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## **China's Future SSBN Command and Control Structure**

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## About the Author

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## Key Points

- ◆ China is developing its first credible sea-based nuclear forces. This emergent nuclear ballistic missile submarine (SSBN) force will pose unique challenges to a country that has favored tightly centralized control over its nuclear deterrent. The choices China makes about SSBN command and control will have important implications for strategic stability.
- ◆ Despite claims that the People's Liberation Army (PLA) Rocket Force will be responsible for all Chinese nuclear forces, Chinese SSBNs currently appear to be under the control of the PLA Navy. However, China may choose to revise its command and control structures as its SSBNs begin armed deterrent patrols. There are three broad command and control models, allocating varying degrees of authority to the PLA Navy or the Rocket Force.
- ◆ China's decisions about SSBN command and control will be mediated by operational, bureaucratic, and political considerations. A hybrid approach to command and control, with authority divided between the navy and the Rocket Force, would be most conducive to supporting strategic stability.

## China's Future SSBN Command and Control Structure

By David C. Logan

China's ongoing modernization program is transforming the country's nuclear arsenal from one consisting of a few liquid-fueled, silo-based missiles carrying single warheads to a larger force of more advanced mobile solid-fueled missiles, some of which are capable of carrying multiple warheads. Perhaps most significant for its nuclear policies, China is also on the verge of fielding its first credible sea-based nuclear deterrent, having already completed four nuclear ballistic missile submarines (SSBNs) and with a fifth vessel currently under construction.<sup>1</sup>

Though China has prioritized political control of its nuclear weapons and maintained a distinctly restrained nuclear posture, Beijing's emerging fleet of SSBNs will pose new challenges to Chinese command and control policies. But which military organization will ultimately command China's sea-based nuclear forces? Some experts have predicted that the newly formed People's Liberation Army (PLA) Rocket Force, the successor to the former Second Artillery, will assume control of the emergent SSBN force, though such a move would entail substantial revision of China's bureaucratic structures.

This article examines options for command and control of China's sea-based nuclear deterrent. It begins by examining evidence that the Rocket Force and its predecessor were assigned exclusive control of the country's land-based arsenal. Next, it describes three notional command and control structures for China's future SSBN fleet, which allocate varying degrees of control to the PLA Navy and Rocket Force. Each of these command and control models implies different requirements for the PLA's personnel policies, institutional organization, and physical infrastructure. The article then examines some of the operational, bureaucratic, and political factors that will likely influence the future command and control structure of China's SSBN force. It closes with a

discussion of the implications of China's SSBN command and control choices for strategic stability.

## Current Chinese Nuclear Command and Control

China's nuclear deterrent has historically consisted of a comparatively small and immature force of land-based ballistic missiles. For decades, the nuclear forces of the former Second Artillery consisted primarily of a few dozen silo-based intercontinental ballistic missiles (ICBMs). China ostensibly developed the capabilities to support a nuclear triad, but those latent technical capabilities never materialized into significant air- or sea-based legs. China's force of H-6 intermediate-range bombers would be capable only of striking regional targets and is not believed to be assigned an active nuclear mission.<sup>2</sup> China constructed one Type 092 *Xia*-class SSBN. However, that ship was armed with very short-range JL-1 (CSS-N-3) submarine-launched ballistic missiles (SLBMs) and is not believed to have ever conducted a deterrent patrol.<sup>3</sup> China has opted for a system of tightly centralized command and control of this limited arsenal. The ability to authorize a nuclear strike is vested solely within the Central Military Commission (CMC), China's highest military decisionmaking body, and Beijing is believed to have maintained a practice of keeping warheads unmated from their missiles and stored in separate locations.<sup>4</sup>

China's emergent SSBN force is poised to change not only the configuration of China's nuclear arsenal but also the policies that guide it. China has already completed four Type-094 *Jin*-class SSBNs, with a fifth hull currently under construction. U.S. military leaders have estimated that China may eventually deploy as many as eight of these second-generation vessels.<sup>5</sup> There is conflicting information about whether these vessels have already begun conducting deterrent patrols, but the Department of Defense estimates that such patrols will begin this year.<sup>6</sup> Though its fleet of Type-094 vessels has only recently become operational, China reportedly has already begun developing a follow-on class of Type-096

SSBNs as well as a third-generation JL-3 SLBM, which would expand the striking range of the sea-based leg of the deterrent.<sup>7</sup>

There has been very little information about the command and control of this emergent SSBN force. Some U.S. experts and nonauthoritative Chinese commentators have predicted that the newly formed Rocket Force would ultimately control all of China's nuclear missiles, including the emergent SSBN force and any future strategic bomber force.<sup>8</sup> However, open-source evidence argues against past or current Rocket Force control over other components of China's nuclear forces.

First, language in China's Defense White Papers and other official documents suggests that the Rocket Force does not currently control China's sea-based nuclear forces and that the navy and the air force may both be assigned a nuclear mission set. As noted by one Chinese nuclear expert, the 2013 Defense White Paper explicitly attributes control of only the land-based *Dongfeng* ballistic missiles and *Changjian* cruise missiles to the former Second Artillery Force.<sup>9</sup> References to China's SLBM, the JL-2 (CSS-NX-14), are notably absent. Video featuring the official song of the newly formed Rocket Force similarly includes references to the *Dongfeng* and *Changjian* missiles but no reference to China's sea-based weapons.<sup>10</sup> In discussing the nuclear counter-attack role of the Second Artillery, the 2013 Defense White Paper goes on to say that "if China comes under a nuclear attack, the nuclear missile force of the PLASAF [PLA Second Artillery Force] will use nuclear missiles to launch a resolute counterattack either independently or together with the nuclear forces of other services" (emphasis added).<sup>11</sup> This comports with older references to the Second Artillery specifically being assigned control over land-based missiles.<sup>12</sup> China's 2008 Defense White Paper stated that "the Navy is equipped with strategic missile nuclear submarines, attack nuclear submarines, and conventional propulsion submarines."<sup>13</sup> The 2013 *Science of Military Strategy*, a PLA textbook vetted by PLA leadership and widely believed to largely represent the strategic thinking of the Chinese military, specifically directs

the PLA Navy to prepare a sea-based nuclear capability: “The Navy should, according to the requirements of ‘nuclear-conventional dual-use equipment and dual warfare [核常兼备，双重作战],’ quicken the development and equipment of a new-type strategic nuclear submarine to form, to a certain extent, a sea-based nuclear counter-strike capability.”<sup>14</sup> Reports following the establishment of the new Rocket Force have reiterated that it controls land-based missile units and has not assumed control of other elements of China’s nuclear forces.<sup>15</sup>

