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BEYOND THE FIRST SALVO: OPERATIONAL CONSIDERATIONS FOR EXPEDITIONARY REPAIR IN THE 21st CENTURY

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Maritime Advanced Warfighting School.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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14. ABSTRACT

Beyond the First Salvo: Operational Considerations for Expeditionary Repair in the 21st Century

The Navy today lacks the Mobile Repair Forces it enjoyed during World War II. The concentration of Intermediate-level maintenance and the vulnerability of Ship Repair Facilities in forward areas potentially prevents the timely restoration of combat capabilities as they are degraded. Redeveloping the capability to conduct Expeditionary Repair, including both afloat and ashore elements, reduces this vulnerability. Expeditionary Repair enhances the timely restoration of capabilities degraded through damage in a contested maritime environment. This paper examines the historical origins of the Navy's Expeditionary Repair capability, how it has evolved over time, and how such a capability contributes to present day efforts to compete effectively in the maritime domain.

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Introduction

As the battle for Okinawa raged, a US ship or landing craft was sunk or severely damaged every 13 hours, on average.[1] However, Mobile Repair Forces (MRF) from Service Squadron (ServRon) Ten had established a forward base at Kerama Retto only 15 miles from Okinawa,[2] with tenders, floating dry-docks and rescue ships providing repair to ships damaged in battle, restoring the combat power of the US Fifth/Third Fleet.[3]

With less than 300 ships in service today,[4] the Navy is smaller than during World War II. While those ships possess greater capabilities in weaponry, scouting, and communications, there are limits to how many can be in a given place at a particular time. Since its ascendancy as a Great Power in the 20th century, the US has sought the "away game," preferring to fight its enemies far from its shores. The US's overwhelming military superiority following the Cold War, more recently combined with budget constraints and a relatively permissive environment, has contributed to the decline of the mobile repair capability that Nimitz described as his "secret weapon" in the Pacific.[5] However, worldwide commitments and a global presence mean that the US is unlikely to have a preponderance of forces in a particular theater of operations at any given time. This relative "under-match" emphasizes the importance of the material readiness of all the forces available in any given theater. An Expeditionary Repair (ER) capability, one effectively performing the same function that ServRon Ten did at Okinawa, is one way to

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[1]Samuel Eliot Morison, *The History of United States Naval Operations in World War II*, vol. 14 (Boston, MA: Little, Brown and Co., 1960), 389

[2] Worrall R. Carter, *Beans, Bullets and Black Oil: The Story of Fleet Logistics Afloat in the Pacific During World War II* (Washington, DC: Government Printing Office, 1953), 331

[3]John D. Keenan, *Observations on Ship Battle Damage Repair During PACEX-89*, (Arlington, VA: Center for Naval Analyses, August, 1990): 3

[4] U.S. Navy, "Fleet Size" Naval Vessel Register, accessed on 14 April 2021, https://www.nvr.navy.mil/NVRSHIPS/FLEETSIZE.HTML

[5]"*ServRon 10-Floating Arsenal*", Popular Mechanics, Nov. 1945, 59

maximize readiness and therefore combat power both before combat and to regenerate degraded capabilities as quickly as possible.

Today, the limited number of US forces, vulnerability of forward Ship Repair Facilities (SRF), long transit distances to rear-area SRFs, and the erosion of mission capabilities, either from enemy action or operational wear, place ER at a premium. In a contested maritime environment, Expeditionary Repair capabilities, both ashore and afloat, are essential to rapidly restoring ships' lost mission capabilities and regenerating combat power. This capability, in turn, allows the fleet to remain competitive beyond the first salvo of the conflict. In addition to addressing the operational problems posed by limited forces and long transit distances, an ER capability also offers a fleet with the flexibility to mass and maneuver and extend its operational reach by shortening lines of communication.

This study considers the role that ER has played in past conflicts, how that capability has atrophied, and how it can play a vital role in future conflicts. It considers both corrective maintenance of material casualties that arise and repair of battle damage sustained in combat to ships and submarines, including auxiliaries and landing craft. Concerning Battle Damage Repair (BDR), this study does not attempt to provide an authoritative estimate of the damage that will likely be sustained in a contested environment or predict the impact of that damage on individual mission capabilities. Instead, it stands on the premise that some percentage of the force will sustain damage from enemy action in combat. This study explores maintenance and repair processes, the historical context of ER, present-day trends, and how ER can help to regenerate combat power quickly enough to impact the outcome of the fight. After identifying the most essential and relevant elements of the challenges facing theater-level maritime forces, this study will also discuss the operational advantages of ER ashore and afloat. While skeptics of ER

might argue that forward SRFs can be defended and their continued use ensured, and therefore that an investment in a more robust ER capability is unnecessary, ER offers operational-level commanders much more than just a different way of doing "business as usual." Recommendations for the development of ER follow the paper's conclusion.

