GRENDEL – Green and efficient Danube Fleet

Work Package 4 – Preparatory Actions

Activity 4.1 – Individual advanced vessel concepts & energy efficient navigation

Consulting Service No. 3 – Improvement of noise and vibration characteristics

Background

The objective of this technical study shall focus on the examination of possibilities for improvement of the structural design of an advanced new-built sister ship (currently under design/construction) of "Amadeus Silver 3", one of Danubia Kreuzfahrten GmbH's most recent river cruise vessels, with a view to achieving lower levels of noise and vibrations in general and in particular in crew quarters.

With a view to the timeline of the design and construction of the new river cruise vessel it is important to have first concrete recommendations for structural improvements in time for integration into the design process.

Article 15.02 (5) of European Standard laying down Technical Requirements for Inland Navigation Vessels (ES-TRIN) prescribes a limit value of 60 dB(A) for crew sleeping quarters. However, it has to be noted that in maritime shipping there are already more ambitious voluntary standards available (e.g. DNV GL Comfort Class), as it can be shown that a high level of comfort in sleeping quarters increases performance and vigilance of the crew, thus significantly reducing the probability of major incidents or even accidents. Furthermore, with a view to the continuously expanding river cruise market it can be expected that a high level of comfort in crew quarters will get increasing importance in the competition for the best crews.

As a collateral benefit of structural improvements targeted at reducing noise and vibration levels in crew quarters it can be expected that noise and vibration levels in passenger accommodation areas can be reduced as well due to dampening effects radiating beyond the immediate crew area, thus further improving the competitive position of a vessel.

As optional elements of the technical study the following tasks might be considered:

1. With a view to improving noise and vibration levels it could be examined if the results of the main part of the technical study would permit to derive general recommendations for measures which could be applied to the existing fleet without excessively interfering with the given structure.
2. Guidance on implementation of the findings of the main part of the technical study in the design/construction/building phase could be a relevant issue with a view to an appropriate application of the recommendations deriving from the main part of the technical study in order to ensure the greatest possible effect of the respective measures.
3. External noise at berthing places is getting continuously increasing public attention. According to Article 8.10 (3) of ES-TRIN the noise generated by a stationary vessel shall not exceed 65 db(A) at a lateral distance of 25 m from the ship's side. However, taking into account increasing complaints by residents and local municipalities concerning noise emitted

by stationary river cruise vessels it can be expected that more stringent legislation will have considerable impact on the availability of berthing places for river cruise vessels which do not significantly go below the statutory requirements for external noise. It can be expected that noise emitted by generator sets will increasingly be targeted by an obligation to hook on to electric shore connection, but noise sources like ventilation and air conditioning will remain anyways. An optional part of the technical study could therefore assess possibilities for noise abatement measures addressing those sources which will still remain active while the vessel is connected to the electric shore-side grid.

Technical Specification

The supplier shall conduct a technical study with the objective to propose structural improvements based on the design of "Amadeus Silver 3" (see **Annex A**) in order to achieve a reduction of noise and vibration levels in the crew quarters of an advanced sister-ship.

The technical investigation shall in any case include:

- Stock-taking measurements of noise and vibrations in representative positions aboard "Amadeus Silver 3"
- Creation of necessary mathematical models of the vessel on the basis of the respective drawings for "Amadeus Silver 3" in order to perform
    - A dynamic finite element analysis for the prediction of vibration levels at low frequencies
    - A statistical energy analysis for the prediction of noise levels

  considering at least the following noise and vibration sources:
    - Main propulsion engines
    - Propellers
    - Generator sets
    - HVAC and Chiller units
    - Auxiliary machinery (compressors, pumps etc.)
- Calibration of the models against the results of the measurements
- Analysis of possible improvement measures taking into account a significant reduction of noise and vibration values in the crew quarters as well as an optimisation of the structural design with a view to low weight solutions
- Derivation of recommendations for concrete structural improvements
- Assessment of positive collateral effects, in particular possible reduction of noise levels in passenger accommodation areas