In addition, China’s Defense White Papers also employ language that appears to attribute a nuclear mission set to the navy and air force. Both services are assigned the role of “strategic deterrence,” a concept that, within the White Papers, appears linked to the nuclear mission.<sup>16</sup> The Second Artillery is uniquely described as “a core force for China’s strategic deterrence.”<sup>17</sup> The opening section of the 2015 Defense White Paper, in describing the main responsibilities of China’s armed forces, includes the requirement “to maintain strategic deterrence and carry out nuclear counterattack.”<sup>18</sup> Elsewhere, the paper states that “the PLASAF will strengthen its capabilities for strategic deterrence and nuclear counterattack.”<sup>19</sup> Every mention of “strategic deterrence” that implies a specific military capability appears linked to the nuclear mission set. Significantly, the army is not assigned a task of strategic deterrence. To the extent strategic deterrence is connected with the nuclear mission set, it is logical such a role would not be assigned to the army given that China’s land-based nuclear weapons have always been controlled exclusively by the Second Artillery.

Second, the Rocket Force appears to have neither the command and control architecture nor the organizational structure necessary to support command of sea-based nuclear weapons. Although recent military reforms sought to improve the ability of the PLA to conduct complex joint operations, the newly formed Rocket Force appears to remain largely outside the integrated command and control structures of the theater commands, instead appearing to maintain the same highly centralized systems of the former Second Artillery.<sup>20</sup> Rocket Force command

architecture appears not to overlap with the other services. Though the Rocket Force has dispatched liaison officers to the theater commands, there do not appear to be any Rocket Force units or organizations that assume the task of coordinating with other services or commanding non-Rocket Force units. In addition, nonauthoritative online sources claim that the navy’s submarine academy in Qingdao features 1-year majors associated with nuclear missile submarines, and faculty at the academy frequently publish on nuclear missile submarine issues.

The Rocket Force and Second Artillery were assigned control of only land-based missiles despite PLA development and deployment of its abortive Type-092 *Xia*-class SSBN. Though that vessel is not believed to have ever conducted a deterrent patrol, it did put out to sea.<sup>21</sup> Together, the sailing of the previous generation of SSBNs and a dearth of any evidence pointing toward Rocket Force involvement suggests the Rocket Force was not assigned control of China’s sea-based nuclear deterrent. Despite China’s continued progress toward a more credible sea-based deterrent and the recent military reforms, there is little evidence to suggest that the Rocket Force has gained responsibility for China’s SSBN force.

## Notional Command and Control Structures

There are three notional command and control structures for China’s emergent SSBN fleet, which allocate varying degrees of command authority to the PLA Navy and Rocket Force. In the first model, the navy maintains operational control over both SSBNs and their associated SLBMs. In the second model, the Rocket Force enjoys operational control over China’s sea-based nuclear weapons and the SSBNs that carry them. In the last model, the navy has operational control of the SSBNs themselves, but the Rocket Force has strategic command over the nuclear weapons carried on the SLBMs. Each model implies different requirements for physical communication infrastructure, personnel selection and training, and organizational design. In all

models, the CMC would maintain the sole authority to authorize the use of nuclear weapons.

In the first model, the PLA would vest full operational control of SSBNs and SLBMs with the navy, though this model would entail the greatest change in China's approach to nuclear command and control and would require the creation of significant new bureaucratic structures and processes. In this model, as with the hybrid model described below, the PLA Navy would retain operational control of the SSBNs. However, the navy would see its role in the nuclear mission greatly enhanced by gaining responsibility for the nuclear weapons themselves. The navy could contend that its experience operating submarines outweighs its lack of experience with the nuclear deterrent mission. The operating patterns of SSBNs, it could argue, are intimately tied to the vessel's ability both to survive and to strike its targets.

Navy control of China's sea-based nuclear weapons might well require the creation of a personnel reliability program within the navy. Though China reportedly has established such programs at its nuclear facilities, it is unlikely that navy personnel have been subjected to the same screening process that members of the Rocket Force undergo.<sup>22</sup> In addition, while China's longstanding practice of keeping missiles unfueled and warheads unmated substantially reduced the likelihood of an accidental, unauthorized, or injudicious launch, China has been slow to adopt the safety and security techniques common to other nuclear states. As recently as the 1990s, China's personnel reliability program was reported to consist of little more than an investigation into the individual's political background, apparently without corresponding investigations into the potential for financial coercion, psychological instability, or substance abuse.<sup>23</sup> This may have changed with the deployment of land-based mobile nuclear ICBMs. Given that SSBNs must deploy with warheads already mated to their missiles, the need to ensure personnel reliability and negative control—guarding against an unauthorized launch—is even greater.<sup>24</sup> Chinese academics have written on the unique command challenges presented by submarines, as well as the desirable characteristics of

submarine commanders and corresponding methods for evaluating candidates for submarine command positions, but there does not yet appear to be an institutionalization of such processes.<sup>25</sup>

Parallel nuclear command and control systems within the Rocket Force and the navy would likely also require an institutional mechanism to coordinate targeting assignments. For decades, China has only needed to develop targeting plans based on a small land-based nuclear force operated by a single branch. However, China's emergent SSBN force and the continued growth in its overall nuclear arsenal will require planning for strikes involving a few hundred nuclear weapons deployed across two domains and operated by two independent services. This need arises for several reasons. First, Chinese leadership would want to avoid multiple redundant strikes against the same target, especially if only a few nuclear weapons survive an initial strike. Second, if a nuclear counterstrike is directed at targets with military value, the PLA may need to better coordinate target selection to ensure operational "synergies," such as ensuring penetration of ballistic missile defense systems and avoiding warhead fratricide and target overkill. Finally, China will have to plan targeting assignments with an eye to the survivability of the nuclear launch platform, especially for its SSBNs. Initiating a nuclear strike would both intensify the adversary's efforts to eliminate Chinese nuclear forces and expose the location of Chinese units undertaking the launch. The need to remain invisible is likely even greater for SSBNs. Their patrols far away from China's shores and their high acoustic signature heighten their vulnerability.<sup>26</sup> China's SSBNs will be loaded with multiple missiles, meaning they are likely to be counted on to conduct follow-on strikes.

