

## **Maquoit III Noise and Vibration Review**

**8/29/25**

Maquoit III is a replacement vehicle and passenger Ferry for Maquoit II of the Casco Bay Lines fleet. J&A Enterprises has been commissioned by the vessels designer Bristol Harbor Group, Inc. to do a preliminary review of the project, giving guidance to the selection/evaluation of noise generation and treatments for its control with specific attention to the propulsion machinery mounting system.

The intended characteristics of the new vessel (still in preliminary design phase) are listed in table I. Given her length, 112 ft, the structural scantlings as required to carry cars and trucks, are substantial, as compared to a lighter duty vessel of that length. This is advantageous for resisting noise, both structureborne and airborne. The vessel arrangement plan is presented in Figure 1.

### **Favorable Design Features**

We have identified characteristics favorable to a quiet vessel, which we list and comment upon, below. This is based on limited design information received. We list and discuss below.

The passenger spaces are all forward of the forward engine room's forward bulkhead, reducing the transmission of airborne and structureborne noise from the engine room.

The ventilation inlets to the engine room and to the cabin are shown to open to the exterior side of the superstructure, giving a significant barrier to the transmission of fan and engine room noise to the passenger areas.

Exhaust ventilation appear to be carried up the exhaust casing, which is aft of the accommodation areas, and emitted above passenger decks. The diesel exhaust stacks, in similar fashion keep the diesel exhaust noise at good separation, aft, from the interior accommodation.

The heavier deck plating (5/16") over the engine room is a beneficial sound barrier against airborne noise from the engine room. Any protective anti-wear deck surface will give further improvement.

### **Unfavorable Design Features**

We have identified characteristics unfavorable to a quiet vessel, which we list and comment upon, below. (This is based on limited design information received to date).

Engine noise from the Caterpillar C-18 engines is loud compared to other diesels, for both airborne and structureborne noise, with dominant spectral peaks in the frequency range 75 to 250 Hz. These require careful attention in the engine mountings and foundations, and all pipe attachments to the engines. Also, attention is required to the selection and location of engine room insulation for this frequency range.

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Thruster noise will be significant at the fore deck spaces during maneuvering. The importance of this noise will depend upon the duration and power output of thruster operation required during docking and departure operation. The side loading design of Maquiot, by eliminating 180-degree rotations, probably reduces the duration of thruster operation. However, this should be further reviewed in selecting and positioning the thruster.

The aft, side facing, windows in the Main Deck Passenger Cabin provide a surface for radiation of engine structure borne machinery noise. Machinery installation (mounting and foundations) as well as window installation – glazing and glass selection (laminated) – are important elements to consider for control of this path.

Finish of the interior spaces, for quiet operation and good acoustic separation of conversations between passenger groups requires selection of cabin headliners with good sound absorbing properties such as those from Dampa, or similar.

Air conditioning requires moving of high volumes of conditioned air and can be a source of significant noise. Whatever noise limit targets are decided upon, the air system should be designed for noise limits equal to 3 dB quieter, or better. This allows achieving the targets when summed with other sources also totaling that same 3 dB margin.

The selection of the exhaust silencers and their installation, including vibration isolation mounting, are critically important for achieving the best grade of silencing. A selection of Hospital Grade silencers is a good first choice.

Hydraulic Systems- If the vessel is choosing between electric driven and hydraulics – engine driven – electric driven will be better for low noise. Such might include local electric driven remote hydraulic power packs. If not electric, but engine driven hydraulics is used, then isolation and/or hydraulic silencers will be required for the quieter grades of silencing.

Propeller noise will certainly be a dominant noise source at the aft cargo deck, based upon conventional design practice and hardware. However, this location is not a passenger space, and crew need not locate themselves there for long periods at cruise speed. So, levels greater than 85 dB(A) may be allowed. Reasonable design practice to reduce propeller noise is:

- Minimize flow obstruction upstream of the propellers

- Maintain Clearance of the propeller tips to the hull equal to 20% of the prop diameter

- Design the propeller for a maximum prop tip speed (circumferential) of 125 ft/sec.

