

Feature: Ford carrier faces redesign questions, gets positive deployment feedback

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Key points

- USN officials believe the design for aircraft carrier USS Gerald R Ford is making it easier to fix and modernise
- A potential requirement to alter Ford's launching system could lead to a new carrier design

UPDATED

Fixing and modernising aircraft carrier USS *Gerald R Ford* (CVN 78) is proving to be easier and more affordable than its Nimitz-class forebears, according to Rear Admiral Kavon Hakimzadeh, commander of Norfolk Naval Shipyard (NNSY), where the work is being done.



USS Gerald R Ford, shown here, arrived recently at Norfolk Naval Shipyard for maintenance and modernisation. (Janes/Michael Fabey)

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Rear Adm Hakimzadeh told *Janes* on 22 July that the Ford-class design had proven more durable and effective than expected during the ship's recent 11-month deployment.

The USN *Ford*-maintenance analysis comes in the wake of navy officials' positive assessment of *Ford*'s combat performance during its deployment, touted by the USN as the longest in the post-Vietnam War era. USN officials have said publicly through the first half of 2026 that *Ford*'s new

on-board systems have exceeded expectations in surpassing Nimitz-class operations.

In particular, navy officials have underscored the performance of the ship's Electromagnetic Aircraft Launch System (EMALS) catapult technology that uses linear induction motors, saying EMALS sortie rates outpace those of Nimitz-class carriers.

However, the ship's design and especially the introduction of EMALS may be jeopardising the future acquisition of Ford-class carriers because President Donald Trump wants the navy to switch back to steam-powered catapults. Trump has excoriated USN officials for relying heavily on electric systems to operate *Ford*, and has sought a redesign.

Speaking on 15 July at the Pennsylvania Defense and Innovation Summit, Trump turned to Secretary of Defense Pete Hegseth and said, “Pete, we're not letting any more ships be built with the ridiculous billions of dollars more they spent on electric catapults, and they're not good.” Trump added, “We're changing all of that. Right, Peter? You'll be fired so fast if you don't.” Some in the audience laughed.

The overall design of Ford-class carriers, to create a ship anchored by a new augmented electric-power infrastructure, built essentially for EMALS, likely means modifications to reintroduce steam-based catapults into carrier hulls would require extensive redesigns, according to defence analysts, industry sources, and USN officials familiar with the design and operations of the ships.

EMALS was part of total-ship effort to re-imagine the carrier for electric systems and remove the steam equipment and piping that took up space and weight — and required notable maintenance — aboard those vessels.

Steam catapults cannot be reinstalled into a ship with a new electric infrastructure that lacks any of the piping and other systems for steam, according to defence analysts and current and former USN and shipbuilding officials who are familiar with carrier construction programmes. Those officials also noted the key industry suppliers who provided steam catapult components no longer exist.

“They'd have to redesign the ship all over again,” Hudson Institute senior fellow Bryan Clark told *Janes*. “Even with the reactor, they'd have to redesign to accommodate for steam piping. They got rid of all the steam-powered stuff. It's all turned electric.”

Nonetheless, USN and carrier-builder HII officials have publicly discussed modifying Ford-class ships to address concerns raised by President Donald Trump about using electromagnetic catapults instead of the steam-based systems on Nimitz-class ships. The shipbuilding plan notes the navy is “reviewing the CVN 82 [*William J Clinton*] design baseline”.

HII officials have maintained publicly they will do what the USN wants the shipbuilder to do, although HII CEO Chris Kastner told investment analysts on 31 July that the navy had provided no direction on design changes.

Simplified launch

The newer USN carrier launching system may in some ways be a more simplified design, USN and industry officials familiar with carrier operations, as well as defence analysts, told *Janes*.

Ford was designed to sustain 12-hour daily sortie rates of 160 and daily surge rates of 270 over 24 hours, according to USN officials and public reports about the Ford-programme. Nimitz-class ships have demonstrated a 12-hour daily rate of 120 and 24-hour surge rates of 240.

During 2020 operational trials, *Ford* completed 167 sorties in a day, naval officials reported.



