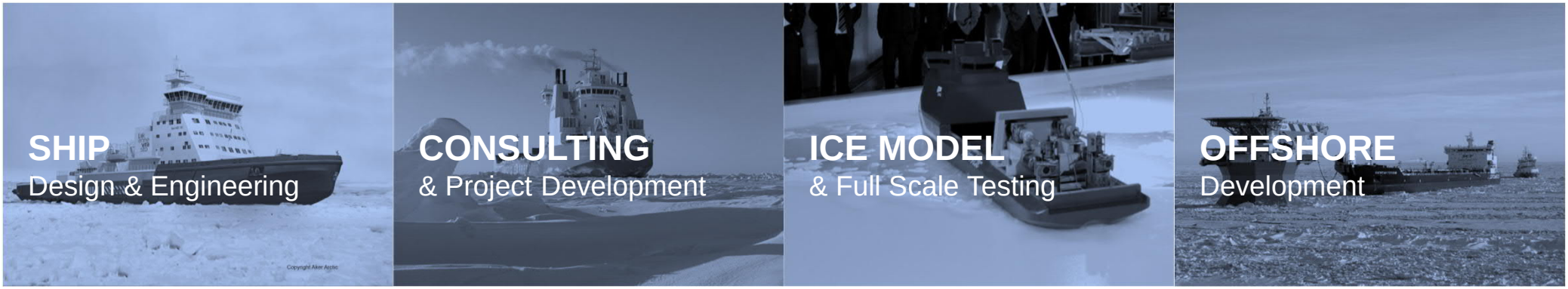


50 Years of Ice Model Testing

Topi Leiviskä
Head of Research and Testing
Aker Arctic Technology inc
28.2.2019

Manhattan project (ESSO)

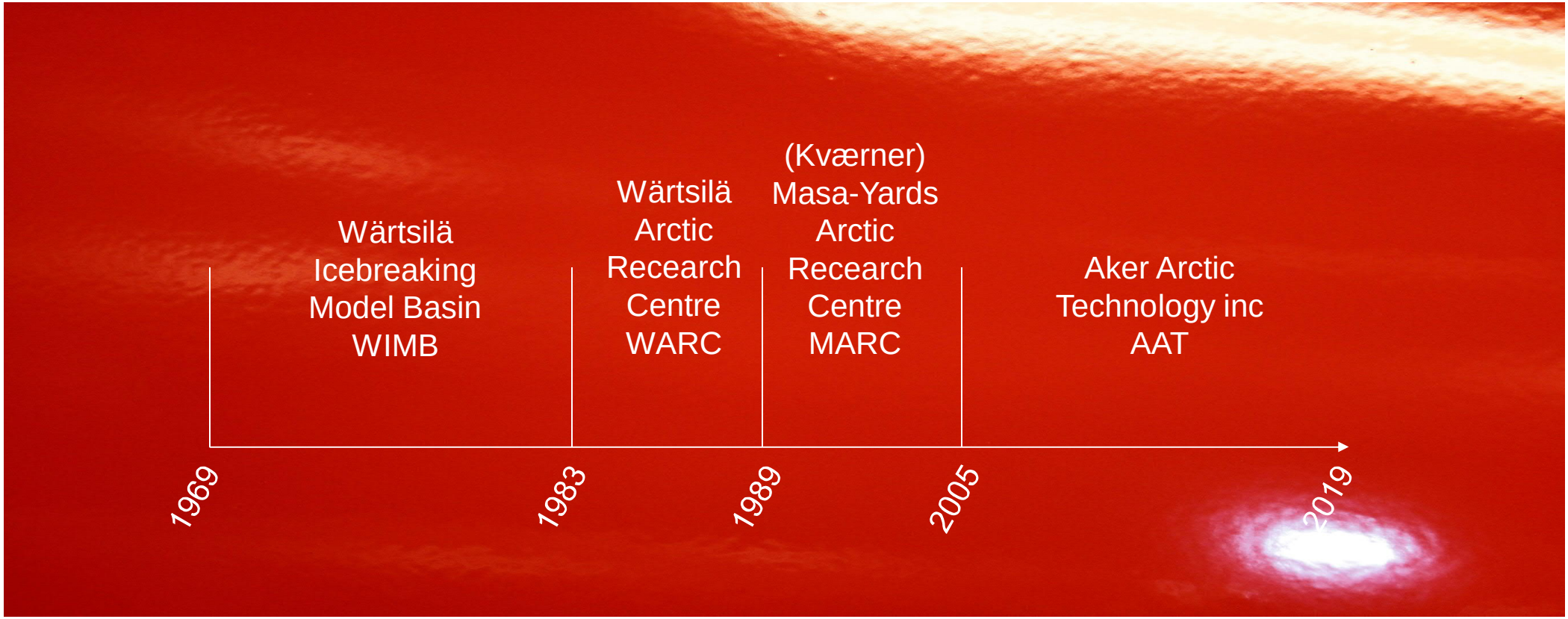
- Mid 1960s large oil reservuars were localized in the Alaskan Noth Slope
- It could be feasibly transported to the market through the Northwest Passage
- A decision was taken to modify an existing 106,000 DWT tanker, SS Manhattan
- Manhattan was refitted for the arctic voyage with an icebreaker bow in 1968–69
- During the retrofit process, the oil company Esso (Humble Oil) suggested to study the performance in ice of the newly designed bow in model-scale
- Esso decided to invest in construction of the first ice model testing facility in Finland
- The first ice model test basin in Finland was ready for testing at the end of 1969