- Design the propeller to match the engine performance and boat speed.

### Noise Targets

The Table, below shows noise levels measured on Machigonne and on a shelter deck ferry having rigid mounted engines and little noise reduction treatment. We believe the noise of the current Casco Bay Lines fleet to be represented by measurements that J&A made of Machigonne II. The ABS COMF noise limits for passenger vessels, and for Workboats (Aft Deck Gross Tons less than 10,000), are presented in the bottom row of the table. An aspirational target for improved quiet vessels, for the near future, would be ABS COMF. Based on the table below and past experience, It is clear that the ABS limits are out of range for the main deck cabin, but might be achieved, or nearly, for the -01 deck cabin. Meeting the -01 deck exterior noise will depend upon wind and water noise.

**Levels \_dB(A) and Class, ABS COMF, limits**

| Space                             | Aft Mn Dk,<br>exterior | Passg'r<br>Mn dk Aft | Passg'r<br>Mn Dk,Fwd | Passg'r<br>-01 dk<br>exterior | Pilot<br>Hs |
|-----------------------------------|------------------------|----------------------|----------------------|-------------------------------|-------------|
| Machigonne                        | 81                     | 79                   | 66 -64               | 74                            |             |
| Island Ferry                      | 90                     |                      | 80                   |                               | 64          |
| ABS HAB                           | 85 (workboat<br>HAB)   | 55                   | 55                   | 65                            | 65          |
| Proposed<br>target<br>Maquoit III | 85                     | 65                   | 65                   | 65-70                         | 65          |

It is clear from this table that there is major improvement required to meet the COMF limits.

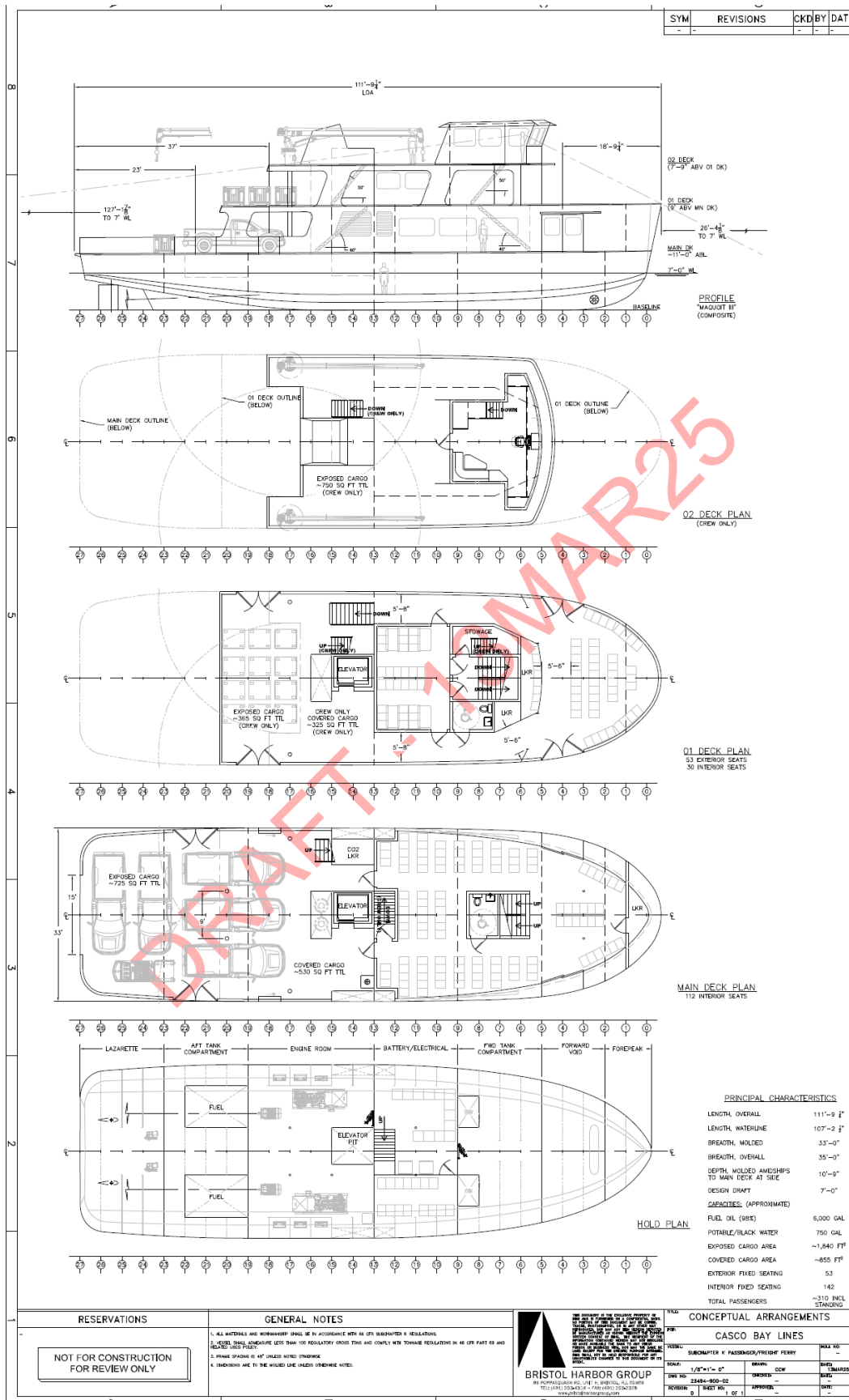
The existing fleet of Casco Bay boats are noisy and built with low regard for noise reduction. The Machigonne II is an existing ferry, about to be replaced by an electric/hybrid powered ferry in current construction. The new hybrid diesel electric powered vessel is expected to be significantly quieter than the old boat, allowing comfortable travel, with conversation, relaxation, and easy use of personal devices. .