It is unclear what body is currently responsible for developing and disseminating targeting plans. Some experts have argued that any operational and targeting plan would be developed by the CMC, with approval provided by the standing committee of the Chinese Communist Party (CCP) Politburo.<sup>27</sup> However, while any decision to launch a nuclear strike must be reviewed and approved by political leadership, others suggest that targeting responsibility

may be concentrated within the Rocket Force. American experts have described the Second Artillery chief of staff as the “most senior strategic targeting position within the CCP, CMC, and PLA.”<sup>28</sup> To the extent that the Rocket Force is responsible for devising targeting plans, navy control of China’s emergent SSBN fleet would require the creation of new organizational structures to coordinate Rocket Force and navy nuclear forces. However, if targeting responsibilities are already vested within a PLA-wide institution such as the CMC, there may be less need for bureaucratic reshuffling. For instance, John Lewis and Xue Litai have argued that China’s nuclear forces are commanded through the Strategic Forces Bureau within the General Staff’s Operations Department, which provides a direct line of control from the Central Military Commission to brigade-level units in the field.<sup>29</sup> This could provide a ready forum through which to coordinate nuclear targeting plans.

In the second model, the Rocket Force would make a play for control of China’s SSBN force and its SLBMs, arguing that its experience operating nuclear weapons should outweigh the navy’s experience operating submarines. This model would give the Rocket Force control of China’s sea-based deterrent, including both operational control of SSBNs and the missiles they carry. In this model, the navy would exercise administrative control over SSBNs and their associated personnel, but operational control would be transferred to the Rocket Force. Senior Rocket Force staff would be responsible for target selection and assignment. The Rocket Force would also determine the tempo and location of deterrent patrols and exercise operational command of vessels on patrol.

The Rocket Force might argue that its experience vetting and training personnel and providing the CMC effective negative control qualifies it to control all the country’s nuclear forces. The navy, it might contend, would have to develop redundant and untested bureaucratic structures and operating procedures and that, given the failures of the previous generation *Xia*-class vessel, the navy hardly has much more experience operating SSBNs. Indeed, in an article earlier this year outlining the recent reforms to

the Rocket Force, Song Zhongping, a former instructor at the PLA Second Artillery Engineering University and well-known commentator on China’s nuclear forces, predicted that the newly formed Rocket Force would eventually control all of China’s nuclear forces, stating, “I think it’s just a matter of time.”<sup>30</sup>

Such a model would still require substantial coordination between the Rocket Force and the navy even if the PLA Navy had no command authority over SSBNs. Selection of patrol areas must consider the marine operating environment and the antisubmarine warfare capabilities that might be deployed there. Rocket Force officers do not possess the necessary training or expertise to make such evaluations, which might necessitate emplacement of navy officers within the Rocket Force chain of command. In addition to the inherent need for navy expertise in conducting any SSBN deterrent patrols, the particular design characteristics of China’s SSBNs will require additional coordination with PLA Navy assets. Given their high acoustic signature and China’s unfavorable maritime geography, China’s sea-based fleet will have to depend on the PLA Navy for protection, especially in transiting the various maritime chokepoints that separate China from the open ocean.

This model might also require the construction of new communications infrastructure. Given the challenges of radio propagation through water, communications with deployed submarines often depend on special very low frequency (VLF) radio facilities. If the Rocket Force had operational control over SSBNs, it might have to construct new VLF facilities to communicate with deployed SSBNs.<sup>31</sup>

A third hybrid model could see the Rocket Force exercising strategic command over China’s nuclear weapons while devolving lower-level tactical and operational control of SSBNs to naval commanders. In this dual command structure, the navy would be responsible for force provision, determining deterrent patrol areas, and exercising operational command of SSBNs while on patrol. However, the SLBMs housed on these vessels could only be launched on receipt of an order by the CMC



delivered through the Rocket Force to the navy's SSBNs. The Rocket Force would be responsible for warhead handling and storage, target selection and deconfliction, and the nuclear personnel reliability program.

The U.S. strategic nuclear command and control architecture provides a ready model for this kind of hybrid structure. Operational control for the various legs of the U.S. nuclear triad is vested within the commander, U.S. Strategic Command (USSTRATCOM), a joint functional combatant command that is also responsible for space, global strike, missile defense, and counter-weapons of mass destruction operations.<sup>32</sup> Under USSTRATCOM, the individual components of the U.S. nuclear triad are organized as single-Service function task forces, with separate task forces for land-based ICBMs, strategic bombers, and ballistic missile submarines, as well as supporting elements such as aerial refueling tankers and mobile command and control assets.<sup>33</sup> The commanders of these respective task forces exercise tactical control over them, while USSTRATCOM retains operational control. The organize, train, and equip functions for the U.S. SSBN fleet are performed by two fleet commanders, Fleet Forces Command (formerly Atlantic Fleet) and Pacific Fleet. USSTRATCOM is responsible for selecting individual targets and assigning them to the units under its command. Such a model would comport with the PLA's steady drive toward greater jointness.

The Rocket Force could even go beyond the hybrid model and extend control over missile launch by placing specially trained Rocket Force launch officers aboard SSBNs. These launch officers could be assigned exclusive control over the codes and keys necessary to launch SLBMs. Security measures could even include biometric identification to ensure that theft of codes or keys would be insufficient to initiate an unauthorized launch.

Such a model would represent a compromise between the two services but could also bring certain operational benefits. The hybrid model could ease the challenges of coordinating operations between SSBNs and supporting navy vessels. Chinese SSBNs could deploy and be commanded as part of SSBN task forces,

including both the SSBN itself and the other navy vessels necessary to protect it either in transit to its patrol area or during its deployment in near-shore bastions. A single navy commander could be granted operational control of the entire task force and command and control executed using existing PLA Navy command structures and communications infrastructure.

## Operational, Bureaucratic, and Political Considerations

China's choice of command and control structures for its future sea-based nuclear weapons will be guided by a confluence of factors, including operational imperatives, bureaucratic politics, and political constraints. Some of these factors are common to all nuclear ballistic missile submarine fleets, while others are unique to or mediated by China's distinctive views about nuclear weapons and the organization of its military.