Icebreaker design in Finland 1933-1970

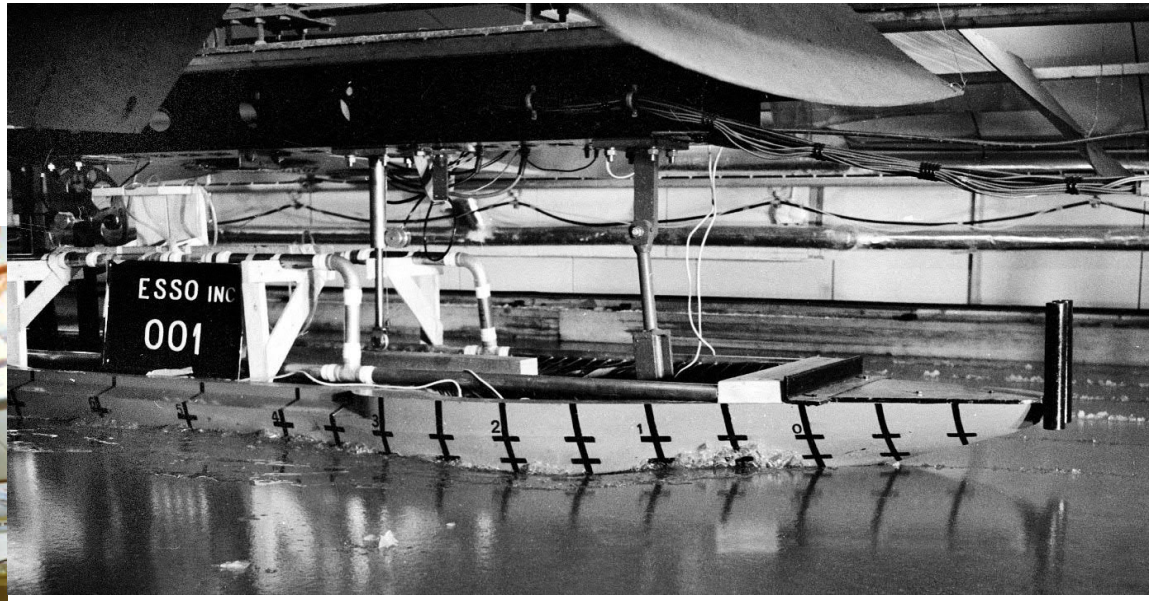
Name (previous names)	Year	Name (previous names)	Year
Louhi (ex-Sisu)	1939	Kiev	1965
Voima	1954	Askiplios (ex-Hanse)	1966
Kapitan Belousov	1954	Murmansk	1968
Kapitan Voronin	1955	Varma	1968
Kapitan Meheklov	1956	Vladivostok	1969
Oden	1957	Polar Star (ex-Njord)	1969
Karu (ex-Karhu)	1958	Dudinka (ex-Apu)	1970
Murtaja	1959	Ale	1973
Moskva	1960	Mega (ex-Aatos, Teuvo)	1973
Sampo	1961	Ermak	1974
Leningrad	1961	Atle	1974
Tor	1964	Urho	1975