What is Expeditionary Repair?

What exactly does "Expeditionary Repair" involve? No DoD-wide definition exists, but for this study, it is considered to be the Joint Maritime Force's ability to conduct both mission-critical Intermediate-level maintenance and BDR in a forward, potentially austere, environment characterized by a high degree of mobility. A "contested" environment, for this study's purposes, includes both uncertain and hostile environments, where "uncertain" territory is not controlled by friendly forces, and "hostile" territory is controlled by hostile forces.[6] ER may or may not operate inside a contested environment but have sufficient mobility to remain near areas where damage will occur. To better illustrate the importance of ER, this section provides background and context for ship maintenance and repair, the historical context of ER, and a discussion of present-day challenges. Historical cases of ship repair illustrate the relationship between ER and material readiness. The section concludes by exploring some of the contributing factors to the need for a credible ER capability.

Three levels of maintenance exist within the DoD. US Code Title X identifies "depot" and "field" levels of maintenance, with "field-"broken down further into "organizational" and "intermediate" levels of maintenance.[7] Organizational maintenance is performed by the personnel who use the equipment, such as a ship's crew; Intermediate maintenance is beyond the

[6]U.S. Navy and U.S. Marine Corps, *Littoral Operations in a Contested Environment* (Washington, DC: Department of the Navy/Headquarters, U.S. Marine Corps, 2017), 3

[7] Office of the Assistant Secretary of Defense (Sustainment), "Maintenance Overview," accessed 15 April 2021, https://www.acq.osd.mil/log/mpp/maintenance_overview.html

capability of a ship's crew and requires special skills, tools, or facilities to complete; Depot maintenance the industrial facilities found at a Shipyard or SRF, such as dry-docks, cranes, foundries and repair shops with capabilities found beyond those at the intermediate-level.

Tenders are ships that provide intermediate maintenance, battle damage repair, and logistic support to assigned ships.[8] For this study, Destroyer Tenders (AD), Submarine Tenders (AS), and general-purpose Repair Ships (AR) are all considered as tenders. Within the Navy, the Naval Sea Systems Command (NAVSEA) is responsible for the construction, modernization, maintenance, and repair of US Navy ships, including overseeing depot-level maintenance at the Navy's four public shipyards.[9] Since the end of the Cold War, the adoption of three levels of maintenance discussed above, the development of combat systems with modular, subcomponent-repairable parts, and access to SRFs in friendly ports combined to drive the Navy away from its reliance on tenders and toward a more consolidated, cost-effective approach[10]. In addition to four public shipyards, the Navy Regional Maintenance Command (CNMRC) was created in 2010 to centralize intermediate maintenance and reduce redundancy. There are four Regional Maintenance Centers (RMC) in San Diego, Mayport, Norfolk, and Naples, with two additional detachments in Manama, Bahrain, and Rota, Spain[11]. Additional Intermediate Maintenance

[8] Richard E. Angel, et. Al., *The Navy's Tender Force Beyond 2000: Expanded Report*, (Arlington, VA: Center for Naval Analyses, November, 1995): 15
[9] Naval Sea Systems Command, "Who We Are – NAVSEA Activities," accessed on 13 April 2021, https://www.navsea.navy.mil/Who-We-Are/NAVSEA-Activities/
[10] Angel, *The Navy's Tender Force Beyond 2000: Expanded Report*, 9
[11] Naval Sea Systems Command, "CNMRC-About Us" accessed on 15 April 2021, https://www.navsea.navy.mil/Home/RMC/CNRMC/About-Us/

Activities (IMA) include two Submarine tenders in active service[12] as well as SRF Japan, with facilities in Yokosuka and Sasebo.[13]

During Exercise *PACEX-89*, the Center for Naval Analyses (CNA) studied BDR and identified four levels of repair (as opposed to the levels of maintenance): "A" level repairs returned the ship to fully mission capable (FMC); "B" level repairs restored the capability to perform at least one essential mission (partially mission capable/PMC); "C" level repairs restored the ability for the ship to transit to a rear-area SRF under its own power; "D" level repairs restored sufficient structural and watertight integrity to allow the ship to be towed or lifted to a rear-area SRF.[14] The ability to conduct "B" level repairs and restore damaged vessels to at least PMC is at the heart of ER.

