The Greening of R/V Sikuliaq

Shrinking a Ship's Environmental Footprint

Ship Particulars

R/V Sikuliaq Timeline

1973 Scientists submitted the first proposal for an Arctic region research vessel.

2009 National Science Foundation announced funding for construction of the Alaska Region Research Vessel and awards project to University of Alaska Fairbanks. Construction of the ship began.

2010 University of Alaska Fairbanks renamed the Alaska Region Research Vessel the Research Vessel Sikuliaq.

2011 Keel laying ceremony held at shipyard.

2012 Sikuliaq was christened and launched.

June 2014 Marinette Marine Corp. delivered Sikuliaq to University of Alaska Fairbanks, signaling the completion of the major construction phase.

November 2014 Sikuliaq embarked on its first science cruise in the South Pacific Ocean.

February 2015 Sikuliaq arrived in Alaska waters for the first time, Ketchikan served as the ship's first Alaska port.

March 2015 Commissioning ceremony in home port of Seward, Alaska.

Characteristics	Sikuliaq
Overall Length	261 feet
Draft	18.9 feet
Beam	52 feet
Performance	
Cruising Speed	10.5 knots
Endurance	45 days
Ice-breaking	2.5 feet at 2kph
Capacities	
Scientist Berths	24
Crew Berths	20 + 2 marine technicians
Science Labs	2100 square feet
Lab or Storage Vans	Up to 4 vans
Deck Working Area	4360 square feet
Fresh Water Storage	13,190 gallons
Water Making Capacity	6000 gallons/day
Fuel Capacity	185,000 gallons
Disability Accommodations	Yes: labs, galley, staterooms

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Research Vessel Sikuliaq

The Sikuliaq – pronounced see-KOO-lee-auk and translated from Inupiaq as "young sea ice" – is a 261-foot oceanographic research vessel designed to operate in harsh conditions to help advance polar and subpolar scientific research. Owned by the National Science Foundation and operated by the University of Alaska Fairbanks, the Sikuliaq is the first ice-capable vessel in the United States academic research fleet.

NSF

About the Sikuliaq

Sikuliaq is able to cut through first-year sea ice up to 2.5 feet thick and is outfitted with state-of-the-art equipment to bring scientists to ice-choked polar regions of the globe. Additionally, the ship design strives to have the lowest possible environmental impact, including a low underwater radiated noise signature for minimal disruption to marine mammals and fisheries.

The vessel is part of the University-National Oceanographic Laboratory System (UNOLS) and is home ported in Seward, Alaska. Sikuliaq will be able to accommodate up to 24 scientists and students at a time, including those with disabilities, providing scientists from across the nation and around the world an opportunity to learn more about marine life, our oceans, our atmosphere and our global climate.

Learn more about R/V Sikuliaq online at:
www.sikuliaq.alaska.edu

Follow along with the ship on social media.

- Facebook: R/V Sikuliaq
- Twitter: @sikuliaq
- Instagram: rvsikuliaq

Bottom Coating

- The standard ablative bottom coating system for anti-fouling is **not** used on Sikuliaq
  - Non-ablative bottom coating that is highly ice resistant
  - Reduced frictional resistance over conventional bottom coating and low VOC during application
  - Reduced friction resistance results in reduced hull resistance for improved fuel economy
  - The non-ablative nature of the coating, combined with low VOC, results in reduced solvent emissions and no release of biocides into the water.

Waste Management

- Incinerator
  - Capable of burning solid waste and waste oil
  - Complies with both US and European requirements
  - Burning the waste oil not only provides for safe disposal but increased energy efficiency by reducing the need for diesel fuel to run the incinerator

Integrated Power Plant Concept

- Designed with an integrated power plant
  - Combines generation of both ship's service electrical power and ship's propulsion into a common electrical plant with a load management system
  - Improves overall energy efficiency of the Sikuliaq
    - Allows the operator to adjust electrical generation capacity to more closely match the electrical demand
    - Uses anywhere from one to four diesel generators depending on demand
    - Results in minimizing the running of the electrical plant in an "over capacity" condition which improves energy efficiency and reduces emissions

Waste Heat Recovery System

- Waste heat recovery system is used for heating the interior of *Sikuliaq* and for heating hot potable water
  - System recovers the waste heat from both the water jacket systems and the exhaust systems of ship's diesel generators
  - Results in reduced energy consumption for heating the Sikuliaq by taking advantage of the waste heat that would normally be lost to the cooling and exhaust systems.
  - Reduces combustion emissions by minimizing how often the diesel fired hot water heater must be operating