WIMB Presentation Video

Time line of the ice model testing facilities

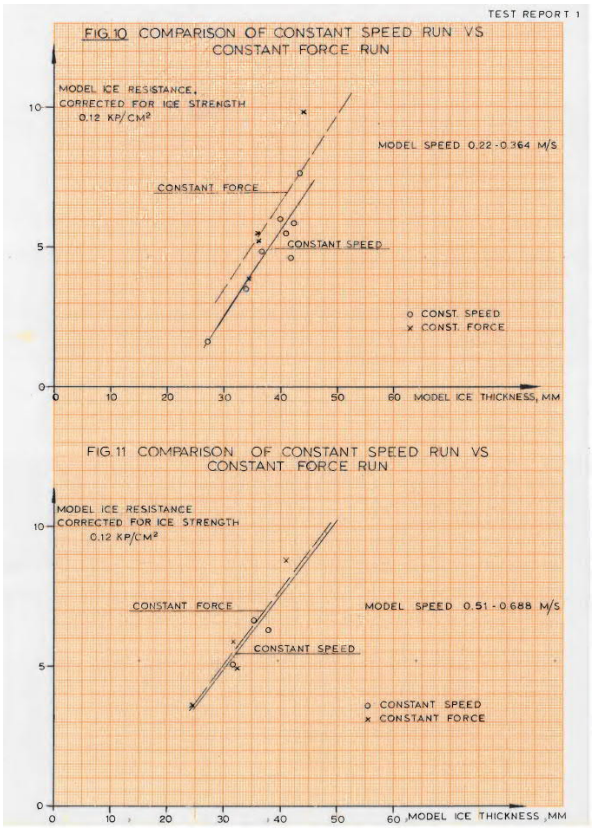


WIMB ice tank and first model tests

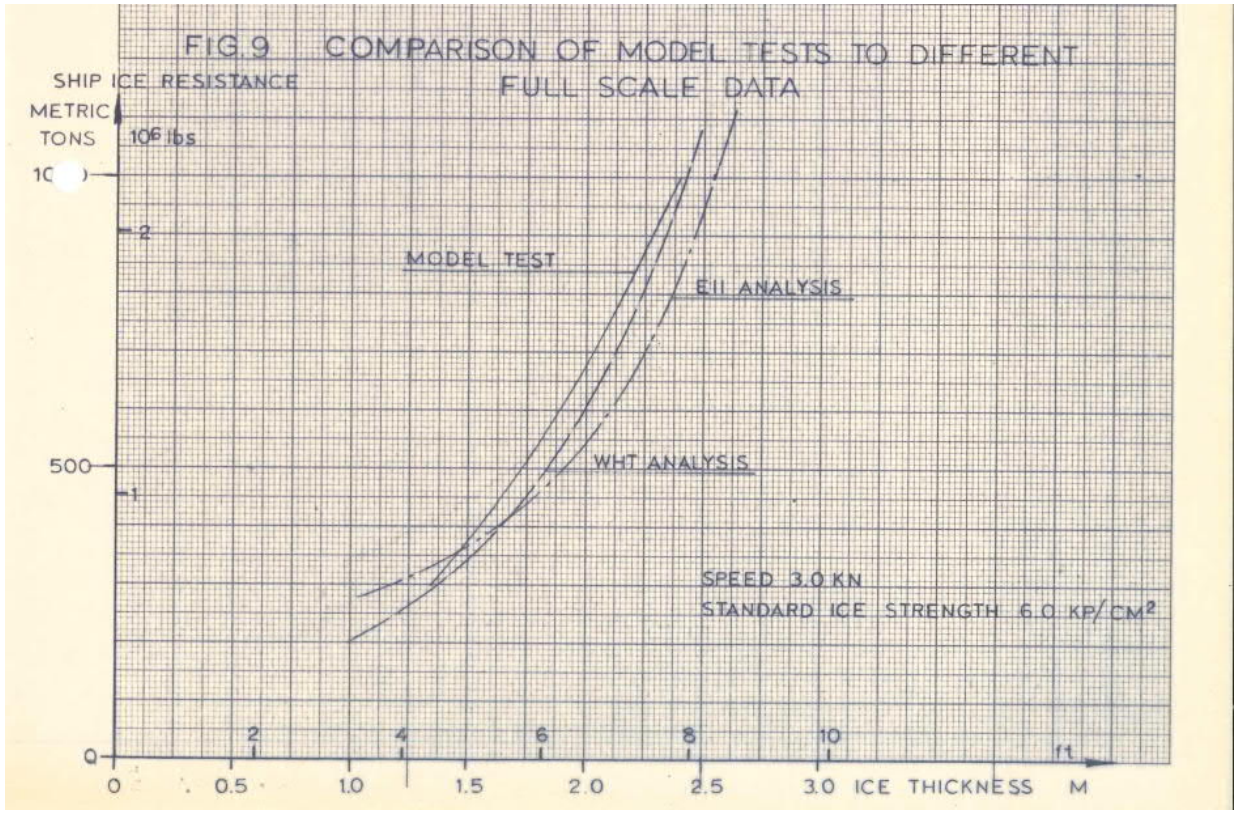


Test results from the first tests at Wärtsilä Ice Model Basin (WIMB)