In general, ballistic missile submarines must pursue two separate and at times contradictory operational imperatives. First, they must ensure survivability by operating undetected by adversary antisubmarine warfare (ASW) assets. Second, they must ensure that their operating zones place the vessel's SLBMs within range of their targets. While land-based ballistic missiles face similar operating tensions, they can be more pronounced for SSBNs operating beyond the protective cover of the nation's territory and with increased likelihood of interacting with the adversary's assets. For less advanced systems like those of China, the tension between ensuring survivability and ensuring range to target is even more pronounced. The JL-2 SLBM has an estimated range of only 7,000 kilometers, meaning Chinese SSBNs would have to reach the western Pacific in order to target the continental United States. However, this requires China's noisy SSBNs to transit a very unfavorable maritime environment potentially flooded with adversary ASW capabilities. The U.S. ballistic missile defense architecture imposes an additional constraint on the operating patterns of Chinese SSBNs. Chinese experts have argued that ensuring penetration

of U.S. ballistic missile defense capabilities is one of the primary drivers of China's push for a sea-based nuclear deterrent.<sup>34</sup> Existing U.S. national and theater ballistic missile defense assets are oriented against missiles approaching from the north and west of the country. Missiles approaching from the south would bypass ballistic missile defense capabilities, but this would require Chinese SSBNs to transit to the South Pacific.

Operations by Chinese SSBNs will, at least in the near term, require substantial support from other navy assets. The high acoustic signature of China's SSBNs, coupled with China's unfavorable maritime geography, means that the vessels are highly vulnerable to ASW operations and will have to be protected by other Chinese ships or submarines. China is largely ringed by countries friendly to the United States, with only a few maritime chokepoints separating China's near seas from the open ocean. China's SSBNs are reportedly very noisy, having an acoustic signature as loud as the Soviet Victor-III SSBNs first deployed in the late 1970s.<sup>35</sup> Some experts have even argued that design features of the *Jin*-class, including oversized missile compartments and many flood openings, limit the extent to which its acoustic signature can be reduced through conventional quieting techniques.<sup>36</sup>

The involvement of other navy assets will be required regardless of whether the country's leadership opts for bastion or open ocean deployments. Adopting a bastion posture would require China to use surface vessels and attack submarines to close off waters near China's shores, such as the Yellow Sea, the East China Sea, or the South China Sea.<sup>37</sup> Notional open ocean deployments might also require at least temporary escorts. Chinese SSBNs are too noisy to make it to and through the various strategic chokepoints separating China's near seas from the open ocean. But some have suggested that China might use other navy vessels to safely escort its SSBNs to strategic chokepoints before setting the vessels free to conduct open ocean patrols.<sup>38</sup> Both of these deployment patterns would require substantial coordination with other naval assets. This would likely place China's SSBNs in close

proximity to both Chinese submarines escorting them and adversary submarines searching for them.

The unique features of Chinese nuclear strategy ease at least one operational requirement: that of developing and executing complex nuclear targeting plans. China is believed to have adopted a countervalue nuclear strategy in which threatening the destruction of a handful of the adversary's largest cities is thought to be sufficient for maintaining strategic deterrence. Such a strategy implies simple targeting against a few soft targets. Developing a second leg of the nuclear triad will require some amount of interservice planning and coordination. But the kind of complex, joint, multiplatform targeting embodied by the U.S. Single Integrated Operational Plan is unnecessary. Chinese plans envision conducting nuclear strikes only in response to having already suffered a nuclear attack. Some experts have even suggested that a nuclear counterstrike might be undertaken several days after absorbing an adversary's first strike.<sup>39</sup> Given China's comparatively small and vulnerable nuclear arsenal, it may be impossible for leadership to know how many or which weapons might survive to conduct a retaliatory strike. This suggests that there may be fewer requirements for coordination between the various legs of China's nuclear arsenal. For example, rather than drafting complex targeting schemes, the CMC reportedly maintains a list of potential targets ranked according to their perceived value depending on, among other factors, the target's value to the enemy, vulnerability, and mobility.<sup>40</sup>

Decisions about command and control of China's SSBN fleet will also be mediated by bureaucratic politics, including the time-honored tradition of interservice rivalry. The emergent SSBN fleet may represent a prime opportunity to bolster a service's resources and prestige, especially in an era of slower economic growth and corresponding slowdowns in defense spending. The respective institutional interests and political power of the Rocket Force and the navy will influence the design of China's SSBN command and control system.

The services may view the nuclear mission as a valuable growth area. Nuclear deterrence may command



greater prestige than other mission sets within the Chinese military. In christening the newly established Rocket Force, Xi Jinping extolled its importance to Chinese national security, describing it as “a fundamental force for our country’s strategic deterrent, a strategic pillar for our country’s great power status, and an important cornerstone in protecting our national security.”<sup>41</sup> The nuclear deterrent mission may also represent a reliable source of resources. China has dedicated substantial resources to undertaking a nuclear modernization program designed to ensure the credibility of its second-strike capability.

However, China’s distinctive views of nuclear deterrence may impose a relatively low ceiling on both the size of its nuclear arsenal and the mission set to which it is assigned. Chinese leaders have generally believed that nuclear deterrence is obtained early along the nuclear curve and that deterrence is largely insensitive to the shape and configuration of nuclear arsenals. China has been undertaking a nuclear modernization program, including a modest expansion of the number of nuclear weapons capable of hitting the continental United States, but the modernization efforts are attributed to concerns about maintaining a credible second-strike capability. China has instead historically opted for a “lean and effective” force, and Chinese leadership has shown little interest in developing a nuclear warfighting capability.<sup>42</sup> The implied limits on the nuclear mission may make it less attractive to commanders seeking to expand the resources and prestige of their service.

It is unclear whether the Rocket Force or navy possess institutional preferences for the nuclear mission set. A disproportionate number of recent senior leaders of the Rocket Force and Second Artillery have served in Base 52, the premier conventional base opposite Taiwan, suggesting an institutional bias toward the conventional mission.<sup>43</sup> Indeed, most of the dramatic growth in China’s missile forces has come among the conventional units; 80 percent of the Rocket Force’s missiles and half its personnel are assigned to conventional units.<sup>44</sup> While the navy has never undertaken an operational nuclear patrol, its senior leadership is composed mostly of officers with experience on surface

vessels with comparatively less representation of officers with experience on submarines.<sup>45</sup>

China’s particular political and strategic views toward nuclear weapons will also impose constraints on the operational command and control of SSBNs. In the nuclear domain, Chinese leadership has generally prioritized negative control over operational flexibility, opting for a system of highly centralized command and control to minimize the risk of accidental or unauthorized launch. The Central Military Commission, the highest-level PLA decision-making body, is the only entity that can authorize a nuclear strike. Some experts have even described a “skip echelon” command and control system whereby the CMC can communicate directly with launch brigades in the field.<sup>46</sup> The PLA has shown a preference for centralizing control over high-value and strategic military assets, including even the Rocket Force’s conventional units. In 2010, two short-range ballistic missile units controlled by the army were transferred back to the control of the Second Artillery. China’s preference for strict centralized control of the country’s nuclear weapons may accentuate the path dependency of any initial force assignments.<sup>47</sup>

