



Carnival Corporation and Global Maritime Partners Complete Simulator Tests Shaping the Future of Navigation

Bridge-simulator tests brought together ports, hydrographic offices, pilots and mariners to help define how next-generation IHO S-100 navigation data will be used at the helm of navigation's next era

Video of the IHO S-100 Test Bed and Sea Trial in Confined Waters can be viewed and downloaded [here](#).

ALMERE, Netherlands (April 20, 2026) – As the maritime industry prepares for the next generation of digital navigation, [Carnival Corporation & plc](#) (NYSE/LSE: CCL; NYSE: CUK), through its Center for Simulator Maritime Training (CSMART), has completed a series of bridge simulator tests evaluating S-100 navigational data in collaboration with international hydrographic offices and industry partners under the International Hydrographic Organization's (IHO) S-100 Test Bed and Sea Trial in Confined Waters. S-100 is a new digital framework developed by the IHO to deliver richer, real-time maritime data for more precise and efficient navigation in complex port environments.

The simulator tests brought together ports, marine pilots, shipboard captains and deck officers, shore-based marine managers, maritime technology providers, and national hydrographic offices from the United Kingdom, the Netherlands, Australia and New Zealand to evaluate S-100 navigational data in confined-water environments. The S-100 in confined waters initiative was recognized as an official IHO Test Bed and Sea Trial, and captured user feedback to support the continued evolution of S-100 standards.

Developed within the IHO S-100 framework using data produced by national hydrographic offices and other industry partners, S-100 integrates multiple types of safety-critical maritime information – including electronic charts, port data and real-time marine conditions such as water levels, tides and currents – into a unified navigational environment displayed on a ship's Electronic Chart Display Information System (ECDIS). By giving mariners a more complete and dynamic picture of their surroundings as they are operating in real time, S-100 data will significantly improve situational awareness, leading to more informed decision-making, which will be particularly powerful to operating safely and efficiently in complex and confined waters where operational margins are small.

“S-100 has the potential to change how ships are navigated, and its full value comes to life when mariners feel confident using it,” said Mark Jackson, managing director, CSMART. “A world-class training environment like ours is the ideal proving ground. By testing S-100 in the simulator first, we can explore how crews interact with the new data to understand what feels intuitive and where training will help support a smooth, practical transition to real-world adoption.”

Evaluating S-100 in Real-World Simulator Conditions

The simulator trials replicated navigation scenarios from four ports, with different operational complexity: the Port of Rotterdam, Netherlands; Port of Napier, New Zealand; Port of Melbourne, Australia and Port of Southampton, United Kingdom. The S-100 test data sets were produced by the national hydrographic offices of Australia, Netherlands, New Zealand and United Kingdom as well as by the Port of Rotterdam, the Australian Maritime Safety Authority (AMSA) and OMC International.

Participants conducted repeated port approaches, transits and departures while using bridge simulators equipped with two S-100 capable ECDIS systems provided by Teledyne and OSI Maritime Systems and two Portable Pilot Units provided by QPS and SEAIq Pilot. All the four systems were connected to two Wartsila Full Mission Bridge simulators.

During the simulations, mariners actively switched between different S-100 data layers, using datasets developed through the IHO Test Bed by participating national hydrographic offices, while maneuvering through simulated port scenarios with tight operational margins. These layers provided detailed information such as three-dimensional seabed representation, changing tidal heights, currents' strength and direction, and under keel clearance management overlays, allowing users to integrate this additional information into planning and conduct of the pilotage.

The simulator environment enabled direct collaboration among end users, data producers and system developers, allowing immediate feedback on data resolution, accuracy, coverage and usability. This approach proved critical to identifying how S-100 products can be optimized for specific port operations without overwhelming the navigator.

“The strength of this test bed and sea trial was the collaboration between CSMART, national hydrographic offices, ports, pilots and technology providers,” said Antonio Di Lieto, senior manager, simulation studies, CSMART. “Having pilots, ship officers, ship managers, hydrographic offices, port authorities and technology providers working together in the simulator made it possible to look at S-100 from multiple perspectives and feed that insight directly back into IHO standards development, ECDIS design and future training needs.”

Understanding S-100 and Its Role in Safer Navigation

S-100 represents a significant shift in how navigation data is created, shared and used. Rather than relying solely on static chart information, S-100 enables multiple, dynamic data sources to be layered together, helping mariners better understand changing conditions that directly affect vessel maneuverability in real-time as they are operating.