Comparison between different testing methods

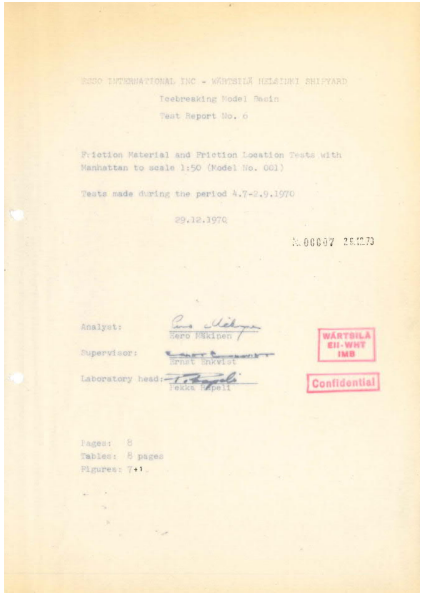


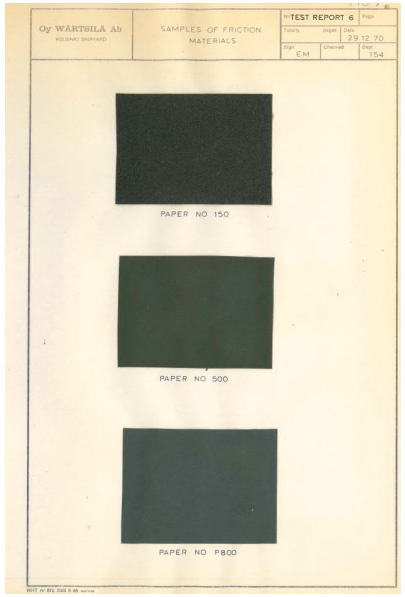
Full-scale model-scale correlation

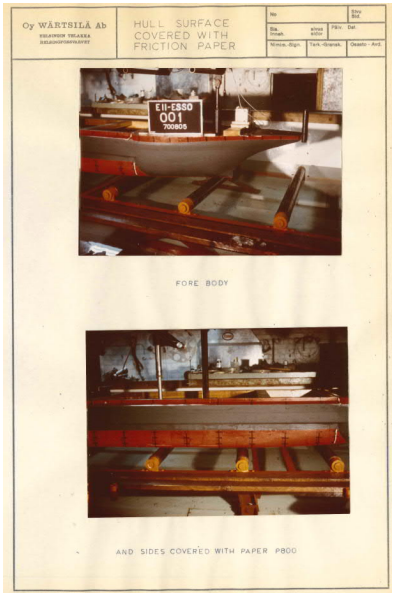


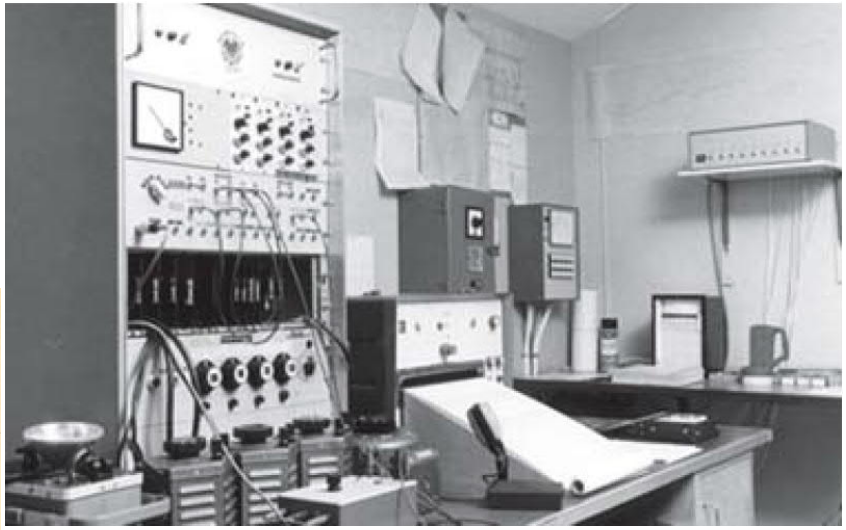
WIMB 1969-1983

- Ice model testing was continued after the Manhattan project