An economic assessment shall estimate and compare:

- Additional costs for implementation of the recommendations derived from the technical investigation on the basis of the costs for the original structural design of "Amadeus Silver 3" in order to achieve:
    - DNV GL Comfort Class 1 (50 dB(A))
    - DNV GL Comfort Class 2 (55 dB(A))

The technical report shall include:

- Recommendations for structural improvements mid of August 2019
- Interim progress report end of August 2019 (7 – 12 slides ppt-presentation)
- Draft technical report end of November 2019
- Comprehensive final technical report end of March 2020
- Publishable report with main facts and lessons learnt (Deliverable 4.1.3 of the GRENDEL project) end of March 2020

OPTIONAL PART:

Option 1

Based on the findings of the main technical study the supplier shall elaborate recommendations for possible retrofitting measures with view to improving noise and vibration levels of the existing fleet. This optional report shall include an easily readable rating of the recommendation addressing at least simplicity of implementation, costs, and expected level of improvement.

Option 2

Based on the findings of the main technical study the supplier shall guide the design office respectively the building yard of the next newbuilding of Danubia Kreuzfahrten GmbH during the structural design and actual building phase in order to ensure appropriate implementation of the recommended measures. The supplier shall propose in particular a sufficient number of on-site surveys and milestones where the supplier's intervention would seem to be necessary, including in any case a final measurement of noise and vibration levels after completion of the vessel and comparison with calculated values.

Option 3

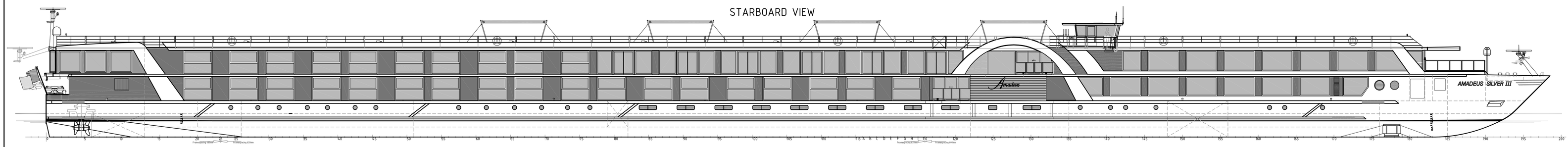
The supplier shall conduct a technical study using the models created in the main technical study with the objective of reducing the external noise of the vessel stationary at a berth and assuming the presence of electric shore connection. This study shall in particular address

- Identification of remaining sources of external noise
- Recommendations for reducing the noise emissions from these sources

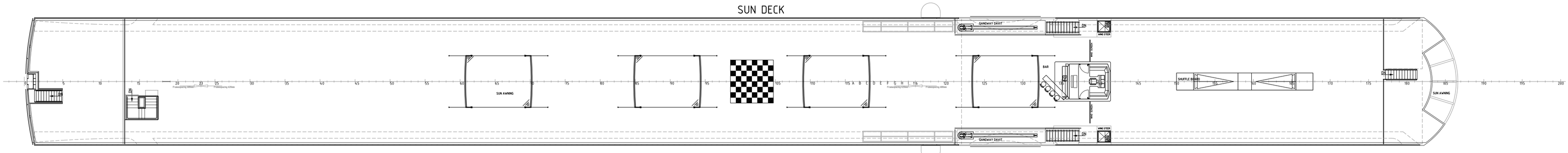
ANNEX A

General Arrangement Plan of "Amadeus Silver 3"

