



PROJECT MEMORANDUM #02

Alaska Regional Research Vessel *Concept Design Phase*

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Date: 8 January 2001
File No.: 00100
To: Bob Elsner, Bob Dinsmore, File

Subject: Mission Profile

Some members of the design committee have expressed a desire to keep the vessel dimensions within current docking constraints at Seward.

Three key factors will influence the principal dimensions:

- Requirement for a double hull in way of tanks carrying polluting liquids (proposed CASPPR and IACS guidelines for arctic vessels)
- Installed horsepower (related to operating environment, ABS Ice Class, vessel size).
- Endurance requirements (i.e., fuel deadweight requirement)

In order to establish a rough idea of whether all the desired requirements can be achieved, we have developed some preliminary data for comparison purposes.

First, let's summarize the key design constraints from the SMR and the Kick-off meeting:

- Maximum length of 210 feet
- Maximum draft of 15 feet
- ABS Ice Class A1
- Endurance of 60 days

At this time we have assumed that installed propulsion power will be on the order of 4,000 to 5,000 bhp. Note, 5,000 hp is the ABS "nominal" horsepower for the A1 ice class. This is not a rigid requirement since you are allowed to demonstrate, via model tests or full scale trials, a lower horsepower for a given class if ice-going performance is adequate (taking advantage of efficient hull form, powering, etc.). The low-end value of 4,000 hp comes from the *R/V ARANDA*, a similar sized vessel with similar ice class.

Normally, and you may recall from the ARV project, ice-breaking endurance can be equated to "full-power days", i.e., the number of days the vessel is able to operate at

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it's full rated propulsion power. The number of full-power days is some fraction of overall endurance depending on the mission profile. Some examples follow:

<u>Vessel</u>	<u>Endurance</u>	<u>Full Power Endurance</u>	<u>%</u>
<i>USCGC HEALY</i>	65 days	35 days	54
<i>R/V ARANDA</i>	60 days	20 days	33
1991 Glosten PRV*	80 days	22 days	28
1994 Glosten ARV	90 days	38 days	42

* This is the '91 design with optional double hull configuration

The UAF fax of 5 December estimates that 25% of a mission may be spent in ice (heavy ice?). Let's estimate a profile as follows:

<u>Mode</u>	<u>Days</u>	<u>% BHP</u>	<u>Equivalent Full Power Days</u>
Ice-free transit	15	50%	7
Transit Heavy Ice	15	100%	10 (abt 25% of time)
Transit Light Ice	10	50%	5
On-Station	<u>20</u>	25%	<u>5</u>
Totals	60		27 45%

We can now estimate the required fuel load based on the following rough assumptions:

- Specific fuel consumption of 0.36 lb/hp-hour (typical for high speed diesels)
- Hotel load (generators) estimated at 550 bhp
- Maximum tank load is 95%, minimum burnout is 10%

So, for the profile estimated above, at 5,000 bhp, the required fuel load would be as follows:

27 days x [24 hrs/day] x [5550 hp] x [0.36 lbs/hp-hr] x [1 LT/2240 lbs] x [309 gal/ LT] x 1.176 =
210,033 gallons

The estimated fuel capacity of the '91 Glosten PRV with double hull is 120,000 gallons. This vessel has principal dimensions as follows:

LOA	218'
B	57'
T	13.5'

Fuel capacity can be increased with an increase in draft, possibly by as much as 10%, to about 130,000 gallons.

Bearing in mind that the '91 PRV was an unusually wide vessel and that the larger open water mission component of the ARRV may dictate more conventional hull proportions, it would appear that a maximum fuel capacity on the order of 120,000

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gallons may be reasonable for the desired vessel dimensions. This means we need to either rethink the mission profile or the vessel size.

Additionally, recent communications with Arno Keinonen [email of 9 January], our hull form/ice performance consultant, raises the following issues for discussion:

From Arno

“A quick note about the operational profile [UAF fax of 5 December]. It does not really matter how long a time the vessel is in ice, it matter what exact location or geographic region, and how much ice and what it is expected to do there. Also, whether it is expected to do this alone or with another more capable icebreaker. This would be in my mind a topic of early and quick discussion. Then this includes two items, indeed the hull strength and that of propulsion is one side of the coin and the other one is the performance, mostly so that it is able to get itself out of trouble if it indeed goes alone to places where significant ice can close in on it.”

“So, the logical question is when and where exactly do they want to go with it? Alaska has three ice regimes geographically, the North Slope which includes the polar pack regions, then the Chukchi Sea and finally regions south of Bering Strait. Distinct ice regimes in each, naturally they vary drastically different time[s] of the year, and from year to year, but at least to ensure that the design at least on the strength scale matches the ice regimes where they are wanting and planning to go.”

We suggest the design committee review this memo in preparation for further discussion on the mission profiles.