The new Maquoit III is intended to be powered by twin Caterpillar C-18 diesels with either direct shaft driven propellers or by a diesel electric drive. The C-18 engine has high structureborne levels as experienced by J&A. In order to gain a reasonable noise reduction on the new Maquoit III compared to the current vessel, attention must be paid to reduction of structureborne noise from the diesels, whether they are diesel electric or direct gearbox driven.



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**Table 1**

| Particulars                |                      |                            |
|----------------------------|----------------------|----------------------------|
| <b>Maquoit III</b>         |                      |                            |
|                            |                      |                            |
| length OA                  | 111.75'              |                            |
| Breadth OA                 | 35'                  |                            |
| Draft, dsn                 | 7'                   |                            |
| Passengers                 | 310                  | 112 on Main dk, fwd        |
|                            |                      |                            |
| Outfit - as other CascoBay |                      |                            |
|                            |                      |                            |
|                            |                      |                            |
| engs (2)                   | CAT C18 D 500 bkW    |                            |
|                            | Shaft Drv or Elctric |                            |
|                            | exh -- Stacks        |                            |
|                            |                      |                            |
|                            |                      |                            |
| gens (2)                   | 72 ekW               |                            |
|                            |                      |                            |
| Eng rm Air                 | in - from exterior   |                            |
|                            | out- up stack?       |                            |
|                            |                      |                            |
|                            |                      |                            |
| <b>structure</b>           |                      |                            |
| main dk                    | 1/4" interior        | 5/16" exterior & aft Cargo |
| Bhd                        | 5/16"                |                            |
| Bottom                     | 5/16"                | 3/8" fwd                   |
| Sides                      | 5/16" lows aft       | 3/8" low fwd               |
| Sides upper                | 3/8"                 |                            |
| Columns                    | 4" sched 80          |                            |