US Navy officials say the Ford catapult system is more efficient for launching aircraft, as shown here. (Janes/Michael Fabey)

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The latest US Navy Shipbuilding Plan, published in May 2026, noted that during its recent deployment, *Ford* executed 10,500 fixed-wing launch and recoveries and the ship completed its sustained sortie generation rate (SGR) demonstration.

“From a combat tactical performance, the Ford class is doing exactly as advertised, outpacing the Nimitz class in sortie [rates], [aircraft] rearming, refuelling, and turnaround time,” Rear Adm Hakimzadeh said.

USN officials said in January *Ford* sortie rates would be released “soon”. But on 24 July, the Naval Sea System Command (NAVSEA) told *Janes* those rates were still being analysed. NAVSEA also declined to provide any further details on possible Ford-class modifications to address launch-system concerns.



The EMALS system, shown here being installed on USS Gerald R Ford, is designed to launch aircraft more effectively. (Janes/Michael Fabey)

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EMALS has been more effective at launching aircraft than legacy catapults, and the design may have resolved some of the issues associated with steam systems, USN sources and defence analysts told *Janes* or noted in reports.

The basic design, for example, takes up less ship space and weight than traditional steam catapult machinery. EMALS requires 566.2 cubic m of space, about half of what's needed for legacy components. That is mostly due to the electric power needed to drive EMALS, which requires none of the hydraulic or pneumatic power systems and associated infrastructure. The EMALS design eliminated the need for cylinders, piston assemblies, and lubrication.

As RAND noted in its 2005 report, *Aircraft Carrier Fleet Accelerating CVN 21 Production Versus Mid-Life Refuelling*, an armature attached to the aircraft launch shuttle rides an electromagnetic wave generated by EMALS down the length of the catapult, controlled digitally to achieve the necessary speed, power, and distance.

A high peak-to-mean acceleration profile for steam-powered Nimitz-class catapults creates an initial shock to reach top speed before deceleration, placing high stresses upon the aircraft airframe, USN officials noted. An electromagnetic wave, however, is meant to provide a smoother acceleration profile, putting less stress on the airframe.

“The technology behind such a system is similar to that used on many modern amusement park roller coaster rides and on the Yamanashi Maglev Test Line, an urban transport system in Japan,” RAND reported.

EMALS features a linear-induction launch motor, prime power interface, a power conversion system, a launch control system, energy storage, and energy distribution system. Integrated into the flight deck, the motor converts electrical current into the electromagnetic wave to accelerate the aircraft. The motor is then reversed to stop the shuttle.

EMALS stores energy in generators, which are recharged from ship's power between launches. A power conversion system controls the electromagnetic wave, providing the appropriate voltage and current to drive the shuttle as needed, depending on flight conditions and the type of aircraft being launched.



Ford-class launching technology is meant to accommodate unmanned aircraft operations, such as for the MQ-25 shown here. (Janes/Michael Fabey)

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Ford's launch control system alerts operators to any failures or other issues, and Rear Adm Hakimzadeh said that EMALS is on track to help provide total ownership savings, which the USN estimates to be USD5 billion.

Part of those savings is due to other electrical-based designs built into *Ford*, which is the first carrier designed with all electric utilities, eliminating steam-service lines and reducing maintenance costs.

Rear Adm Hakimzadeh declined to discuss with *Janes* any issues regarding possible modifications or redesigns for the Ford-class carriers.

“Every time I deal with *Ford*, I become a bigger fan of the planning that took place decades ago,” Rear Adm Hakimzadeh said. “The design is more simplified,” he added. “Spaces are more accessible for workers. There are fewer valves in the system. Traditionally, where you'd have a three-four valve lineup, *Ford* does it with a single, more-robust valve.”

He underscored the benefits, from a maintenance viewpoint, of shifting away from systems based on steam and hydraulic engineering, toward systems that rely on more of an electric infrastructure. “This ship will spend less time in dry dock,” he said. “And we're already starting to realise the cost savings. We still expect that to multiply over the service life of the ship.”

Savings are important as it costs about USD1 billion each year to operate and sustain a carrier, Clark told *Janes*.

Electric carrier

Ford's electric backbone also made it possible for designers to string on the ship networks of sensors that had not existed previously on a carrier, making it possible to better monitor the health of ship-wide systems, and making it easier for maintainers to pinpoint where work is needed.

