

# ONDERZOEK NAAR TOEPASSING VAN UITLAATGASSENKETELS OP DE AUDACIA

## *Bijlagen*

|             |                                    |    |
|-------------|------------------------------------|----|
| Bijlage I   | Plan van aanpak                    | 2  |
| Bijlage II  | General Arrangement van de Audacia | 15 |
| Bijlage III | Plattegrond tekeningen             | 18 |
| Bijlage IV  | Stoomverbruik                      | 25 |
| Bijlage V   | Tegendruk motoren                  | 29 |
| Bijlage VI  | Aanbiedingen leveranciers          | 31 |
| Bijlage VII | Competentieset                     | 45 |





# Plan van Aanpak

Afstudeeropdracht Allseas

Michel van der Niet  
11077123  
Katwijk, maart 2015

## **Voorwoord**

Dit plan van aanpak wordt geschreven voor mijn afstudeeropdracht bij Allseas Engineering B.V. Dit werkstuk is opgesteld voordat mijn daadwerkelijke periode bij m'n afstudeerbedrijf ingaat, zodat ik alle aandacht kan besteden aan de afstudeeropdracht.

Tijdens het schrijven van dit plan van aanpak ben ik 4<sup>e</sup> jaars student HBO-werktuigbouwkunde aan de Haagse Hogeschool te Delft. Met mijn afstudeeropdracht hoop ik deze studie volwaardig af te sluiten.

Het plan van aanpak is bedoeld voor mijn begeleider bij m'n afstudeerbedrijf, Taco Straathof. Verder is het rapport ook bedoeld voor de docenten die mijn afstudeeropdracht gaan beoordelen en alle geïnteresseerd die benieuwd zijn waar mijn afstudeeropdracht over gaat.

Ten slotte wil ik alvast mijn bedrijfsbegeleider Taco Straathof bedanken en mijn tot nu toe onbekende begeleider vanuit de opleiding.

Katwijk, maart 2015

## Inhoudsopgave

|    |                                                       |    |
|----|-------------------------------------------------------|----|
| 1. | <a href="#">1 Inleiding</a>                           | 6  |
| 2. | <a href="#">2 Opdrachtsomschrijving</a>               | 7  |
| 3. | <a href="#">3 Probleem- en doelstelling</a>           | 8  |
|    | <a href="#">3.1 Probleemstelling</a>                  | 8  |
|    | <a href="#">3.2 Doelstelling</a>                      | 8  |
| 4. | <a href="#">4 Projectgrenzen en randvoorwaarden</a>   | 9  |
| 5. | <a href="#">5 Kwaliteitscontrole en risicoanalyse</a> | 10 |
|    | <a href="#">5.1 Kwaliteitscontrole</a>                | 10 |
|    | <a href="#">5.2 Risicoanalyse</a>                     | 10 |
| 6. | <a href="#">6 Aanpak</a>                              | 11 |
| 7. | <a href="#">7 Projectorganisatie</a>                  | 12 |
| 8. | <a href="#">8 Pakket van eisen</a>                    | 13 |
| 9. | <a href="#">9 Projectactiviteiten</a>                 | 14 |

## **1 Inleiding**

Voor het afronden van mijn studie, dien ik mijn vaardigheden te testen aan de hand van een 'meesterproef', het afstuderen. Ik heb besloten om mijn afstudeeropdracht bij Allseas Engineering B.V. uit te gaan voeren.

Aan boord van 1 van de schepen van Allseas, de Audacia, wordt er een hoop energie, in de vorm van warmte, weggegooid. Deze warmte wordt opgewekt door de verbrandingsmotoren. Het doel van deze opdracht is om een systeem op de motoren toe te passen, die er voor zorgt dat de restwarmte wordt omgezet naar nuttige energie. Daardoor zal ook het brandstofgebruik afnemen.

In dit rapport wordt de aanpak van het project beschreven. Als eerst wordt de opdracht verder omschreven, waaruit een duidelijke probleem- en doelstelling wordt geformuleerd. Daarna worden de projectgrenzen en de kwaliteitbehouding beschreven. Verder komen de aanpak, de organisatie en het pakket van eisen met de projectactiviteiten aan bod.

