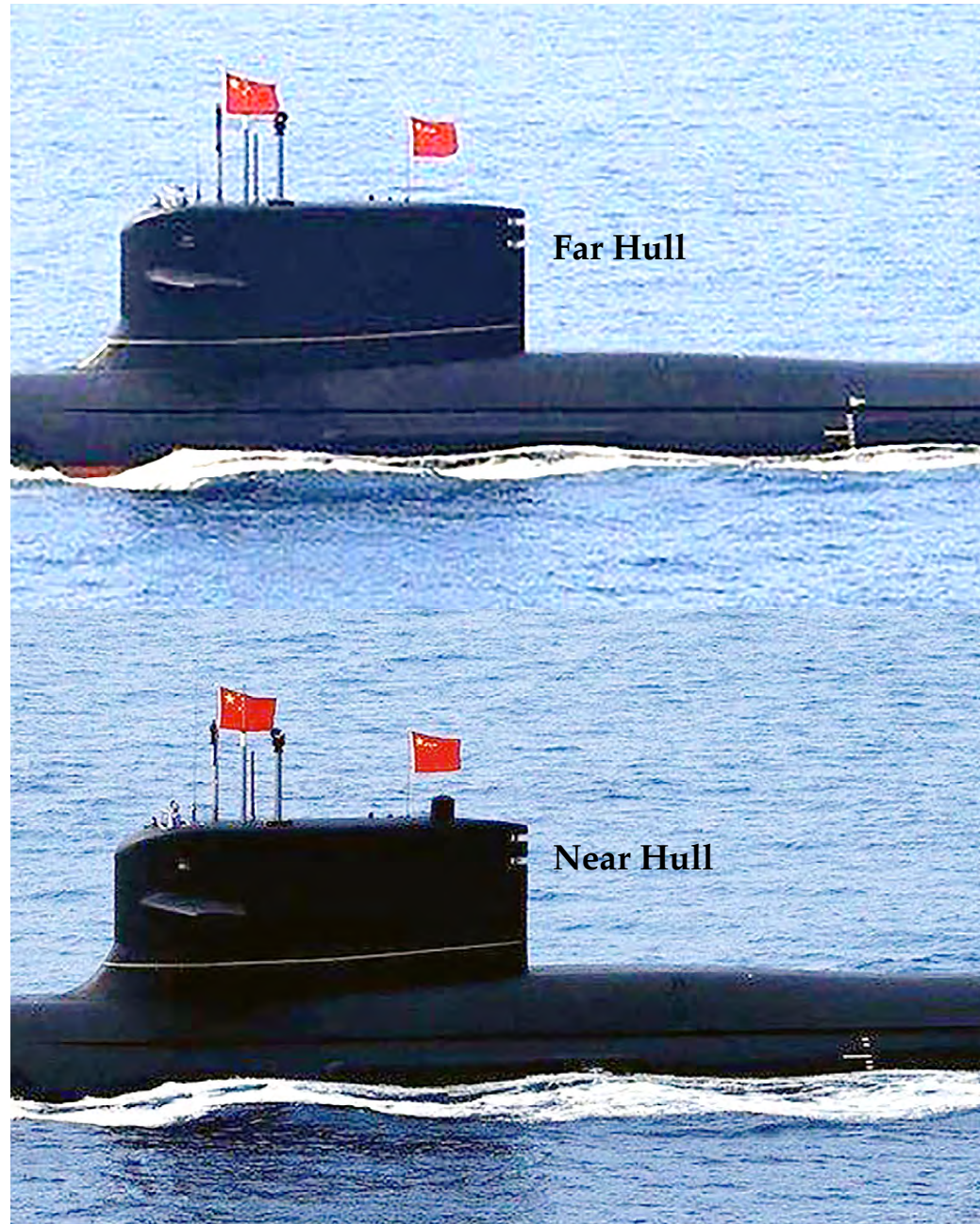


7,000 ton Future SSN

- ◆ Every claim made by an authoritative Chinese source consistently has the submarine VLS tubes positioned *forward* of the sail.
  - The Type 032 model, and placard, as well as the 7,000 ton SSN diagram shown in RADM Zhao's lecture have VLS tubes forward.
  - In both cases the VLS tubes are housed inside the pressure hull, consistent with the general Chinese design concept described earlier.
- ◆ Given the physical constraints, and contradictory design concepts, it is very unlikely that the hump on the Type 093B houses VLS missile tubes.

# No Evidence of VLS Tube Hatches on Type 093B

- ◆ Finally, an examination of the April naval review photos with slight enhancements, lightened and blown up, shows no evidence of any missile tube hatches on either Type 093B submarines even though the slots in the superstructure (limber holes) are visible.