Bio-degradable Hydraulic oil

- Uses bio-degradable hydraulic oil
  - Minimizes risk from any accidental hydraulic oil discharges
  - Recent hose burst with a favorable response from USCG once reported and cleaned up

Double Bottom Hull

- Sikuliaq has a double bottom hull
  - No fuel or oil storage tanks next the shell of the vessel
    - Reduces potential for a fuel spill in the event there is an accidental grounding or collision

Diesel Engines

- MTU 4000 Series
  - 2 X 12 V
  - 2 X 16 V
- EPA Tier II emissions compliant
- Meets the MARPOL Annex VI combustion exhaust limits

Marine Sanitation Device (MSD)

- Installed the “ACT 2” MSD exceeds the US requirement for marine sewage treatment discharge standards
  - Complies with the MARPOL Annex IV standards
  - Is a fresh water flushing system
  - Meets the most stringent marine sewage discharge standards
  - System recycles the fresh water for use and the flushing medium for toilets and urinals

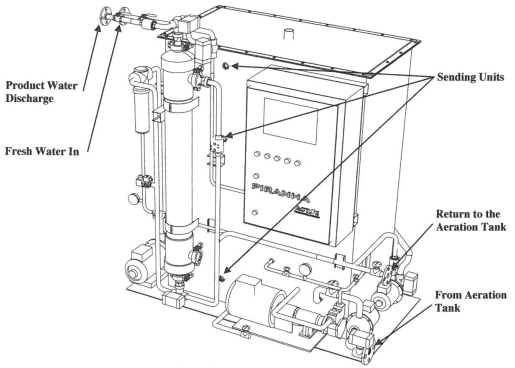
ACT 2 Piranha MSD

ACT 2 TECHNOLOGIES

penumbra marine logistics

ADVANCED WASTEWATER TREATMENT

Standard System Data Sheet For WRS 3—12



COMPONENTS	WRS-3	WRS-4	WRS-6	WRS-8	WRS-10	WRS-12
Aeration Pump (not shown)	1	1	1	1	1	1
Wastewater Supply Pump	1	1	1	1	1	1
Sludge Transfer Pump	1	1	1	1	1	1
Clarification Pump	1	1	1	1	1	1
Filter Supply Pump	1	1	1	1	1	1
Pneumatic 3-Way Valves	4	4	4	4	4	4
Pneumatic 2-Way Valves	4	4	4	4	4	4
Ball Valves	7	7	7	7	7	7
Level Sensors	3	3	3	3	3	3
Filter Modules	1	1	1	1	1	1
Piping— Black Water from H/T	1	1	1	1-1/4	1-1/4	1-1/4
Piping— Biomass Return to H/T	3/4	3/4	3/4	1	1	1
Piping—Product Water Discharge	3/4	3/4	3/4	1	1	1

Ballast Water

- Sikuliaq uses the Hyde Guardian System

HG 100 Model, Treats ballast water at 100 m3 / hour
Relatively trouble free and operates as designed
Uses no chemicals

Trash Compactor

- Processes solid wastes generated aboard that cannot be incinerated
  - Allows the crew to compact solid waste for efficient storage aboard the vessel until it can be off-loaded ashore
  - Once ashore, the solid waste can be either disposed through the local waste system, or recycled depending on the material