Historical Context

The Central Pacific campaign of World War II is arguably the last time a maritime theater was contested, with naval forces fighting over vast distances against a peer competitor, who began the war with a significant overmatch following the attack on Pearl Harbor. The US industrial base built new ships and repaired damaged ones as the Allies advanced toward Japan. After capturing the Gilbert Islands, the Central Pacific Force established an advanced base at Eniwetok, which kept repair capabilities close to the fighting. From 1942 to 1945, US forces established bases at Espiritu Santo,[15], Manus Island,[16] Ulithi,[17] and Kerama Retto.[18]

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[12]Commander, Submarine Force Pacific, "Submarine Tenders" Commander, Submarine Force Pacific, accessed on 31 March 2021, https://www.csp.navy.mil/emorysland/ and https://www.csp.navy.mil/frankcable/
[13]Naval Sea Systems Command," US Naval Ship Repair Facility and Japan Regional Maintenance Center." Naval Sea Systems Command, accessed on 16 April, 2021, https://www.navsea.navy.mil/Home/RMC/SRFJRMC/
[14]John F. Ince and John D. Keenan, "*Requirements for Future Rescue and Towing and Repair Ships for Battle Damage Repair*" (Arlington, VA: Center for Naval Analyses, 1989), 14
[15] Carter, *Beans, Bullets and Black Oil*, 55
[16] Ibid., 174
[17]Ibid., 217
[18]Ibid., 331

During the Central Pacific campaign, ships that were severely damaged, such as *USS Reno*,[19] *USS Houston* and *USS Canberra* [20] were towed to Ulithi, where they received "D" level repairs and were subsequently towed to Manus, where they received "C" level repairs. While all three transited on their own to shipyards in CONUS to receive "A" level repairs, they could also have been returned to service as PMC, returning some essential mission capabilities to the Fleet Commander. At Okinawa, the last and one of the fiercest battles in the Central Pacific campaign, and arguably the last time the US faced a peer competitor who contested the maritime environment, the *USS Newcomb* (DD-586) received damage from four kamikaze planes and one bomb.[21] Severely damaged and left with no propulsion or electrical power, she was towed to the US Navy's forward base at Kerama Retto, only 15 miles West of Okinawa, where she received repairs to her hull, structural bulkheads, and piping.[22] Although *Newcomb* did not return to the fight, "of the 81 Destroyers and picket ships brought to the repair site at Kerama Retto, 15 were restored on-scene, and another 23 saw further post-war service."[23] Many of those severely damaged ships, such as *Newcomb*, provided MRF a source of cannibalization for critical repair parts. A damaged ship that does not sink can still contribute to the fight, whether or not it returns to action itself, given timely access to Intermediate-level repairs.

By the end of the Cold War, the Navy had still had 18 tenders available, several of which supported Operation Desert Storm.[24] The Long Beach, Philadelphia, Norfolk, and Charleston Naval Shipyards, which together sent over 30 flyaway teams (FATs) to support repairs to ships

[19] U.S. Navy, *Structural Repairs in Forward Areas During World War II* (Washington, DC: United States Navy, 1949), 11. Document is now declassified.
[20]Ibid., 21
[21]Morison, *The History of United States Naval Operations in World War II,* vol. 14, 182.
[22] U.S. Navy, *Structural Repairs in Forward Areas During World War II,* 59
[23]Keenan, *Observations on Ship Battle Damage Repair During PACEX-89*, 3
[24]George B. Hendrickson, *Expeditionary Ship Battle Damage Repair,* (Newport, RI: U.S. Naval War College, 1997), 17

damaged during the operation, augmented the *USS Jason* (AR-8) and *USS Acadia* (AD-42) moored in ports within the theater.[25] Additionally, contractor technical representatives flown into theater embarked on ships "to assist with maintenance of complex weapons and C3 systems."[26] Three of the shipyards listed were closed in the 1990s. It is also worth noting that while Iraq possessed theater ballistic missiles (TBMs) and jet aircraft with ASCMs, Desert Storm was not regarded as a contested maritime environment. None of the damage repaired was directly due to enemy action.