Thomas Mellor, Head of Technical Partnerships, UK Hydrographic Office added: “These trials are an important step in moving S-100 from concept into operational understanding. By testing the data in realistic bridge scenarios, we’re able to see not just what S-100 can do, but how it is actually experienced by mariners navigating in confined waters.

By bringing in experienced pilots from ports such as Southampton and London, we were able to ground the simulations in real operational knowledge. Their insight was invaluable in demonstrating how S-100 data could be applied in practice, helping to shape how it is implemented in a way that is both usable and relevant for those on the bridge.”

The outcomes from the simulator test bed and sea trial will be consolidated into a technical report to support ongoing standards development and future training considerations. The results will continue to inform collaboration across ports, hydrographic offices and industry partners, with further engagement planned at forums including the International Harbour Masters Association (IHMA) Congress later this year.

This IHO S-100 Test Bed and Sea Trial in Confined Waters was delivered through close collaboration among Carnival Corporation and CSMART; the United Kingdom Hydrographic Office; the Netherlands Hydrographic Office; the Australian Hydrographic Office; the Australian Maritime Safety Authority (AMSA); Land Information New Zealand; the Port of Rotterdam; the Port of Napier; Port Phillip Sea Pilots (Melbourne); Loodswezen (Rotterdam Pilots); the United Kingdom Maritime Pilots Association; and maritime technology partners including Wärtsilä Voyage Simulation, Teledyne, Raymarine Commercial, SevenCs, OMC International, OSI Maritime Systems, QPS and SEAIq Pilot.

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About the Australian Hydrographic Office

The Australian Hydrographic Office (AHO) is part of the Department of Defence and it is responsible for the provision of nautical charting and associated services in support of maritime safety.

The AHO has supporting arrangements in place to provide hydrographic services to other countries namely, Papua New Guinea and Solomon Islands.

For more information, please visit: [Australian Hydrographic Office](#)

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About Land Information New Zealand

Toitū Te Whenua Land Information New Zealand is the Hydrographic Authority responsible for producing hydrographic data and nautical charts covering New Zealand's area of responsibility. This includes the coastal waters around New Zealand, and parts of both Antarctica and the south-west Pacific.

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About The Netherlands Hydrographic Office

The Netherlands Hydrographic Office, part of the Royal Netherlands Navy, fulfills the state obligation under SOLAS to supply shipping with the information necessary for safe navigation.

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About the United Kingdom Hydrographic Office

The UK Hydrographic Office (UKHO) is a world-leading centre for hydrography, delivering trusted data and expertise that underpin the safety, security and prosperity of our oceans.

Working with partners worldwide, we collect, process and share marine geospatial data that provides a richer understanding of our oceans, coasts and approaches. This insight supports safe navigation, maritime trade, environmental stewardship and national security.

For more information, please visit: <https://www.admiralty.co.uk/>
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Quotes from Participating Organizations

The following statements were provided by organizations participating in the international S-100 testbed initiative. Quotes reflect individual perspectives on the value of collaboration, testing and operational application of S-100.

“Confined waters are where the stakes are highest — ports, harbour approaches, narrow channels. These are the environments where the richness of S-100 data really matters, and where hydrographic offices and ports have to step up. Our role is not just producing accurate data, but producing it at the right resolution, in the right formats, and keeping it current. In confined waters, there's no margin for error — and that's exactly where hydrographic offices and Port Hydrographers have to deliver their best work. S-100 raises the bar for everyone,” noted **Adam Greenland, New Zealand National Hydrographer**.

“S-100 products used in confined waters require high accuracy and timely data. To meet these expectations, port authorities and other key stakeholders must reassess how they collect, manage, and maintain their data so it can effectively support both S-100 implementation and broader e-Navigation objectives,” claims **Alvaro Sanchez, Director National Charting, Australian Hydrographic Office**. “Testbeds and sea trials have shown what is possible when interoperable S-100 products are available. They have also highlighted the critical importance of high-quality data and the need for an internationally agreed dissemination framework that enables real time or near real time distribution.”

“The international testbed is critical at this stage of S-100,” said **Herman Schouten van der Velden, head of publications, Netherlands Hydrographic Service (NLHO)**. “It allows us, in a controlled and safe environment, to check whether our procedures, data and products are truly aligned – and to get direct feedback from end users so we can improve.”