Hull Configuration and Propulsion

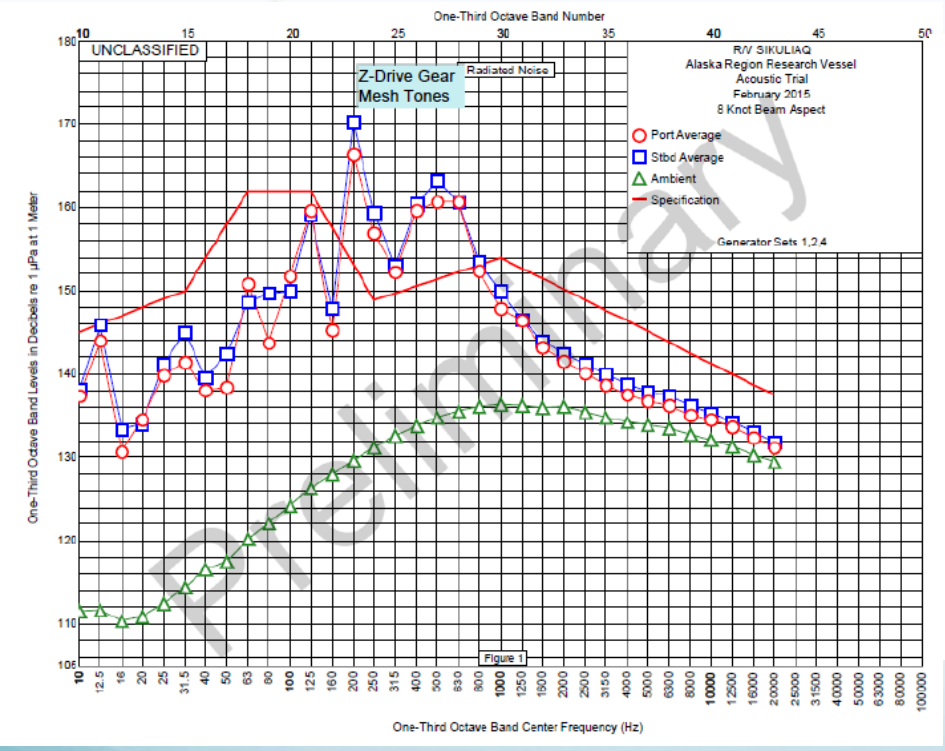
- Designed within the constraints of operating an ice capable ship
  - The design incorporates many requirements to minimize the underwater radiated noise (URN) signature of the vessel
  - Reduced URN is an advantage to the science sonar systems
  - Reduces the noise impact on marine mammals in the general vicinity of the operations area
- Major Machinery Mountings
  - Major machinery is mounted on noise and vibration damping mounts

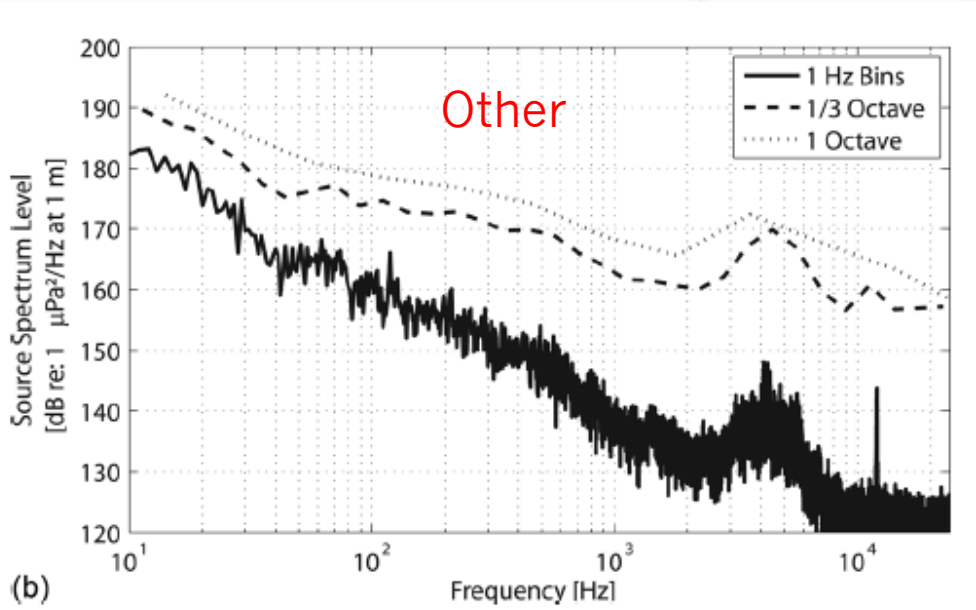
Hull Configuration and Propulsion

- Propellers
  - Designed to minimize cavitation noise to the maximum extent possible while still maintaining adequate strength for ice operations
- Noise Damping Treatments
  - Extensive use throughout the ship
    - Overheads
    - Jointer bulkheads
    - Structural bulkheads
- Resulting design not only achieves excellent URN reduction, but it also minimizes the airborne noise for improved habitability within the ship for the crew and embarked scientists

Comparing radiated underwater noise between Sikuliaq and Other at 8 knots

At 1/3 octave band, Sikuliaq has a 200 Hz peak source level of 170 dB re: 1uPa @ 1m. At the same frequency, Other vessel generates average source levels close to 175 dB. At lower
frequencies down to 50 Hz, Other vessel produces over ~180 dB while transiting in open water.





R/V SIKULIAQ Acoustic Trial Results (ACTRL 02/15)

Roth, et al. *Icebreaker Noise in the Arctic Ocean*, JASA 2013.