Today, only two Submarine Tenders remain in service, both included in the 18 that were present at the end of the Cold War, with no remaining Destroyer Tenders or Repair Ships in service.[27] The centralization of Intermediate maintenance into fewer IMAs and fewer platforms results in the creation of critical vulnerabilities to our SRFs, particularly those within an enemy's Weapons Engagement Zone (WEZ), that can be held at risk and targeted at the outset of a conflict. The solution to these challenges can be found by looking to the past for answers.

Expeditionary Repair - Back to the Future

Today, US ER capabilities have declined, placing greater importance on SRFs in forward areas, even while adversaries' abilities to hold forward SRFs at-risk have expanded through developments in Medium- and Intermediate-Range Ballistic Missile technology. Table 1 lists the ranges and quantities of selected Theater Ballistic Missiles.

[25]Angel, *The Navy's Tender Force Beyond 2000: Expanded Report*, 73
[26]Ibid., 64
[27]U.S. Navy,"Hull Classification Symbols: AD, AR" Naval Vessel Register, accessed on 14 April 2021, https://www.nvr.navy.mil/QUICKFIND/HULLLIST_SHIPS.HTML

Country	Missile	Range (miles)[28]	Number[29]
China	DF-16	540	36
China	DF-17	971	16
China	DF-21	931-1087	24
China	DF-11	162	108
China	DF-15	324	81
China	DF-26	2485	110+
North Korea	Pukgusong (testing)	310	-
North Korea	Hwasong-12 (development)	1863	-
Iran	Shahab-3	1242	50*
Iran	Ghadr-1 (testing)	1242	-
Iran	Emad-1 (testing)	1242	-
Iran	Sajjil (development)	1242	-
Iran	Khorramshahr (development)	1863	-
Quantities marked with an "*" are estimated.			

Table 1: Ranges and Quantities of Selected MRBM/IRBM, Conventional Warhead only

The US can achieve the ER capability it previously enjoyed by recapitalizing ER afloat platforms and integrating new technologies such as additive manufacturing into concepts such as Expeditionary Advanced Basing Operations (EABO). The effective use of ER to restore combat power in-theater could occur by two means: ER afloat and ER ashore. Not only does ER, either ashore or afloat, eliminate the critical vulnerability of forward SRFs, but both offer operational advantages to a Fleet Commander. This section examines both of these capabilities and how each addresses the Fleet Commander's problem of maximizing available combat power.

The importance of a repair capability to regenerate combat power becomes more apparent in light of the loss rate versus the production/replacement rate of ships. While one hit may result in a "mission kill," rendering the platform NMC for some time, the effects of an ASBM, ASCM,

[28] Individual missile ranges found in *Jane's*, "Weapons: Strategic,"
[29] International Institute of Strategic Studies, *The Military Balance*, vol. 121, issue 1 (2021), Chapter Six (Asia) and Chapter Seven (Middle East And North Africa)

torpedo, mine, or debris hit depend on the type of vessel and location of the damage. CNA estimated "B" level repairs taking between one to 15 weeks to complete,[30] depending on the kind of platform and damage sustained, which offers insight into the loss rate of mission capabilities from battle damage. Besides weapon type, the hit rate is also a contributor to the loss rate of ships and mission capabilities.

Forces removed from service in-theater require replacements to maintain combat power, whether they are deployed units redirected from other theaters or surged from CONUS. Although units arriving from CONUS or other theaters may come into the theater of combat faster than the time it takes to repair ships that are damaged, it is reasonable to assume that ships will sustain damage faster than force flow into the theater. Table 2 lists the average construction times for several classes of ships.