Rear Adm Hakimzadeh noted: “When *Ford* was being hooked up to my electrical distribution at Norfolk Naval Shipyard, that system observed and tracked hiccups in my electrical distribution system better than my existing systems could on the base. *Ford* sees anomalies at the pier [in the base system] better than what I have instrumented around the shipyard.”

At sea, *Ford* maintenance and systems resilience matched or surpassed that of Nimitz-class ships, as *Ford*-class carriers were designed to do, he said.

“The maintainability and durability of EMALS and the Advanced Arresting Gear (AAG) – once we got the systems online in the hands of sailors, the results were what were expected in the design days,” Rear Adm Hakimzadeh said.

When it comes to maintaining *Ford*-class ships, the navy requires fewer sailors for the work. By eliminating the hydraulic, steam-powered systems to launch and recover aircraft or to move weapons through the ship, designers also whittled away teams of mechanics needed to maintain those systems.

Ford reactors

The *Ford* class's two A1B pressurised water nuclear reactors generate about three times the ship service electrical power of the Nimitz class because of higher core energy density and “lower demands for pumping power”, RAND noted in the 2005 report. The A1B attributes have been confirmed in several USN budget requests as well as defence analysts reports, including the April 2019 Congressional Research Service report *Navy Ford (CVN 78) Class Aircraft Carrier Programme: Background and Issues for Congress*.

The new reactor is a simpler system with fewer components and half the number of valves, major pumps, condensers, generators, and piping needed for Nimitz-class reactors. The system is easier to maintain with fewer people and takes up less space on the ship, according to USN officials, documents, and those operating both classes of ships. With modern electronic controls and displays, the new reactor requires fewer watch stations.

Such changes cut propulsion-related manpower by about half, and decreased depot-level maintenance needs by a fifth, according to USN estimates at the inception of the programme.

The new reactor system made it possible to install a new zonal electrical distribution system in *Ford*-class ships. Nimitz-class carriers use a radial architecture that distributes ship-wide power through 41.9 km of distribution cable from the central ring bus of the system to the ship's various emergency power and load centres.

Ford's zonal distribution system eliminates about 10 km of electrical cable by concentrating various load centres in segregated zones on the ship, making it easier to modernise the system and

reconfigure it after battle damage, RAND said.

Rear Adm Hakimzadeh noted that *Ford* was able re-engage with fleet operations after a five-day emergency repair period following an on-board fire during its recent deployment.

Ford also includes overall design changes intended to create more deck plate space for aircraft operations, such as relocating the ship island and elevators to move aircraft or weapons and refuel aircraft.

In his speech at the Pennsylvania Defense and Innovation Summit, Trump said, “They have it [the ship island] in the back instead of in the middle. It's supposed to be in the middle where you have more room.”

The Ford-class deck design is meant to improve aircraft handling, storage, and flow, while the relocated smaller island farther aft is to make it possible to increase aircraft operations.

The smaller island is also designed to help resolve a centre-of-gravity issue on Nimitz-class ships, according to USN and HII officials involved in the Ford-building programme. To further address that problem, *Ford* utilises three aircraft elevators and two hangar bays compared to four aircraft elevators and three hangar bays on the Nimitz class.



The smaller and relocated USS Gerald R Ford island, shown here, created more deck space for aircraft operations. (Janes/Michael Fabey)

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As RAND also reported, the Nimitz class's weapon-handling systems and flight deck were designed with tactical nuclear weapons in mind and are optimised neither for high rates of sortie generation nor future smart weapons.

In his speech, Trump questioned weapons-storage locations, saying, “They have the ammunition under the tower. I say, if I'm the enemy, I know where I'm aiming.”

“Weapons-handling paths on Nimitz-class ships were designed for the potential nuclear missions of the Cold War,” RAND said. “The current flow of weapons from storage areas in the interior of the ship to loading on aircraft involves several horizontal and vertical movements to various staging and build-up locations. These movements around the ship are time-consuming and manpower-intensive and typically involve sailors manually moving weapons loaded on carts. Also, the current locations of some of the weapons elevators conflict with the flow of aircraft on the flight deck, slowing down the generation of sorties or making some elevators unusable during flight operations.”

