Microsoft declares its underwater data center test was a success

Enlarge / The *Northern Isles*, a 12-rack / 864-server underwater data center pod, is winched off the seafloor in this picture after its two-year trial deployment.

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Microsoft retrieved a 40-foot-long, 12-rack, self-contained underwater data center from its seafloor home offshore from the Orkney Islands earlier this summer.

The retrieval of the *Northern Isles* began the final phase of Microsoft's Project Natick research initiative, exploring the concept of deploying sealed server pods just offshore major population centers as a replacement for traditional onshore data centers.

Why put servers underwater?

- On the day of its 2018 deployment, the *Northern Isles* sported a gleaming white paint job with colorful Microsoft logo. Two years underwater isn't kind to that sort of thing, though…
  Scott Eklund
- Take it from a former sailor—things don't stay pretty for long when submerged, especially when left unmoving

on the ocean floor.
Jonathan Banks

- A thorough power-washing reveals the gleaming original surface of the *Northern Isles*. In production, we suspect any additional cost for a colorful logo won't be considered worthwhile.
Jonathan Banks

Project Natick has been underway for several years; we covered the two-month trial deployment of *Leona Philpot*, the company's first underwater server pod, in 2016, and the deployment of the newly retrieved Orkney Isles pod in 2018.

The potential disadvantage of sealed underwater "data centers" is obvious—they must be extremely reliable, since they can't be serviced on a regular basis. There is a somewhat less intuitive, counterbalancing advantage, of course—they don't have any pesky humans wandering around inside them, potentially dislodging cables, unplugging things, or otherwise injecting chaos.

There are more advantages to these miniature underwater data centers. Seafloor-based pods don't require expensive commercial real estate, and they get nearly free cooling from the surrounding tons of seawater.

The logistic advantage may be even more important than the cooling or immediate financial one. It takes significant time and specialized effort to acquire and develop commercial real estate for a traditional data center in a major city—building a sealed pod and deploying it on the seafloor nearby should be considerably simpler and faster.

Retrieving the *Northern Isles*

- The *Northern Isles* was towed back to dock partially submerged, carried between the beams of a gantry barge.

Jonathan Banks

- Naval Group and Microsoft technicians remove the endcap from the *Northern Isles* for inspection after it's back on dry land.
- Quarters were pretty cramped on the old "Usetafish" ballistic missile submarines I serviced while in the Navy—but not *this* cramped.
  Jonathan Banks

The *Northern Isles* underwater data center pod was built by Naval Group (a defense and renewable marine energy contractor) and is locally supported by Green Marine, an Orkney Island-based marine engineering and operations firm. It spent two years beneath the water at the European Marine Energy Centre, where tidal currents peak at 9mph and storm waves reach 60 feet or more.

Both deployment and retrieval of the *Northern Isles* needed particularly calm weather and a full day of careful work involving robots and winches between the pontoons of a gantry barge. In the course of the pod's two years underwater, it acquired a coating of algae and barnacles, as well as cantaloupe-sized sea anemones colonizing sheltered nooks in its base.

Analyzing the results

Enlarge / The entire 12-rack, 864-server data center is slid from the hull of the *Northern Isles* as a unit, after preliminary *in situ* analysis.
Jonathan Banks

Before sliding the 12-rack, 864-server data center unit out of the pod's hull, Microsoft's researchers took internal air samples from the still-sealed pod for analysis in Redmond. "We left it filled with dry nitrogen, so the environment is pretty benign in there," Microsoft Special Projects researcher Spencer Fowers said. Analysis of the air after the two-year deployment will give the team additional information about cable and other equipment outgassing.

The servers deployed aboard the *Northern Isles* failed at a rate approximately one-eighth what experts would expect from the same servers in a traditional, human-serviced data center over the same period. Microsoft's team hypothesizes that this is partly due to the sealed, inert nitrogen atmosphere the pod was pressurized with before deployment.

Without any oxygen for human technicians to breathe or excessive humidity for their comfort, there are fewer

opportunities for chemical corruption of components. Lack of bumping and jostling by those same human operators likely also contributed to the servers' unusually low failure rate.

Sustainability and efficiency

Enlarge / Windmills like this one provide 100 percent of the electricity grid which services residents of the Orkney Islands—a cable from that grid also supplied power to the *Northern Isles*, in addition to tidal turbines and wave energy converters.
Scott Eklund

The successful two-year deployment of the *Northern Isles* demonstrates the feasibility of greener, more sustainable power initiatives for data centers, above and beyond the efficiency of cooling the data center itself.

One reason the Project Natick team deployed the *Northern Isles* to the Orkney Islands is because its grid is supplied 100 percent by wind, solar, and experimental green technologies under development at the European Marine Energy Centre itself. "We have been able to run really well on what most land-based

data centers consider an unreliable grid," Fowers said.

Ben Cutler, a project manager for Project Natick, believes that co-located offshore wind farms could viably power production deployments similar to the *Northern Isles*. Even light wind conditions would likely be enough to power the pods, with a shore powerline bundled in with the pod's fiber-optic data cabling as a last resort. Cutler also notes that the seawater cooling for such deployments isn't just cheaper than traditional cooling—it leaves freshwater resources vital to humans and wildlife untapped.

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