## **2 Opdrachtsomschrijving**

Aan boord van de Allseas schepen wordt een grote hoeveelheid brandstof verbruikt. De brandstof wordt voornamelijk gebruikt voor het op positie houden van de schepen. Daarnaast zijn er op de schepen een hoop installaties te vinden welke een relatief grote energie afnamen hebben. Eén daarvan is het stoom systeem welke wordt gebruikt voor het warm houden van tanks, separators, de verdamper (water makers), drinkwaterverwarming en verwarming van ruimtes.

Op dit moment wordt al deze energie opgewekt d.m.v. olie gestookte ketels. En dit terwijl er ook restwarmte is terug te winnen vanuit de motoren. Daarnaast zal er naar alle waarschijnlijkheid ook een energie besparing worden gevonden in het slimmer omgaan van de verbruikers.

Doel is om in kaart te brengen wat de huidige situatie is en welke mogelijkheden er zijn om de afname van energie te reduceren en daarnaast het vinden van de meest passende oplossing om energie terug te winnen. Dit alles wel met alle daarbij behorende aspecten zoals technische haalbaarheid en terugverdiëntijden.

### 3 Probleem- en doelstelling

*In dit hoofdstuk wordt de probleem- en doelstelling van de opdracht duidelijk op papier gezet en afgebakend. Afbeelding 3.1 is een foto van het betreffende schip*

#### 3.1 Probleemstelling

De probleemstelling van dit project is als volgt:

*Hoe kan de restwarmte, die door de brandstofmotoren van de Audacia geproduceerd worden, het beste benut worden?*

De probleemstelling duidt aan, dat de geproduceerde restwarmte benut kan worden voor nuttige dingen zoals;

- Het verwarmen van het tapwater aan boord.
- De boilers op temperatuur houden.
- Het ondersteunen van de verwarming aan boord.

Bovenstaande punten geven aan dat d.m.v. restwarmte een energie besparing kan worden behaald, die uiteindelijk leiden tot een vermindering van het brandstofgebruik van het schip.



Afbeelding 3.1, De Audacia

#### 3.2 Doelstelling

De doelstelling zijn de uitwerkingen en antwoorden van de probleemstelling die in de vorige paragraaf beschreven staan. Voor het schip moet een investeringsvoorstel worden opgesteld, waarin de volgende punten beschreven staan:

- De brandstof reductie van het schip.
- De investeringskosten (CAPEX)
- De terugkerende (de operationele) kosten (OPEX)
- De terugverdiendtijd van de installatie.
- De technische haalbaarheid van het systeem.

Als ondersteuning van het voorstel wordt er een presentatie, een verdediging en een eindverslag opgeleverd, waarin de weg naar het investeringsvoorstel beschreven staat.

#### **4 Projectgrenzen en randvoorwaarden**

*Omdat dit project een grote omvang heeft, is het belangrijk om de opdracht goed af te bakenen. Verder zorgen deze punten voor een duidelijk doel van de afstudeeropdracht.*

De belangrijkste projectgrens is om bij het afsluiten van mijn afstudeerperiode een investeringsvoorstel op te stellen voor het gebruik van de door de brandstofmotor geproduceerde restwarmte. Dit wordt gedaan in een periode van 17 weken.

Er wordt onderzoek gedaan naar verschillende (bestaande) oplossingen voor dit probleem. Hiervoor wordt er contact gelegd met verschillende aanbieders van deze oplossingen. Hiervan wordt bekeken welke het beste past bij het probleem.

Er gaat weinig of geen aandacht naar het onderzoeken naar nieuwe, nog niet bestaande oplossingen voor dit probleem. Dit doordat de ontwikkelkosten daarvoor te hoog komen te liggen en de kans op succes erg laag ligt. Hiernaast zouden deze ook nog goedgekeurd moeten worden door classificeringbureaus.

Het project loopt tot het opleveren van het voorstel. Mocht er tijd over zijn, wordt er vanzelfsprekend ook gekeken naar het vervolg van dit project.

Tijdens deze opdracht wordt er zowel een begeleider vanuit het bedrijf als vanuit de opleiding toegewezen aan de afstudeerder. Deze helpen en geven hem advies tijdens het project.