Ship	Construction Time (months) (1)	Average Years to Build One Ship(2)
CVN(3)	68	5.6
DDG	40	1.7
SSN	39	1.6
LCS(4)	34	1.4

Note 1. Average number of months from date the keel was laid to commissioning, to the nearest month for the five most recently commissioned vessels in the class.
Note 2. Average construction time divided by number of building yards.
Note 3. Includes *USS Gerald R. Ford* (CVN-78), which took 92 months from keel date to commissioning. Average of last 4 *Nimitz* class CVN is 61 months.
Note 4. Both LCS variants

Table 2: Construction Times for Selected Ship Classes[31]

Given the construction times listed, we may assume that combat losses cannot be replaced by new construction alone. These factors combine to form the assumption that forces

[30] Hendrickson, *Expeditionary Ship Battle Damage Repair*, 19
[31] U.S. Navy,"Hull Classification Symbols: AD, AR" Naval Vessel Register, accessed on 14 April 2021, https://www.nvr.navy.mil/QUICKFIND/HULLLIST_SHIPS.HTML

in-theater are effectively irreplaceable. Barring a large-scale mobilization of units from CONUS, the forces in a theater will not increase appreciably and, even then, would not happen quickly.

While SRFs inside an enemy's WEZ are vulnerable to targeting by TBMs, land-based bombers, and cruise missiles, even if they are not entirely indefensible. The nature of SRFs, with dry-docks, warehouses, repair shops, and cranes, make them both visible and of high value to US forces. The combination of high-value and limited concealment will likely result in SRFs inside an enemy's WEZ will be targeted, rendering them unusable along with any ships that happen to be in that SRF when it comes under attack.

While forward SRFs inside an enemy WEZ are vulnerable, there are few Navy-certified SRFs with a Master Ship Repair Agreement in place between theaters of operations and CONUS. These distances result in a penalty of time for damaged ships returning to a friendly SRF certified for use and replacement forces to transit into a theater. Establishing ER sites outside of but closer to an enemy's WEZ reduces time lost to transiting and speeds up repairs of effectively irreplaceable forces.

Finally, the inevitable degradation of readiness underscores the need for timely repair. If a ship's defenses intercept an incoming missile, the kinetic energy of its fragments may still cause damage to the ship. Even defenses that are 100% effective cannot eliminate the possibility of damage. Similarly, combat forces are likely to suffer attrition due to material casualties completely independent of enemy action. Preventive maintenance, aggressively pursued, can minimize material casualties requiring intermediate-level maintenance. However, with limited intermediate or depot-level capability in a theater of operations, such casualties are difficult or even impossible to correct without repair activity (RA) assistance. Forces that are effectively irreplaceable combined with the certainty of degraded combat power highlights the need for ER.

ER Ashore

An ER ashore capability would resemble a cross between FAT employment in Desert Storm and an EAB. As other expeditionary forces seize and secure new locations or develop and expand facilities in uncontested areas, fleets could establish an ER capability ashore. An ashore ER site would share many characteristics with a Foward Arming and Refueling Point (FARP) EAB[32], providing intermediate-level maintenance and repair from a relatively small, secure, and mobile footprint. An ashore ER site near an airhead would expedite the receipt of parts, RA personnel, and Contractors Authorized to Accompany the Force (CAAF). It would also include mobile repair facilities such as a "Shop-in-a-Box," a CONEX box modified into a workshop, shown in Figure 1, which could consist of additive manufacturing technologies or contain pre-staged Pack-Up Kits (PUK) of parts and material. The airfield would also permit the rapid transport of repair parts or personnel to the damaged ship by helicopter. An ER site could also be established at an existing port facility and leveraging any rigging or industrial equipment available. A harbor and port facility could service the damaged ship in port, effectively becoming a more secure, mobile SRF if one was available. A port facility without an airhead, however, does not fully support ER ashore. If no air facility is readily available, constructing and securing one is essential, even if only sufficient for rotary-wing aircraft. Of the two varieties, developing an ER ashore capability is likely more rapidly achievable.

[32]U.S. Marine Corps, *Tentative Manual for Expeditionary Advanced Base Operations,* (Washington, DC: Headquarters U.S. Marine Corps, 2021), 8-12

Figure 1: Concept for "Shop In A Box"[33]

One operational advantage of ER ashore is its security. An ER built on the model of EABO would provide defenses in all domains. Ground forces would establish a landward perimeter and air defenses, maritime forces would secure approaches from the sea if any, and air forces would provide defensive counter-air cover. Contributing to the security and survivability of an ashore ER site is the fleet's ability to establish it outside an enemy's WEZ or contested area. This security, enabled by mobility, is one of the primary advantages over-relying on fixed, forward SRFs. Given the complexity of modern systems and the military's reliance on contractors today,[34] safely and securely providing Reception, Staging, Onboarding, and Indoctrination to CAAF is essential.