“Testing S-100 with real-world users is essential. Hearing directly from captains and pilots shows us how dynamic data – like water levels and surface currents – can transform confidence and maneuverability in confined waterways,” explained **Tom Mellor, head of technical partnerships, UK Hydrographic Office**.

Matt Garland, technical relationship manager, UK Hydrographic Office, added, “Putting S-100 data in front of pilots and navigators for the first time has been invaluable. Their feedback shows how much additional navigable space and confidence these datasets can unlock.”

“S-100 is closely linked to the concept of e-Navigation. It will improve safety of navigation and strongly support port operations, but it also challenges us to present complex, dynamic data in a way that remains clear for mariners,” explained **Natalie Leiding, engineer, SHOM; vice chair, IHO Committee on Standards and Services**.

“S-100 represents the next evolution of maritime safety. By testing these systems through simulation, we can analyze, refine and get it right – before it's applied in real-world operations,” **Mark Jackson, managing director, CSMART** discussed.

“S-100 will not only enhance safety through higher-resolution data, but also create operational opportunities by allowing ships to better understand and quantify safety margins during port maneuvers,” said **Antonio Di Lieto, senior manager, simulation studies, CSMART**.

“Bringing all stakeholders together – pilots, captains, operators, manufacturers and hydrographic offices – creates alignment that I've rarely seen in my career,” said **Richard Boydon, director of marine operations, Princess Cruises**. “That collaboration is what will ensure S-100 succeeds.”

Paolo Ravera, captain, Princess Cruises says, “What S-100 gives us is confidence. The visual representation of safe water and hazards makes it much clearer where the ship can operate, which improves planning, execution and decision-making in confined waters.”

“S-100 is the future of navigation,” replied **Andrea Spinardi, captain, Princess Cruises**. “Having more accurate, live information – about depth, currents and port infrastructure – will further enhance our already-safe navigation practices and support even better decision-making for mariners.”

“What makes this testbed unique is that the entire chain is here – ports, hydrographic offices, pilots and end users,” said **Ben van Scherpenzeel, director, nautical development policy & plans, Port of Rotterdam**. “That interaction is priceless, because you only see what really works when you test it operationally together.”

“The biggest advantage of S-100 is that all the information comes together in one picture,” explained **Stephan Grol, pilot, Port of Rotterdam**. “Instead of searching across multiple systems, pilots can work with layered data that gives a clearer, more accurate view of the waters we’re navigating.”

“This is a revolutionary step for the industry,” added **Robbie Jensen, marine manager and senior pilot, Port of Napier**. “S-100 gives captains and pilots access to high-detail information that builds confidence, opens up navigable space and fundamentally changes how we operate in confined waters.”

“S-100 helps build a shared mental model on the bridge,” said **Damian Laughlin, marine pilot and director, Port Phillip Sea Pilots**. “That shared understanding between pilots and bridge teams is absolutely critical for safe execution in confined waters.”

According to **Chris Hoyle, chair, UK Maritime Pilots’ Association; pilot, Southampton**, “Using layered S-100 data gives pilots and bridge teams a clearer understanding of usable and unusable water space, particularly in emergency or contingency situations where margins matter most.”

According to **Nikita Kadrov, head of product, Wärtsilä Simulation**, “S-100 brings us closer than ever to real-world situational awareness through electronic charts. It improves safety and efficiency, but it also requires strong collaboration across data, tools and training to fully realize its potential.”

“Consistency is critical. Mariners need confidence that S-100 data is produced and displayed the same way across regions, otherwise trust in the system can be lost before it even reaches full adoption,” explained **Andy Murray, director of navigation solutions, Raymarine Commercial**.

“The real benefit of S-100 is helping mariners make sense of an increasingly complex set of data – so they understand not just the information itself, but also its limitations when making operational decisions,” said **Giles Lesser, New Zealand business development manager, OMC International**.

“As a long-standing provider of IMO-certified WECDIS, OSI Maritime Systems is proud to have contributed to the development of S-100,” said **Jim Girard, President and CEO, OSI Maritime Systems**. “S-100 represents a major advancement for tactical navigation, building on the proven foundation of ECPINS and our industry-leading charting engine to enable richer data integration, greater interoperability, and enhanced operational effectiveness.”