China’s prioritization of negative control over operational flexibility may argue for a division of command authority such as in the third model. The concentration of operational control and launch authority within a single service would likely streamline command and control from the CMC staff to deployed launch units. This would decrease the requirements for onerous interservice coordination and increase the positive control of China’s sea-based nuclear weapons. However, China’s prioritization of political control over operational flexibility might cause leadership to decide against a highly efficient command structure. Instead, China may opt for dividing responsibility for vessel operations and launch authority between two different services, which would reinforce negative control and further reduce the likelihood of an accidental, unauthorized, or injudicious launch.<sup>48</sup>

Despite China’s historic preference for negative control, some American experts have argued that its ongoing modernization efforts may lead to operational

capabilities that could reduce longstanding constraints on China's nuclear policies and present new options for employing its nuclear forces. These observers posit that this could lead to an alteration of Chinese nuclear policies.<sup>49</sup> This may be most pronounced with regard to China's sea-based nuclear weapons. A recent article in the journal *Fire Control and Command Control* by members of the PLA Navy Submarine Academy identifies the difficulty of maintaining reliable communications with deployed ballistic missile submarines, arguing that "relevant command departments must draw up war plans and contingency plans in advance and consider ahead of time all manner of complex situations in order to ensure the smooth completion of the missile attack mission."<sup>50</sup> This language intimates a prioritization for positive control—that is, a desire to ensure that nuclear missiles are always launched on a legitimate order, even if it potentially increases the likelihood of an unauthorized launch. Still, official Chinese writings state that alerting and firing of nuclear weapons must be ordered by the CMC, and there is little evidence that China's political leadership has undergone such a change in its views toward nuclear deterrence.<sup>51</sup>

## China's Future SSBN Force and Strategic Stability

China's choice of command and control structure for its SSBNs will have important implications for strategic stability between China and the United States. Other experts have written thoughtfully on the importance of various operational choices related to deterrent patrol patterns, predelegation of launch authority, and interactions with conventional assets.<sup>52</sup> The internal command dynamics of China's SSBNs are no less important.

Given the above operational, bureaucratic, and political considerations, it appears possible that China might opt for a bifurcated command and control structure in which the navy controls China's nuclear ballistic missile submarines and the Rocket Force controls its sea-based nuclear missiles. Such a structure would appear to require the least disruptive changes to the current bureaucratic

structures of the PLA, best satisfy China's preference for centralized control of nuclear weapons, and most comport with China's distinctive approach to nuclear deterrence.

The political commissar model in the Soviet and Chinese militaries provides some precedent for a notional dual command structure, and the SSBNs operated by USSTRATCOM are commanded at the higher levels by an officially joint military command. In the Soviet Union, SSBNs were controlled by the navy, but the launch of an SLBM required the agreement of both the commander and the political commissar.<sup>53</sup> The PLA has been known to assign political commissars who have spent years in one service to serve in units of another service. This provides some precedent for a bifurcated command structure.

However, a dual command and control structure is unprecedented in the history of nuclear ballistic missile submarines operated by other services, and such an official division of command authority would be unique and likely would face a number of challenges. In the end, Chinese leadership may find it simpler to opt for the default and vest control of SSBNs within the navy while attempting to craft the structures necessary for secure strategic command and control and personnel reliability.

Regardless of the ultimate command and control structure, there are a number of steps China can take with regard to its SSBN fleet to enhance strategic stability. First, China should ensure that all or at least key personnel serving on its SSBNs are subject to thorough vetting as part of a personnel reliability program. Such programs should include investigations not only into people's political backgrounds, but also their psychological well-being, indications of substance abuse, or vulnerability to political coercion.

Second, China should attempt to establish an operational firewall between the command and control structures of its SSBNs and those of the country's other submarine forces. China is modernizing and expanding its fleet of conventionally armed attack submarines, which will likely feature heavily in any potential conflict with the United States.<sup>54</sup> U.S. antisubmarine warfare efforts designed to counter China's conventional submarine forces

might inadvertently jeopardize China's sea-based nuclear weapons by either destroying the SSBNs themselves or the command and control infrastructure shared by China's conventional- and nuclear-armed submarine forces.<sup>55</sup> To minimize the chances of entanglement between those forces, China should develop separate command and control structures supported by nonoverlapping communications facilities. China should also deploy its SSBNs away from both enemy ASW assets and, potentially, its own conventional submarines. Beijing might establish separate basing and support facilities for its SSBNs as well.

Third, China should adopt a cautious approach to its SSBNs, especially as it struggles to perfect quieting technology and operational practices. Some experts have suggested that, given the technical limitations of China's current class of ballistic missile submarines, including the high acoustic signature and the short range of its missiles, the SSBN fleet may be intended more for training and technology demonstration. However, China's expected fleet of five to eight SSBNs suggests that the vessels may be intended for actual deterrence operations. Until China has confidence in the survivability of its sea-based deterrent, it should avoid emphasizing its role in deterrent operations. In writing about the advantages of a sea-based deterrent, Chinese experts have noted a global trend of other nuclear powers shifting a greater share of their forces to their SSBNs, writing that "from a global perspective, sea-based nuclear forces will continue to occupy a greater proportion in national deterrence systems."<sup>56</sup> China should avoid adopting a similar approach and instead maintain most of its nuclear force in the form of its mobile land-based systems, which are currently more survivable.

In addition, Beijing should continue its policies of highly centralized control of nuclear weapons in its emergent sea-based force. Some experts have argued that China's authoritarian political culture, like that of the former Soviet Union, will lead its leadership to opt for tight control of its SSBN force.<sup>57</sup> In the context of SSBNs, this likely means, first and foremost, not delegating launch authority to lower-level commanders. China should also install advanced security features on its missiles, such as

the permissive action links used by the United States, and ensure that launches can only be initiated by the simultaneous actions of multiple vetted and authorized crew members.