Ford's redesign eliminated horizontal weapons movements within the ship and relocated the elevators from storage areas to dedicated weapons-handling areas. The Advanced Weapons Elevators (AWEs) use linear motors instead of hydraulics for faster lifts of higher load weights.

The new catapult system made it possible to redesign the launching laydown and increase sortie rates on *Ford's* larger flight deck. Flight deck teams on Nimitz-class ships cannot use Catapult 4 to launch fully loaded aircraft because of wing clearance along the edge of the flight deck, according to USN officials, which is no longer the case on *Ford*.

Nimitz maintenance

In his speech, Trump said a navy seaman told him about the catapults: “Steam is better, sir. We can fix it with a hammer and a blowtorch. When the electric goes bad, I have to send to MIT to get geniuses over here,” the president said.

Nimitz-class steam catapults have also been a maintenance challenge for decades.

For catapults, arresting gear, and other key systems, it became impossible during the 1990s to replace some parts on Nimitz-class ships, USN officials said. Maintainers had to find ways to fix the equipment without replacement parts or develop work-arounds, those officials said.

Nimitz-class carrier C-13 Mod 1 or 2 catapults are based on a British design founded on technology dating to 1950. The steam-powered, direct-drive, flush-deck system is made up of distributed subsystems reliant on complete system operability for each launch, according to USN catapult operators who described operations.

On the flight deck, a shuttle on a roller-mounted sled is hooked through an aircraft tow bar to a spreader connected to a shuttle attached to a steam-driven spear-shaped piston in one of the two side-by-side rows of slotted cylinders in a trough under the flight deck. A Bridle Tensioning System ensures aircraft are secured properly to the shuttle.

The steam pressure to operate that catapult is piped through the ship from the carrier's engineering spaces into accumulators, large tanks beneath the launching engines that store high-pressure water and saturated steam.

When needed to unleash the instant energy to launch an aircraft, that steam is piped to receivers through flow-control valves and then transferred to the power cylinders to drive the pistons and propel the shuttles. Sealing strips on the cylinder slots where pistons are forced forward prevent

steam from escaping.

Catapult operators preheat the cylinders to minimise the potential damage to the launching engine from the superheated steam. The steam-supply pipes also are warmed before launch operations.

Two 1.8-m cylinder water brakes at the forward end of the catapult stop the steam-driven pistons from smacking into the bow hull of the ship. The tips of the piston spears ram into brake cylinders, building pressure and stopping the piston-and-shuttle assembly instantly.

Another rotary retraction engine system retracts the shuttle and the launching engine pistons after the catapult has been fired.

The whole catapult launching system also relies on hydraulic and lubrication systems and is controlled by a series of panels, lights, and switches used to operate the catapult throughout the various sequential operational phases.

Sailors aboard USS *Nimitz* (CVN 68) during 24-25 June interviews emphasised to *Janes* how difficult it is to maintain those systems. *Janes* spoke with them as *Nimitz* travelled north along the US East Coast following its Southern Command (SOUTHCOM) operations.

Nimitz maintainers told *Janes* the catapults require round-the-clock work to keep them operational. Still, legacy carriers such as USS *Dwight D Eisenhower* (CVN 69) have proven effective for aircraft operations in recent missions in the Red Sea and other conflicts in that region.

As noted by RAND, a single *Nimitz*-class carrier catapult can launch an aircraft once every 60 seconds. The class's four catapults operating together can launch an aircraft once every 20 seconds. However, RAND also noted disadvantages that could curtail future fleet operations for carriers with steam-powered catapults, including a maximum aircraft-launching weight of about 31,751.5 kg.

“In addition to the limitation on the weight of the aircraft at launch, the peak-to-mean ratio of the force applied by the catapult increases at lower energy levels. Thus, lighter aircraft are more difficult to launch,” RAND reported.

As noted in the May Shipbuilding Plan, *Ford* provides an “expanded launch/recovery envelope purpose-built to integrate heavier 6th-generation manned or unmanned platforms and lighter-weight unmanned collaborative combat aircraft”.

More generally, though, catapult operators and maintainers told *Janes*, the entire complex system must operate smoothly – any drop in hydraulic pressure or a suspected water system leak can lead to a cancelled launch. Sometimes, there are ‘hangfires’, when there's been a signal to launch and the fire button's been pressed, but launch valves don't open.