- First years were time of calibration
  - Model-scale full-scale correlation
  - Model hull friction testing

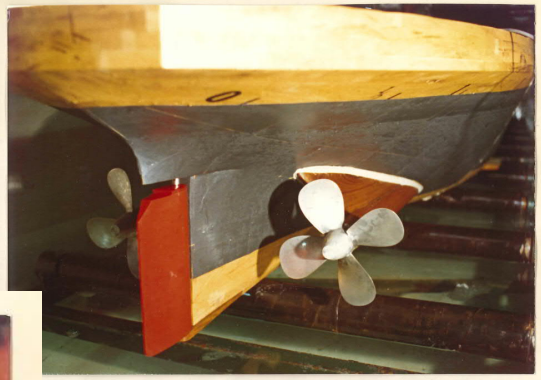








Atle/Urho class icebreker



aft-body of Model 1. Note the sand paper used increase the friction coefficient.

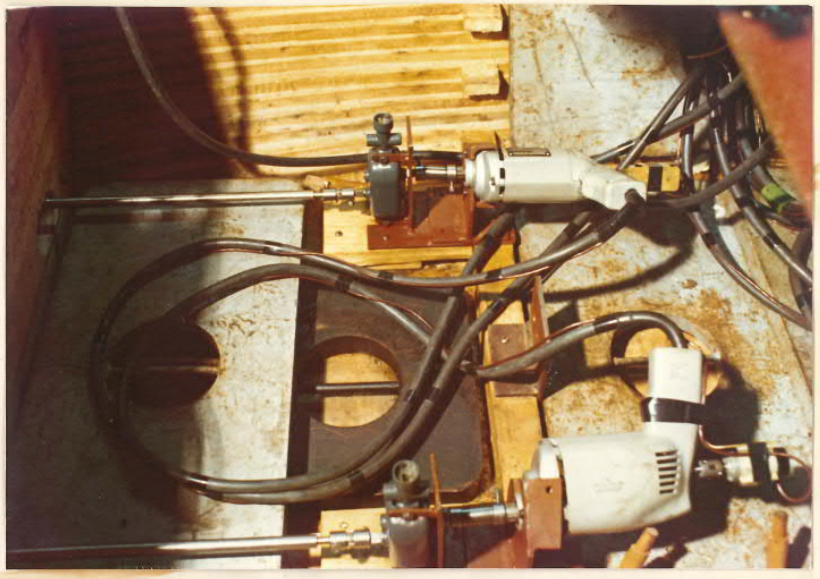


Fig. 5 The aft propulsion motors. Note the gearing.