Nuclear ballistic submarines have long been viewed as the most survivable and, therefore, stable component of the notional nuclear triad. But the mere existence of SSBNs is insufficient to guarantee a second-strike capability or contribute to strategic stability. Much depends on the technical and operational characteristics of the vessels themselves, as well as the nuclear weapons they carry. Questions of command and control are especially salient for SSBNs given the communication difficulties, the independence of the crew, and the potential for interaction with the adversary. Especially in the interim, as China's sea-based deterrent matures, Beijing should ensure that its command and control policies work to bolster and not undermine stability.

## Notes

<sup>1</sup> Department of Defense (DOD), *Military and Security Developments Involving the People's Republic of China 2016* (Washington, DC: DOD, April 26, 2016), 26.

<sup>2</sup> Hans M. Kristensen and Robert S. Norris, "Chinese Nuclear Forces, 2016," *Bulletin of the Atomic Scientists* 72, no. 4 (June 2016), 5–6. U.S. defense officials have recently suggested that the PLA Air Force may be assigned to or working toward a nuclear mission, though details are scarce. See, for example, DOD, *Military and Security Developments Involving the People's Republic of China 2016*, 38; and Hans M. Kristensen, "Air Force Briefing Shows Nuclear Modernizations but Ignores U.S. and UK Programs," Federation of American Scientists (FAS), May 29, 2013, available at <<https://fas.org/blogs/security/2013/05/afgsc-brief2013/>>.

<sup>3</sup> Andrew S. Erickson and Michael Chase, "China's SSBN Forces: Transitioning to the Next Generation," *China Brief* 9, no. 12 (June 2009).

<sup>4</sup> For more information on China's policies and practices for handling its nuclear warheads, see Mark A. Stokes, "China's Nuclear Warhead Storage and Handling System," Project 2049 Institute, March 12, 2010, available at <[https://project2049.net/documents/chinas\\_nuclear\\_warhead\\_storage\\_and\\_handling\\_system.pdf](https://project2049.net/documents/chinas_nuclear_warhead_storage_and_handling_system.pdf)>.

<sup>5</sup> Admiral Samuel J. Locklear, USN, "Statement Before the Senate Armed Services Committee on U.S. Pacific Command Posture," April 16, 2015, 9, available at <[www.armed-services.senate.gov/imo/media/doc/Locklear\\_04-16-15.pdf](http://www.armed-services.senate.gov/imo/media/doc/Locklear_04-16-15.pdf)>.

<sup>6</sup> Language from the latest DOD report on the Chinese military suggested that China had not yet conducted deterrent patrols, but would begin soon: "China will probably conduct its first SSBN nuclear deterrent patrol sometime in 2016." DOD, *Military and Security Developments Involving the People's Republic of China 2016*, 26. Other statements by U.S. defense officials, however, have suggested that Chinese SSBNs have already begun conducting patrols, though the vessels may not have been

armed. See, for example, Kris Osborn, "Admiral Says China Outnumbers U.S. in Attack Submarines," *DOD Buzz*, February 26, 2015, available at <[www.dodbuzz.com/2015/02/26/admiral-says-china-outnumbers-u-s-in-attack-submarines/](http://www.dodbuzz.com/2015/02/26/admiral-says-china-outnumbers-u-s-in-attack-submarines/)>; Vincent R. Stewart, "Statement for the Record: Worldwide Threat Assessment," Statement Before the Senate Armed Services Committee, February 9, 2016, available at <[www.dia.mil/News/Speeches-and-Testimonies/Article-View/Article/653278/statement-for-the-record-worldwide-threat-assessment/](http://www.dia.mil/News/Speeches-and-Testimonies/Article-View/Article/653278/statement-for-the-record-worldwide-threat-assessment/)>.

<sup>7</sup> DOD, *Military and Security Developments Involving the People's Republic of China* 2016, 26.

<sup>8</sup> See, for example, "Expert: PLA Rocket Force May Have Strategic Nuclear Submarine, Bomber," *China Military Online*, January 8, 2016, available at <[http://english.chinamil.com.cn/news-channels/pla-daily-commentary/2016-01/08/content\\_6850119.htm](http://english.chinamil.com.cn/news-channels/pla-daily-commentary/2016-01/08/content_6850119.htm)>; Kelsey Davenport, "China Elevates Nuclear Rocket Force," Arms Control Association, March 3, 2016, available at <[www.armscontrol.org/ACT/2016\\_03/News/China-Elevates-Nuclear-Rocket-Force](http://www.armscontrol.org/ACT/2016_03/News/China-Elevates-Nuclear-Rocket-Force)>; Shannon Tiezzi, "The New Military Force in Charge of China's Nuclear Weapons," *The Diplomat*, January 5, 2016.

<sup>9</sup> "The Diversified Employment of China's Armed Forces," State Council Information Office, April 2013, available at <[http://news.xinhuanet.com/english/china/2013-04/16/c\\_132312681\\_2.htm](http://news.xinhuanet.com/english/china/2013-04/16/c_132312681_2.htm)>.

<sup>10</sup> "New Branch of PLA Shows off Missiles in Music Video," *Global Times*, February 14, 2016, available at <[www.globaltimes.cn/content/968296.shtml](http://www.globaltimes.cn/content/968296.shtml)>.

<sup>11</sup> "The Diversified Employment of China's Armed Forces."

<sup>12</sup> For example, "China's National Defense in 2008" [2008 年中国的国防], Xinhua [新华], January 1, 2011, available at <[www.mod.gov.cn/affair/2011-01/06/content\\_4249949\\_4.htm](http://www.mod.gov.cn/affair/2011-01/06/content_4249949_4.htm)>.

<sup>13</sup> Ibid.

<sup>14</sup> Shou Xiaosong [寿晓松], *The Science of Military Strategy* [战略学] (Beijing: Military Academic Works, Academy of Military Science, 2013) [军事科学出版社], 214.

<sup>15</sup> Sun Kuaiji [孙快吉], "The World Looks on at the Creation of the Rocket Force" [放眼世界看火箭军建设], *PLA Daily* [解放军报], May 3, 2016, available at <[www.81.cn/jfjbmap/content/2016-05/03/content\\_143402.htm](http://www.81.cn/jfjbmap/content/2016-05/03/content_143402.htm)>.

<sup>16</sup> Despite the connection between the nuclear domain and the concept of "strategic deterrence," the two concepts do not appear to be synonymous within Chinese defense writings. For discussion of an increasingly expansive Chinese conception of "strategic deterrence," see Michael S. Chase and Arthur Chan, *China's Evolving Approach to "Integrated Strategic Deterrence"* (Santa Monica, CA: RAND, 2016); Michael S. Chase and Arthur Chan, "China's Evolving Strategic Deterrence Concepts and Capabilities," *The Washington Quarterly* 39, no. 1 (Spring 2016), 117–136.