Sailors aboard USS Nimitz say it's difficult to maintain the ship's catapault machinery, shown here.
(Janes/Michael Fabey)

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Aviation Boatswain's Mate - Equipment (ABE3) Austin Aldridge underscored the difficulties to *Janes* in simply keeping the catapaults in an 'up' or working status. "Things just get out of adjustment," he said. "There are hydraulic or steam leaks, or lube oil leaks."

One of the most laborious jobs is to "rev" a catapault – where sailors take an old wire and connect a new wire, ABE3 Aldridge said. "It's time-consuming."

An equally time-consuming task is the nightly maintenance performed by sailors on the catapaults, according to ABE3 Maynard Manalo, with the work taking all night. The maintainers must manually vent the system, to force out all air. The sailors must 'free up' the water brakes.

The arresting engine under the flight deck circulates 172.4 kg of hydraulic fluid at a pressure of 10,000 PSI (690 Bar) to operate a hydraulic ram. The engine and associated Mark 7 machinery require constant care, according to the maintainers.

Sailors need to ensure the arresting wires maintain the proper tension for the tailhook stop of an aircraft landing on a carrier, ABE2 Porsha Randle said. That means making sure the wires are good, the engines are working properly, and there are no cylinder leaks.

There are special jobs, like repacking a cylinder used by arresting gears to stop the aircraft by pushing a large ram through a tube of hydraulic fluid.

ABE2 Randle noted, "Cylinders will leak. You've got to test all fluid and jack the cylinder all the way in or out," detaching the cylinder and jacking out the internal piston. Sailors repack it with new seals, stripping down and removing the components to rebuild it to create a new seal to withstand 1,600 PSI (110 Bar), she said.

Aviation Structural Mechanic (AM) 1st Class Brian Mease told *Janes* he must constantly inspect the arresting gears. “I’m looking for cracks,” he said, because a crack in critical components could lead to snapped landing wire and a possible aircraft mishap.

“You can see where the manpower savings are” for the new carrier design, Rear Adm Hakimzadeh said.

Nimitz-class ships have proven problematic to maintain, according to USN officials and defence analysts, and this prompted the redesign decades ago of carriers under what was then called the CVN 21 project that morphed into the Ford-class ships.

“A Nimitz-class aircraft carrier spends considerable time in the shipyard — one-third of its life, from commissioning to decommissioning,” RAND noted in its 2005 report.

After *Nimitz* commissioned into the fleet in 1975, it proved to be more durable than the first US CVN – USS *Enterprise* (CVN 65). Based on its experience with *Enterprise*, the navy had planned for *Nimitz* to have a total operational life of about 30 years, consisting of two 13-year operational periods split by midlife overhaul set to last about three years.

The USN discovered, though, that the new Nimitz-class reactor design core life could be extended to as much as 23 years, RAND reported. The service then planned for a total *Nimitz* lifespan of 49 years – two 23-year operational periods separated by the three-year overhaul.

Nimitz has, as of this writing, been in service for 51 years – and the class has remained mostly the same during that time. Except for a ship-wide fibre-optic system for Nimitz-class carriers after USS *Harry S Truman* (CVN 75), and a bulbous bow for ships after USS *Ronald Reagan* (CVN 76), the basic carrier hull, mechanical, and electrical (HM&E) design has remained unchanged since *Nimitz* entered the fleet.

There are no topside margins for change, RAND noted. Any additions that increase topside weight will disrupt the operational centre of gravity. “The biggest problems facing the Nimitz class are the limited electrical power generation capability and the upgrade-driven increase in ship weight and erosion of the centre of gravity margin needed to maintain ship stability,” RAND noted. “These limitations constrain the ability to incorporate many new technological advances, especially those that require additional electrical power or add weight to the ship.”

Nimitz electricians and machinists noted the issues of dealing with the old and legacy systems aboard the ship. Electrician Mate 1st Class Carl Dillahunty said, “We have motors from the 1970s. And the supply chain isn’t really good.” The biggest challenge is often “to keep everything running”, he said.