A secure location ashore with an air facility enables the throughput of repair parts and personnel, the second advantage of ER ashore. An air facility that could receive repair parts by MV/CV-22 relieves the burden on a CVN, LHD, or LHA, if one is even nearby and available, improving operational flexibility. An even larger runway that could accommodate C-130 or C-

[33] Briefing, Naval Sea Systems Command, subject: Wartime Acquisition Support Plan – Shop in a Box Roundtable In brief, 17 February 2021.
[34]Chairman, U.S. Joint Chiefs of Staff, *Operational Contractor Support*, Joint Publication (JP) 4-10 (Washington, DC: CJCS, 4 March 2019), I-11

17 aircraft or contracted commercial jets further enhances the site's capability to receive FATs, a greater volume of repair parts, and heavier or larger components to the repair site. Another advantage of ashore ER sites is their flexibility. A site used for repair can simultaneously support other logistic functions, such as rearming, refueling, and resupplying the joint force.

The most significant operational advantage of ER ashore, though, is mobility. The expeditionary nature of a "repair EAB" means that all of its capabilities, mobile shops, CONEX boxes full of parts, and personnel can relocate relatively quickly. Either by moving to keep up with the fleet's advance further into contested territory, or further expanding into an advanced base, as Manus Island did during World War II while the joint force established other forward bases, the hallmark of ER ashore is mobility.

ER Afloat

For all its virtues, an ER ashore has one major limitation: it is ashore and, therefore, is limited by geography. An afloat ER capability offers even greater mobility and flexibility than ER ashore. While the US can likely turn the concept of ER ashore into a fielded capability faster, an ER capability afloat provides significant advantages in capacity, mobility, and flexibility to the fleet.

An ER afloat capacity would more closely resemble SERVRON Ten at Ulithi in 1944 than the Middle East in 1991 conducting repairs to the fleet in friendly shipyards in-theater. Damaged ships could be serviced by repair personnel from tenders in floating dry docks. At the same time, other ships moored alongside the tender could offload ammunition and refrigerated stores and receive temporary high- and low-pressure air and fresh water to conduct repairs on affected systems. Rescue ships would augment the ship’s force damage control efforts and

provide firefighting support, while ocean tugs would tow ships without propulsion to the safety of the afloat ER site.

Presently, limitations due to the number of available platforms present a barrier to an effective ER afloat capability. The Navy currently only has two floating dry-docks in Service, one in Groton, CT and one in San Diego, CA[35] both of which support RAs in CONUS. Floating dry-docks are not the only platform that is in short supply. The Navy currently only operates two Submarine Tenders (AS) with an intermediate-level capability.[36] Tenders' mobility and intermediate maintenance capability are ideally suited for ER, but their mobile maintenance/repair capability is limited with only two units. Another limited asset is Fleet Ocean Tugs (T-ATF). The Navy currently operates three Powhatan-class ATFs, capable of towing vessels not capable of making way on their own.[37] In the absence of this capability, the Navy could either task other vessels to tow damaged ships or arrange for towing services via a third-party contractor if one is available. The combined lack of platforms imposes a penalty for transit to a friendly SRF.

One advantage of ER afloat is the capacity for repairs. Tenders provide more substantial repair capabilities than a FAT from CONUS or an ER ashore site, both in terms of the number and skill of repair personnel onboard and its services as a floating IMA. Similarly, floating dry docks provide nearly the same capabilities as an SRF, particularly if they are combined with the repair capabilities of a tender or augmented by RA personnel from an ashore ER site, performing "C" or "D" level repairs to permit towing.

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[35] Commander, Submarine Force Pacific," SUBPAC Commands-Arco," accessed on 13 April 2021, https://www.csp.navy.mil/arco/

[36]U.S. Navy,"Hull Classification Symbols: AS" Naval Vessel Register, accessed on 14 April 2021, https://www.nvr.navy.mil/NVRSHIPS/HULL_SHIPS_BY_CATEGORY_AS_70.HTML

[37]U.S. Navy,"Hull Classification Symbols: AD, AR" Naval Vessel Register, accessed on 14 April 2021, https://www.nvr.navy.mil/NVRSHIPS/HULL_SHIPS_BY_CATEGORY_ATF_74.HTML

Another significant advantage of ER afloat is its mobility. Even more so than ER ashore, ER afloat can move with the fleet as SERVRON Ten did, keeping repair facilities reasonably close to where damage would occur. Like ER ashore, afloat ER units can mass where they are needed, providing just the right level of repair support to the fleet, where and when they are required. Mobility of afloat ER units also translates to security because the fleet can establish the afloat ER site outside the enemy's WEZ. Unlike both forward SRFs and ER ashore sites, they do not appear on a map, making enemy efforts to target them more difficult.