# Type 093B ASCM Capability



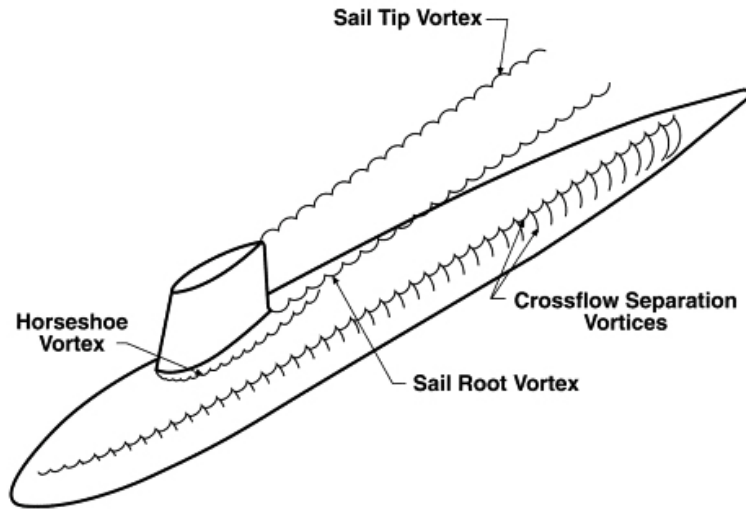
YJ-18 Submarine Launched Missile Canister



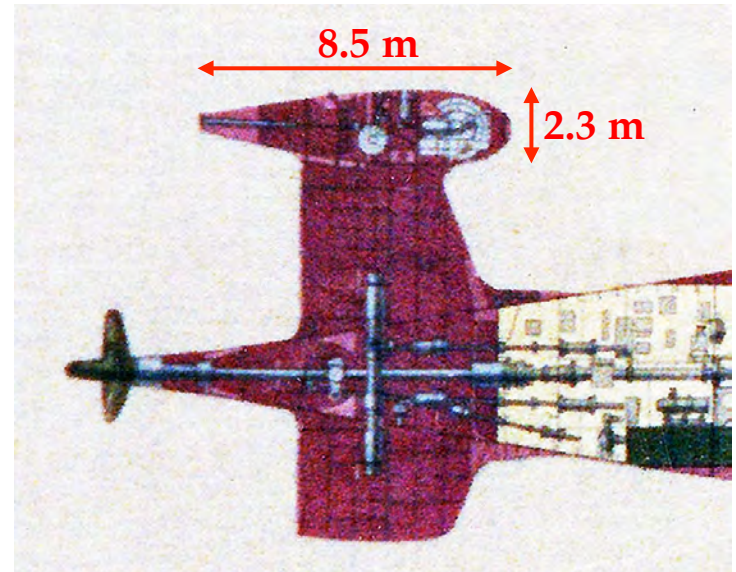
YJ-82 Submarine Launched Missile Canister

- ◆ China's Type 093B will have an anti-ship missile capability, but it will be limited to torpedo tube launched weapons.
- ◆ In fact, the photo take in June 2016 of the weapons loading evolution on a Type 093B shows the canister being lowered looks much more like the YJ-18 launch canister from RADM Zhao's lecture than the canister for the YJ-82 missile.

# Hump Size – Why so Large?



Water flow around a submarine's sail.



Project 671RTM Victor III SSN stern pod

- ◆ The overall size, shape, and positioning of the Type 093B hump is probably driven by hydrodynamic issues. The Victor III stern pod is also considerably larger than the array handling equipment held inside, but the length and streamline shape speak to the concerns the designers had with water flow.
- ◆ The hump extends forward of the sail's trailing edge, slowly arcing upward until past the sail before reversing and arcing back down.
  - The forward part along the sail diverts the flow of water up and over the rest of the hump, thereby preventing the formation of another, and likely more intense set of horseshoe vortices that would increase the drag on the submarine as well as increase propeller blade related noise at moderate to high speeds.

# Type 093B Conclusions

- ◆ There are six, possibly seven, Type 093 submarines within three subclasses. All three variants are the same with regard to hull length and diameter.
- ◆ The major differences with the Type 093B are associated with the addition of a passive towed array sonar system. The stern deployment tube is consistent with that seen on the Type 094 SSBN and the large streamlined hump aft of the sail provides the necessary volume for the towed array handling equipment.
  - Similar to the stern pod on Russian Project 671RTM Victor III SSNs.
  - The towed array provides a much needed very low frequency passive narrowband search capability that has been lacking in previous Chinese SSNs.
- ◆ The physical characteristics of the three Type 093 variants, the lack of visual evidence of missile tube hatches, and known Chinese submarine designs strongly argues against a VLS on the Type 093B and any ASCM capability would have to be torpedo tube launched.
- ◆ The shape and size of the Type 093B hump is likely driven by hydrodynamic concerns. Like the fillet at the base of the sail, the rest of the protuberance on the Type 093B is to prevent the formation of strong horseshoe vortices that would increase drag and blade related noise.