WIMB testing

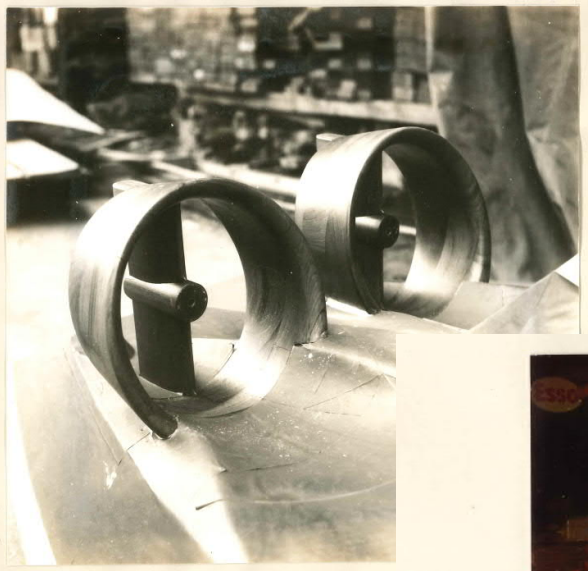
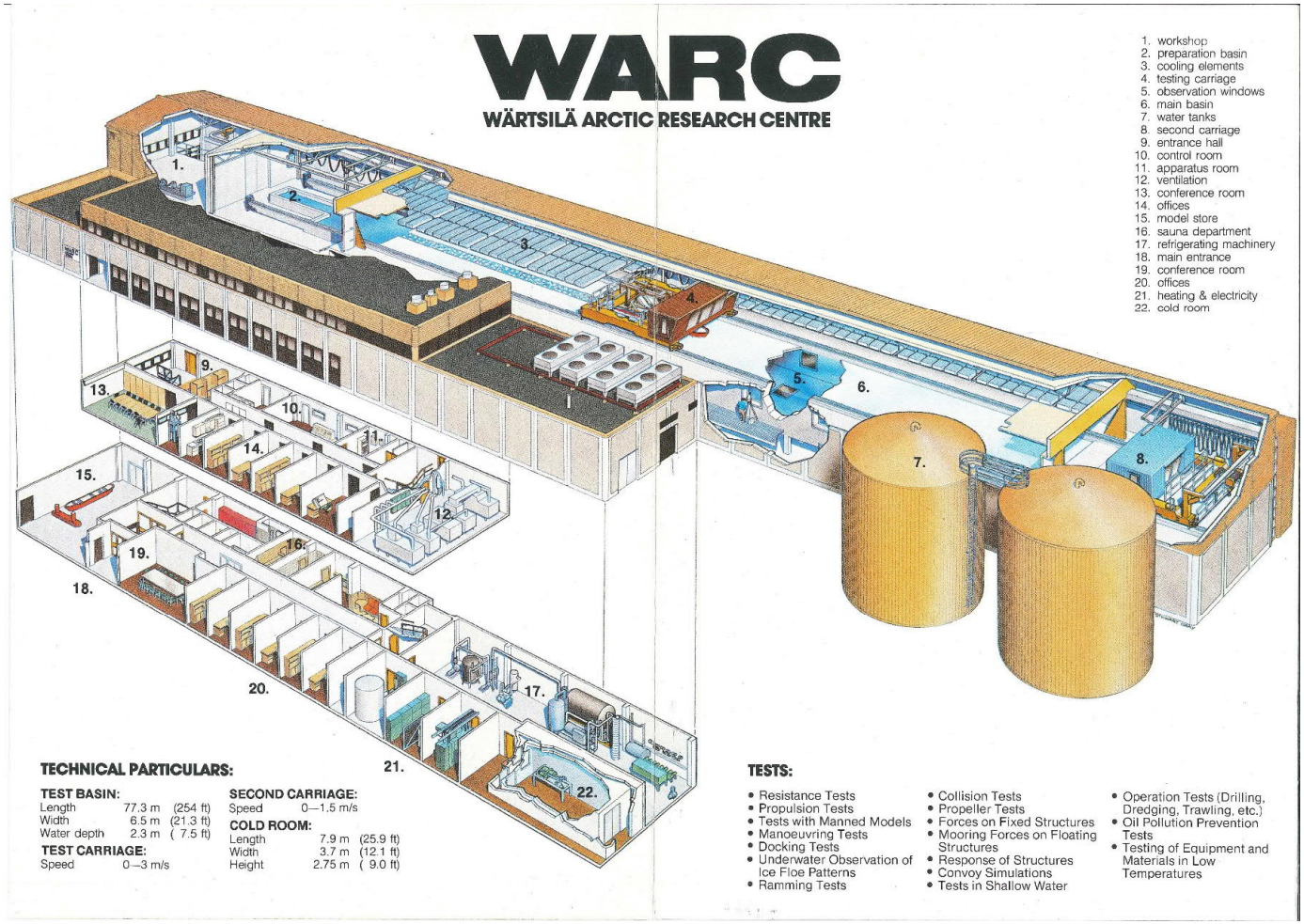


Fig. 4 The aft-body of Model 3, i.e. th
nozzles.

000 HP bubbling breaking level ice.

Fig. 18 The model in a ridge with 4000 hp bubbling.
Note spray of water.