<sup>17</sup> "The Diversified Employment of China's Armed Forces."

<sup>18</sup> "China's Military Strategy," State Council Information Office, May 26, 2015, available at <[http://news.xinhuanet.com/english/china/2015-05/26/c\\_134271001\\_2.htm](http://news.xinhuanet.com/english/china/2015-05/26/c_134271001_2.htm)>.

<sup>19</sup> Ibid.

<sup>20</sup> David C. Logan, "PLA Reforms and China's Nuclear Forces," *Joint Force Quarterly* 83 (4<sup>th</sup> Quarter 2016), 57–62.

<sup>21</sup> John Wilson Lewis and Xue Litai, *China's Strategic Seapower: The Politics of Force Modernization in the Nuclear Age* (Stanford: Stanford University Press, 1996); Hans M. Kristensen, "China SSBN Fleet Getting Ready—But for What?" FAS, April 25, 2014, available at <<http://fas.org/blogs/security/2014/04/chinassbnfleet/>>.

<sup>22</sup> Hui Zhang and Tuosheng Zhang, *Securing China's Nuclear Future* (Cambridge, MA: Harvard Kennedy School Project on Managing the Atom, 2014), 55.

<sup>23</sup> Herbert L. Abrams, "Human Reliability and Safety in the Handling of Nuclear Weapons," *Science and Global Security* 2 (1991), 339.

<sup>24</sup> Generally, *positive control* refers to the ability to launch a nuclear strike whenever the authorized political decision has been made. *Negative control* refers to the ability to avoid unauthorized launches.

<sup>25</sup> Pan Yutian [潘玉田] and Wu Mengmeng [吴猛猛], "Important Characteristics Uniquely Held by Submarine Command Officers" [潜艇指挥官特有品质要素], *Journal of Political Work* [政工学刊], 2015, 32–33. Both authors are affiliated with the PLA Navy Submarine Academy.

<sup>26</sup> For an official unclassified depiction of the relative acoustic signatures of China's submarines, see U.S. Office of Naval Intelligence (ONI), *The People's Liberation Navy: A Modern Navy with Chinese Characteristics* (Washington, DC: ONI, August 2009), 20–23. For a discussion of the implications of the high acoustic signature of China's SSBNs, see Jeffrey Lewis, "China's Noisy New Boomer," Arms Control Wonk, November 24, 2009, available at <[www.armscontrolwonk.com/archive/202544/chinas-noisy-new-boomer/](http://www.armscontrolwonk.com/archive/202544/chinas-noisy-new-boomer/)>.

<sup>27</sup> John W. Lewis and Xue Litai, "Making China's Nuclear War Plan," *Bulletin of the Atomic Scientists* 68, no. 5 (2012), 58.

<sup>28</sup> Mark Stokes and Russell Hsiao, "Leadership Transitions in the Second Artillery Force at the 18<sup>th</sup> Party Congress: Implications for Roles and Missions," *Asia Eye*, Project 2049 Institute, May 7, 2012, available at <<http://blog.project2049.net/2012/05/leadership-transitions-in-second.html>>.

<sup>29</sup> John Wilson Lewis and Xue Litai, *Imagined Enemies: China Prepares for Uncertain War* (Stanford: Stanford University Press, 2006), 119–121. This bureau likely now resides within the Central Military Commission Joint Staff Department.

<sup>30</sup> See, for example, "Expert: PLA Rocket Force May Have Strategic Nuclear Submarine, Bomber," *China Military Online*, January 8, 2016, available at <[http://english.chinamil.com.cn/news-channels/pla-daily-commentary/2016-01/08/content\\_6850119.htm](http://english.chinamil.com.cn/news-channels/pla-daily-commentary/2016-01/08/content_6850119.htm)>.

<sup>31</sup> For discussions of China's very low frequency facilities, see Wu Riqiang [吴日强], "China Does Not Need to Hurry in Allowing Its Strategic Nuclear Submarines to Patrol" [中国不必急于让战略核潜艇战备巡航], *Defense Times* [国防时报], December 31, 2015, 8; Bonnie Glaser and Matthew Funaiolo, "Submerged Deterrence: China's Struggle to Field an SSBN Fleet," Asia Maritime Transparency Initiative, Center for Strategic and International Studies, May 9, 2016, available at <<https://amti.csis.org/submerged-deterrence-chinas-struggle-field-ssbn-fleet/>>.

<sup>32</sup> For an overview of the missions assigned to U.S. Strategic Command (USSTRATCOM), see "Mission and Priorities," U.S. Strategic Command, April 2016, available at <<https://www.stratcom.mil/mission/>>.

<sup>33</sup> For more information on the organization of nuclear forces under USSTRATCOM and the various command relationships between those forces, USSTRATCOM, and the military Services, see "Task Forces," U.S. Strategic Command, available at <[www.stratcom.mil/task\\_forces/](http://www.stratcom.mil/task_forces/)>; *Annex 3-72, Nuclear Operations of U.S. Air Force Doctrine: Presentation of Nuclear Forces* (Maxwell Air Force Base, AL: Curtis E. LeMay Center for Doctrine and Education, updated May 19, 2015), available at <<https://doctrine.af.mil/download.jsp?filename=3-72-D20-NUKE-OPS-Force-Presentation.pdf>>.

<sup>34</sup> Tong Zhao, "China's Sea-Based Nuclear Deterrent," Carnegie-Tsinghua Center for Global Policy, June 30, 2016, available at <<http://carnegietsinghua.org/publications/?fa=63909>>. For a technical discussion of the interaction between China's SSBNs and the U.S. ballistic missile defense architecture, see Wu Riqiang, "Survivability of China's Sea-Based Nuclear Forces," *Science and Global Security* 19 (2011), 91–120.

<sup>35</sup> ONI, *The People's Liberation Navy*, 22.

<sup>36</sup> Christian Conroy, "China's Ballistic-Missile Submarines: How Dangerous?" *The National Interest*, November 18, 2013.



<sup>37</sup> For some discussion of possible deployment strategies and locations, including assessments of the acoustic conditions in the maritime zones near China's shores, see Tian Jianwei [田剑威], "Type-094 Nuclear Submarine: China's 'King of the South China Sea'" [094 型核潜艇—中国“南海之王”], *Communists* [共产主义者], no. 8 (2014), 60–61; Owen R. Cote, "Assessing the Undersea Balance Between the U.S. and China," Security Studies Program Working Paper (Cambridge: Massachusetts Institute of Technology, 2011), 4–11; Wu Riqiang [吴日强], "Have China's Strategic Submarines Begun Patrolling?" [中国战略核潜艇开始战备巡航了吗?], *Modern Ships* [现代舰船], no. 1B (2016), 33; Tong.