Electrician Mate 3rd Class Neiva Robles noted to *Janes* that it’s common to replace ageing wiring in *Nimitz*, especially for air-conditioning plants and pumps. It’s often a matter of determining what the priority repairs are.

“A lot of [*Nimitz*] drawings are outdated,” ship Hull Technician 2nd Class Frank Walker told *Janes*, adding sailors often must reverse-engineer schematics to solve issues. Chief Machinist Mate

Tyler Seitz told *Janes* there are issues due to the ship's age. "Parts are no longer available. They don't make them anymore."

He cited refrigeration plants as an example, adding, "There's a lot of retrofitting on this boat. We have to go to the 'ghost fleet' [of decommissioned ships] and bring that equipment back."

Anchored by a duo of Westinghouse A4W nuclear reactors, the Nimitz-class electrical power grid is described by RAND as a "very large, complex system" with "pipes of more than 30 sizes, more than 1,200 valves, and more than 20 major pumps".

RAND reported about Nimitz-class carriers: "Because of the 60-plus watch stations manned when the ship is under way, significant manpower requirements accrue to the reactor room."



Much of piping in Nimitz-class ships, like that shown here, has been removed from Ford-class carriers. (Janes/Michael Fabey)

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Redesigning a carrier for steam would mean the USN could again have to face the issues the service needed to resolve with the Nimitz class – costlier maintenance, parts, and equipment shortages, centre-of-gravity concerns, and greater difficulties in operating unmanned aircraft, said Clark. "There's no logical basis for this [wanting to return to steam catapults], given how EMALS has performed [during the recent deployment]," he said.

Ford availability

For now, though, USN officials are focused on fixing *Ford* after its extended time at sea.

As navy officials extended *Ford's* deployment beyond what Nimitz carriers had done, there was an expectation that some of the new, unproved systems might fail or that the ship would be much worse for wear, Rear Adm Hakimzadeh noted.

"But nothing shut down in the middle of combat," he said. "We stress-tested that system in high seas and high levels of combat generation in multiple theatres for multiple months. It came through

for us – better than Nimitz[-class ships].”

He added, “The thing that jumps out at me is how well the ship's material condition held up. After 11 months of deployment, we had expected it to be pretty beat up. But *Gerald R Ford* showed up at Norfolk Naval Shipyard two weeks ago and many of her spaces are inspection ready now.”

In mid-August, *Ford* will be starting its regularly scheduled planned incremental availability (PIA) – a general maintenance and modernisation period that most USN ships undergo following a lengthy deployment.

The PIA work package is to include scheduled inspections and replacement of some physical plant equipment, modernisation of the electrical distribution system, and a technical refresh of aircraft launch-and-recovery equipment.

“Simultaneously, there will be another [availability] – for emergent work for fire damage,” Rear Adm Hakimzadeh told *Janes*.

US Naval Forces Central Command on 12 March confirmed that *Ford* had experienced a fire that day, which had originated in the ship's main laundry spaces while the carrier was operating in the Red Sea in support of Operation ‘Epic Fury.’

At that time, Norfolk Naval Shipyard sent an emergency repair team to board the ship at Naval Support Activity Souda Bay on the Greek island of Crete. Now more permanent repairs will be made to address the damage.

“There are 80 spaces affected from minor smoke [damage],” Rear Adm Hakimzadeh said. “Fourteen spaces require intensive overhaul,” he said, citing electrical and ventilation work in the laundry, crew berthing spaces, and restrooms.

The shipyard team has done advance work on the carrier while it was at Naval Station Norfolk. The shipyard commander said he expects to keep to schedule for the carrier availabilities, saying, “We anticipate the work will be completed and *Ford* will be redelivered to fleet in early 2027.”

[Special report: Nimitz aircraft launches and recoveries depend on maintainers](#)

[HII cites aircraft carrier milestones as US Navy notes delays](#)

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[Despite extended operational deployments, carrier Ford faces additional testing](#)

Comment

USN fleet operations are built around the carrier strike group (CSG) concept, so any major redesign of the Ford-class ships and resulting carrier-building hiatus could have a major impact on the entire navy deployment concept of operations.

This is especially true given the ageing Nimitz-class fleet. The ageing ships also face finite reactor-core lives, which constrain retirement and refuelling decisions