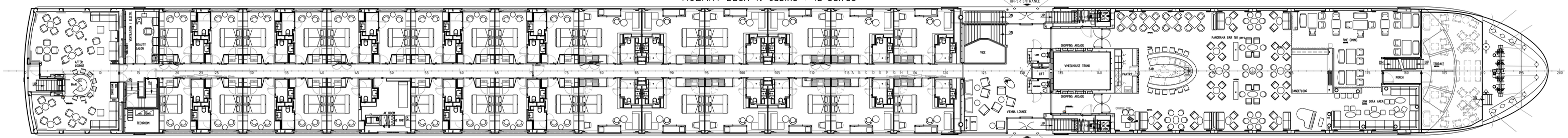
STARBOARD VIEW



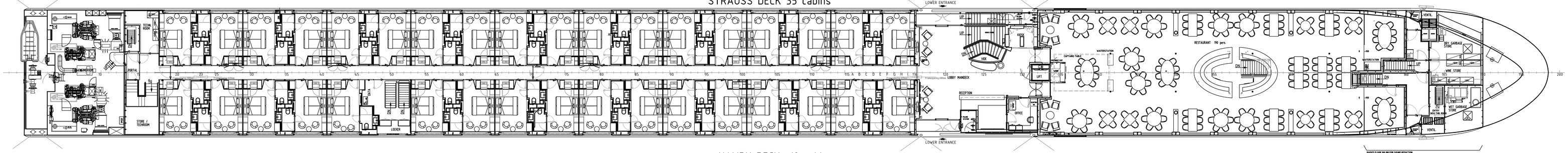
SUN DECK



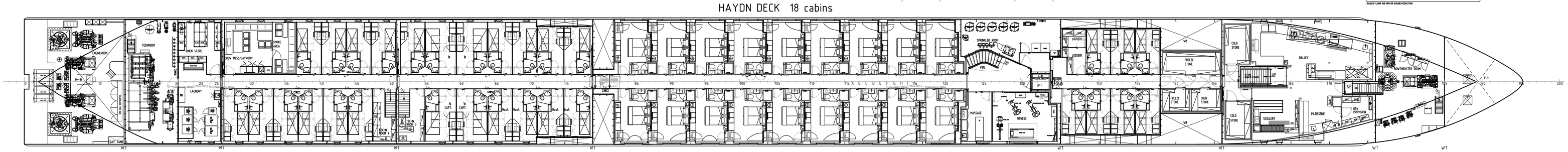
MOZART DECK 19 cabins + 12 suites



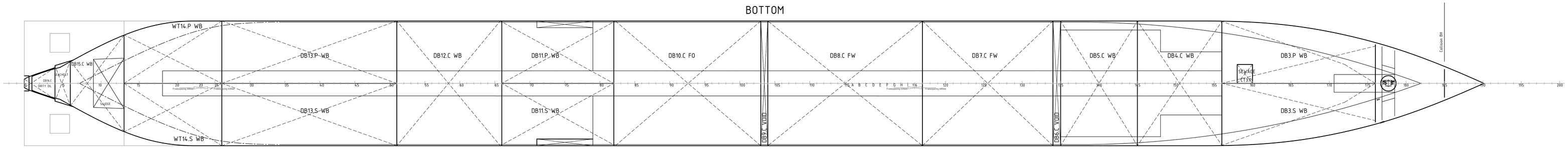
STRAUSS DECK 35 cabins



HAYDN DECK 18 cabins



BOTTOM



m/s Amadeus

MAIN DIMENSIONS

LENGTH	OVERALL	135,00 M.
BREADTH	OVERALL	11,45 M.
BREADTH	M.L.D.	11,10 M.
DEPTH		3,25 M.
DRAFT	(OPERATIONAL)	1,45 M.
DRAFT	(BALLAST)	2.10 M.
AIR DRAFT	(T=2.10m)	6,00 M.

CAPACITIES 224 PERS.

CABINS 84		168 PAX.
CREW DOUBLE	26x	52 PERS.
CREW SINGLE	4x	4 PERS.

APPROVED BY CLIENT	APPROVED BY CLASSIFICATION	SCALE	DRAFTSMAN FINISHED DATE	SHEET OF	DRAWING NUMBER
		1 = 100	05-05-2015	1 of 1	NB 468 01301-C

CLIENT : LueftnerCruises
PROJECT REF. : P21502
CLIENT'S DOC. :

SUBJECT :
GENERAL ARRANGEMENT PASSENGERSSHIP

De Hoop Lobith