The mobility of ER afloat forces also enables a Commander's maneuver, that "movement of forces in relation to the enemy in order to gain a positional advantage."[38] Just as in World War II, if an ER site could repair damage in days instead of weeks or months,[39] and "B" level repairs are completed, restoring as many mission capabilities to as many ships as possible, forces in a theater can stay in the fight longer, without requiring reserves to backfill their losses or replacements to arrive from elsewhere.

Finally, the mobility of ER afloat forces enhances a fleet's operational reach by shortening lines of communication, especially if a ship has sustained damage to propulsion or sensors. After four kamikaze hits, it is unlikely that USS Newcomb could have made it to Ulithi, even under tow. SERVRON Ten's forward base at Kerama Retto, only 15 miles from Okinawa, extended Fifth Fleet's operational reach and restored nearly 20% of damaged ships on-scene, which saw action in the same conflict in which they sustained damage.[40]

Beyond operational mobility that enables maneuver and extends operational reach, afloat ER forces have another advantage over forward SRFs: their strategic mobility. Afloat units can

[38]Chairman, U.S. Joint Chiefs of Staff, *Joint Operations,* (incorporating change 1), Joint Publication (JP) 3-0 (Washington, DC: CJCS, 22 October 2018), A-2
[39]*ServRon 10-Floating Arsenal*", Popular Mechanics, Nov. 1945, 62
[40]John D. Keenan, *Observations on Ship Battle Damage Repair During PACEX-89,* 3

be moved around the world, providing Fleet Commanders in every theater with an ER capability, and supporting the Navy's global presence, enhancing material readiness wherever they are needed.

Because of these advantages, both varieties of ER offer advantages over the current reliance on RMCs and forward SRFs. ER ashore and afloat capabilities offer redundancy, reducing critical vulnerabilities and providing the fleet with the ability to conduct "B," "C," and "D" level repairs and to maximize every available platform's ability to contribute to the maritime fight. If given the opportunity to restore multiple platforms to PMC status, the Fleet Commander requires both the capability to link shooters to sensors, as demonstrated by the Naval Integrated Fire Control-Counter Air (NIFCCA) concept and a framework to match and employ those partial capabilities. A fleet or logistics task force commander would have to assess damage across the fleet and provide "triage," identifying those ships to receive priority of repair and which ships furnish repair parts, even if it resulted in their cannibalization.

Similarly, optimizing mission capabilities gained through ER requires the integration of NAVSEA, responsible for repairing the damaged ships, and the fleet, responsible for maximizing warfighting ability. A warship CO is authorized to issue an at-sea departure from specification (DFS) to ensure their ship's safety and combat effectiveness. However, this DFS expires upon arriving in a US-controlled port.[41] A Fleet Commander or logistics task force sub-commander requires the authority to adjudicate on the spot whether a CO's at-sea fix is "good enough" for continued operations, whether to direct the vessel to an ER site to receive intermediate-level repairs or if the damage is grave enough, to direct the ship to the nearest SRF for depot-level repairs to achieve maximum use of partial capabilities.

[41]U.S. Navy, *Joint Fleet Maintenance Manual*, COMUSFLTFORCOMINST 4790.3, vol. V, V-I-8-16

Both ER varieties provide the Fleet Commander with mobility that improves security, enhances maneuver, and extends operational reach. Each has limitations the other does not, such as geographic limitations for ashore ER sites, the requirement to provide defense for afloat ER sites, and the limits of afloat sites to receive parts and personnel carried in fixed-wing aircraft. The two capabilities are not mutually exclusive and are, in fact, complementary. The ideal ER site would consist of a floating dry dock, and tender moored in a port or lagoon outside the enemy's WEZ with CONEX boxes staged and a helipad or airstrip secured or built nearby. Such an ER site offers nearly every capability as a forward SRF while offering advantages in mobility and security.

Restoring the Fleet's Combat Power – Quo Vadis?