<sup>38</sup> Tong.

<sup>39</sup> Li Bin, "China and Nuclear Transparency," in *Transparency in Nuclear Warheads and Materials: The Political and Technical Dimensions*, ed. Nicholas Zarimpas (New York: Oxford University Press, 2003), 51–53.

<sup>40</sup> Lewis and Xue, 59.

<sup>41</sup> Wang Shibin [王士彬] and An Puzhong [安普忠], "Founding Ceremony for Army Leading Organization, Rocket Force and Strategic Support Force Held in Beijing" [陆军领导机构火箭军战略支援部队成立大会在京举行], *China Military Online* [中国军网], January 1, 2016, available at <[http://cd.81.cn/content/2016-01/01/content\\_6841020.htm](http://cd.81.cn/content/2016-01/01/content_6841020.htm)>.

<sup>42</sup> For more on Chinese views of nuclear weapons and Chinese nuclear strategy, see Jeffrey Lewis, *Paper Tigers: China's Nuclear Posture* (New York: Routledge, 2014), 13–42; M. Taylor Fravel and Evan S. Medeiros, "China's Search for Assured Retaliation: The Evolution of Chinese Nuclear Strategy and Force Structure," *International Security* 35, no. 2 (Fall 2010), 48–87. For evidence about the continued stability of those views, see Fiona S. Cunningham and M. Taylor Fravel, "Assuring Assured Retaliation: China's Nuclear Posture and U.S.-China Strategic Stability," *International Security* 40, no. 2 (Fall 2015), 7–50.

<sup>43</sup> David C. Logan, "Career Paths in the PLA Rocket Force," forthcoming.

<sup>44</sup> For estimates on delivery systems, see *Military and Security Developments Involving the People's Republic of China 2016*, 25; Kristensen and Norris, 2. For estimates on personnel assignment, see Jeffrey Lewis, "China's Belated Embrace of MIRVs," in *The Lure and Pitfalls of MIRVs: From the First to the Second Nuclear Age*, ed. Michael Krepon, Travis Wheeler, and Shane Mason (Washington, DC: Stimson Center, May 2016), 105.

<sup>45</sup> For information on recent leadership, including past career experience of PLA Navy leaders, see ONI, *The People's Liberation Navy*, 36–40; Jeffrey Becker, David Liebenberg, and Peter Mackenzie, *Behind the Periscope: Leadership in China's Navy* (Alexandria, VA: Center for Naval Analyses, 2013), 57, 91.

<sup>46</sup> Kenneth W. Allen and Jana Allen, *Building a Strong Informalized Strategic Missile Force: An Overview of the Second Artillery Force with a Focus on Training in 2014*, China Brief (Washington, DC: The Jamestown Foundation, 2016), 26.

<sup>47</sup> See, together, Dennis J. Blasko, *The Chinese Army Today: Tradition and Transformation for the 21<sup>st</sup> Century* (New York: Routledge, 2012), 96; Mark Stokes, "Expansion of China's Ballistic Missile Infrastructure Opposite Taiwan," *Asia Eye*, Project 2049, April 2011, available at <<http://blog.project2049.net/2011/04/expansion-of-chinas-ballistic-missile.html>>.

<sup>48</sup> China's highly centralized approach to commanding its strategic weapons, including nonnuclear assets such as conventional ballistic missiles, direct-ascent antisatellite weapons, and the DF-21D antiship missile, suggests the prioritization of political control over operational flexibility.

<sup>49</sup> See, for example, Chase and Chan, *China's Evolving Approach to "Integrated Strategic Deterrence."*

<sup>50</sup> Yang Hongbo [杨洪波], Li Jianlin [李建林], and Hong Zhenqi [洪贞启], "Framework for an Auxiliary Decision-Making Support System for SLBM War Command" [潜射导弹作战指挥辅助决策支持系统框架], *Fire Control and Command Control* [火力与指挥控制] 40, no. 1 (January 2015), 123.

<sup>51</sup> "The Diversified Employment of China's Armed Forces"; Cunningham and Fravel.

<sup>52</sup> See, for example, Brendan Thomas-Noone and Rory Medcalf, "Nuclear-Armed Submarines in Indo-Pacific Asia: Stabiliser or Menace?" Lowy Institute, September 2015, available at <[www.loyyinstitute.org/files/nuclear-armed-submarines-in-indo-pacific-asia-stabiliser-or-menace\\_0.pdf](http://www.loyyinstitute.org/files/nuclear-armed-submarines-in-indo-pacific-asia-stabiliser-or-menace_0.pdf)>; Tong.

<sup>53</sup> Jeremy Page, "When Sub Goes Silent, Who Has Control of Its Nuclear Warheads?" *Wall Street Journal*, October 24, 2014.

<sup>54</sup> ONI, *The People's Liberation Navy*, 18–20.

<sup>55</sup> For a thorough discussion, see David C. Logan, "Conventional-Nuclear Entanglement in China's Missile Forces," forthcoming. For some past discussion of the risks of entanglement, see Lewis and Xue, "Making China's Nuclear War Plan," 60–62; Thomas Christensen, "The Meaning of the Nuclear Evolution: China's Strategic Missile Force Modernization and Its Implications for the United States," *Journal of Strategic Studies* 35, no. 4 (August 2012), 468; Michael Glosny, Christopher Twomey, and Ryan Jacobs, "U.S.-China Strategic Dialogue, Phase VIII Report," Naval Postgraduate School, November 2014, 10; Cunningham and Fravel.

<sup>56</sup> Guo Wei [郭维], Yang Qingxuan [杨清轩], and Su Qiang [苏强], "Research on the Developments and Trends in Foreign Ballistic Missile Submarines" [国外弹道导弹核潜艇发展趋势研究], *Ship Science and Technology* [舰船科学技术] 37, no. 7 (July 2015), 233, as quoted in Tong.

<sup>57</sup> Toshi Yoshihara and James R. Holmes, "China's New Undersea Nuclear Deterrent: Strategy, Doctrine, and Capabilities," *Joint Force Quarterly* 50 (3<sup>rd</sup> Quarter 2008), 33.

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