Wärtsilä Arctic Research Centre WARC 1983



WARC presentation video

WARC – Icebreaker Bow Research

(Kværner) Masa-Yards Arctic Research Centre (MARC)

Double Acting Ship (DAS)

(Kværner) Masa-Yards Arctic Research Centre (MARC)

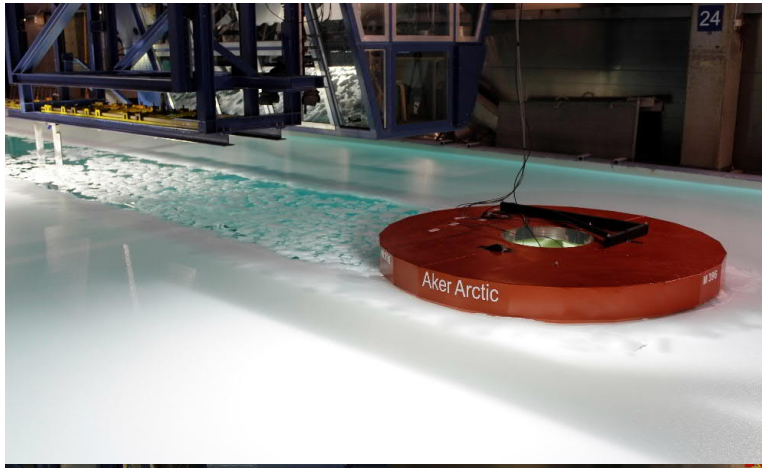
MARC – Oblique Icebreaker

Aker Arctic Technology inc 2005

Third Generation Facility

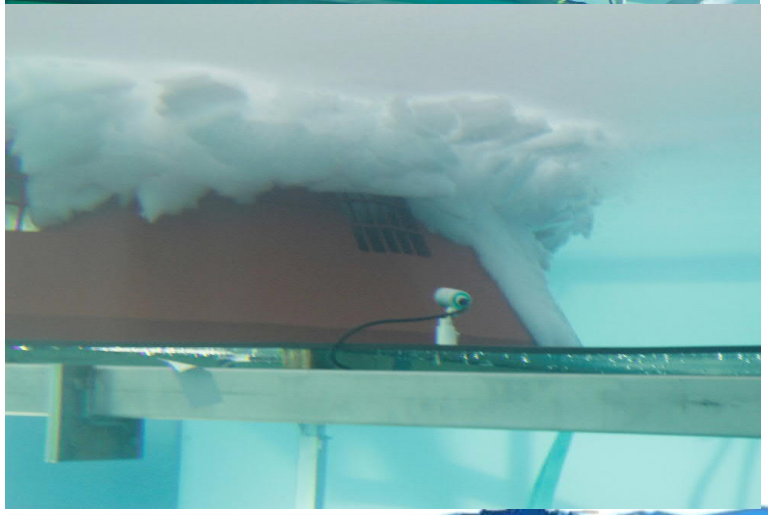
Fgx model ice is still in use

Testing of Offshore Structures



Floating mode structure tests

Gravity based structure tests



Arctic Module Carriers Audax and Pugnax

Arctic module carriers Audax and Pugnax were developed for the transport of massive LNG plant modules to the Yamal Peninsula. With a length of 206.3 m, a 43 m wide cargo deck, and PC3 ice classification, the heavy cargo ships are designed to navigate in exceptional ice conditions.

Icebreaker Polaris

Polaris, built in 2016, is the most powerful icebreaker ever to fly the Finnish flag and the first icebreaker in the world to feature environmentally friendly dual-fuel engines capable of using both low-sulfur marine diesel oil (LSMDO) and liquefied natural gas (LNG). It has excellent manoeuvrability due to the two Azipod units in stern and one in bow.

Yamal Max Arctic LNG Carriers

Aker Arctic has been leading the development of Arctic LNG carriers over the years resulting in Yamalmax icebreaking LNG carriers. The vessels are based on the DAS™ concept and capable of operating independently without icebreaker escort along the Northern Sea Route. The hull form has been extensively tested in Aker Arctic ice model test laboratory.
The first Yamalmax carrier, Christophe de Margerie, was delivered in 2016.

Aalto Cooperation – Cooperation agreement with Aalto University

AALTO ICE TANK

- Large Ice Tank
  - 40 m x 40 m
- Turning Circle Tests
- Manoeuvering Tests
- Test in Compressive Ice

Today at Aker Arctic

- DP-testing
- Testing with autonomous ships

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