Why is regenerating combat power so difficult? The vulnerability of forward SRFs to TBMs is part of it. Limited US platforms such as Tenders and floating dry-docks is another, as is the tyranny of distance. All these factors combine to create both interactive and structural complexities. Faced with these challenges and others discussed in this section, regenerating combat power in a contested maritime environment is an ill-structured or "wicked" problem.

As the size of the fleet decreases, enemy capabilities to hold Forward SRFs at-risk increase, and the time-distance to rear-area SRFs remains constant, as does the certainty of eventual degradation of combat power, the importance of rapidly repairing ships to restore even partial mission capability is at a premium.

The multitude of challenges described above combines to form three overarching problem statements. First, combat forces are effectively irreplaceable in a contested theater. Second, without ER, damaged ships must transit great distances over a commensurate period,

meaning that combat power in a theater can only decrease. Third, combat power will degrade over time even with 100% defensive effectiveness or no enemy action at all.

A credible and robust ER capability addresses nearly every aspect of the problem's complexity. While it does not speed up construction timelines or shorten transit distances from CONUS, it provides a Fleet Commander with the best ability to maximize ready combat power. ER addresses the wicked problem at hand and offers operational advantages not found in the fleet today. The mobile repair capability gained through ER facilitates mass and maneuver, sustaining US forces in the fight for longer, allowing them to seize and hold the initiative. An ER capability is not an untested, theoretical capability. World War II demonstrated the value of ER in a maritime fight, and there is already a model for "what right looks like" with ER afloat. While additive manufacturing and the "Shop-in-a-box" are untested in combat, the capability to seize and secure ashore sites to enable ER was also demonstrated in World War II, as it was at Kerama Retto.

Recommendations

The Fleet cannot achieve a robust ER capability without action by national leadership, particularly regarding those measures involving doctrine, material, and personnel. The following recommendations range from the operational to the national-strategic levels. Each contributes to achieving ER as described above. Measures marked with an "*" are currently in progress.

- Capitalize on current initiatives to establish ER as a core capability and maximize participation from NAVSEA and OPNAV N4 in Fleet Exercises, Wargames to further

align the maintenance and repair enterprise with warfighting concepts, including concept development exercises such as those conducted at Manus[42] and Ulithi.[43]*

- Develop an integrated framework balancing comprehensive repair and operational needs to optimize partial capabilities to "triage" damaged ships, adjudicate DFSs closer to the fight in terms of both time and distance, and maximize the employment of partially mission-capable ships.

- Continue developing concepts that link sensors with shooters, such as Naval Integrated Fire Control - Counterair (NIFCCA), to maximize the use of damaged ships' partial mission capabilities. As ER restores mission capabilities, every ship's ability to contribute to scouting, command and control, defensive awareness, and offensive and defensive firepower improves a Fleet's relative combat power.

- Incorporate "Repair" into the TM for EABO as another variant of an EAB, as well as into Navy concepts, such as Distributed Maritime Operations and Joint doctrinal publications, including the adoption of a DoD-wide definition for "Expeditionary Repair."

- ER afloat cannot be accomplished without sufficient numbers of platforms. ER afloat requirements should be informed by a net assessment of current ER capabilities, with new construction guided by gaps identified by the net assessment. The FY-21 five-year shipbuilding plan already includes one Submarine Tender and three Rescue-Tugs.[44]* Rehabilitating platforms currently inactive or stricken could also mitigate the lack of platforms.[45]

- Adversaries' current and expected WEZ's in theaters inform which areas they may contest in the future. Investing in infrastructure projects such as surveying anchorages, dredging channels, improving or reinforcing piers, and building, widening, or lengthening airfields will enhance ER ashore sites when they are needed.

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[42]Tim Fish, "Australia, US Set to Expand Papua New Guinea Naval Base," US Naval Institute News, usni.*org*, 23 November 2018, accessed 10 April 2021, https://news.usni.org/2018/11/23/australia-u-s-set-expand-papa-new-guinea-naval-base

[43]Richard Miller, "USS Emory S. Land Visits Historically Significant Atoll In Ulithi" csp.navy.mil, 7 December 2019, accessed 10 April 2021, https://www.csp.navy.mil/Media/News-Admin/Article/2153510/uss-emory-s-land-visits-historically-significant-atoll-in-ulithi/

[44]Ronald O'Rourke, *Navy Force Structure and Shipbuilding Plans* (Washington, DC: Congressional Research Service, 2021), 12.

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