## **5 Kwaliteitscontrole en risicoanalyse**

*In dit hoofdstuk wordt de kwaliteitsbewaking en de risicobeheersing van het project beschreven. Deze wordt gegeven aan de hand van een SWOT-analyse. Tijdens het afstuderen wordt er veel vrijheid gegeven aan de student. Het doel van de SWOT analyse is om te voorkomen dat bij een grote vrijheid het einddoel niet wordt behaald.*

### **5.1 Kwaliteitscontrole**

De kwaliteit van het afstuderen kan behouden worden door een goede samenwerking tussen de afstudeerder en de partijen waarmee hij te maken krijgt, met name zijn twee begeleiders. Hiervan wordt verwacht dat tijdens de loop van zijn afstuderen er constant feedback op de gevonden resultaten wordt gegeven.

Elke week wordt er door de afstudeerder terug gekeken naar zijn geboekte resultaten. Door deze feedback steeds toe te passen, wordt er een sterk eindproduct opgeleverd.

### **5.2 Risicoanalyse**

De risicobeheersing wordt gehanteerd aan de hand van een SWOT. Hierin staan de sterke en de zwakke punten van de afstudeerder beschreven. Ook worden hier de kansen en de bedreigingen beschreven die de afstudeerder tegen kan komen.

#### **Sterke punten**

- De afstudeerder is al bekend met het bedrijf waar hij gaat afstuderen
- Doordat het plan van aanpak al geschreven is voordat het afstuderen begint, kan hij meer tijd besteden aan de daadwerkelijke opdracht
- In een vorige minor, heeft de student al vakkennis opgedaan aan brandstofmotoren en het berekenen van restwarmte en andere vormen van (warmte)energie.
- De afstudeerder is zelf erg geïnteresseerd in de maritieme kant.

#### **Zwakke punten**

- Tijdens de opleiding is er vrijwel geen aandacht besteedt aan schepen of andere watertuigen.
- Als de afstudeerder uitvalt (door ziekte o.i.d.) worden de werkzaamheden van de opdracht tijdelijk stopgezet.

#### **Kansen**

- Het opleveren van een eindproduct waar het schip en het bedrijf echt iets aan heeft.
- De ervaring die ik hierbij oploop, te gebruiken in de toekomst.
- De kans om te werken in een internationaal bedrijf.

#### **Bedreigingen**

- Doordat het schip nu in Australië aan het werk is, is er weinig mogelijkheid om de doelgroep van het project te zien.

Door de bedreigingen tegen te gaan kan er gekeken worden naar andere schepen van het bedrijf. Tijdens de afstudeerperiode is er een ander schip, de Lorelay, binnen. Dit kan als vergelijkbaar doel worden beschouwd.

## 6 Aanpak

Voor de aanpak van het project is gekeken naar de hoofdvraag van de probleemstelling. Deze luidt: *Hoe kan de restwarmte, die door de brandstofmotoren van de Audacia geproduceerd worden, het beste benut worden?*

Als eerst wordt er gekeken naar de huidige situatie van het schip. Er wordt gekeken hoeveel restwarmte het schip produceert. Hiernaast wordt er ook gekeken naar de beschikbare ruimte van het schip. Wanneer dit duidelijk en vastgelegd is, wordt er gekeken naar verschillende technische oplossingen. Deze worden verzameld bij verschillende leveranciers en worden tegen elkaar afgewogen. Hier uit komen een paar concepten die verdere uitwerkingen nodig hebben.

De concepten worden naast het bestaande systeem van het schip gelegd. Hier wordt gekeken waar de inbouw mogelijk zijn en wat de beste locatie is voor het restwarmteterugwinningssysteem.

Wanneer er besloten is wat het beste systeem is, wordt er in overleg met de technische tekenaars de systeem plaatsing ontworpen. De afstudeerder overlegt samen met de technische tekenaars van het bedrijf waarop gelet moet worden bij het vastleggen van het systeem

Parallel met het tekenen en ontwerpen van het systeem wordt er een investeringsvoorstel geschreven naar het management van het bedrijf, waarin onder andere de terugverdien tijden en de effecten van het systeem staan beschreven.

Er dient door de afstudeerder een scriptie te worden geschreven over de doorgelopen stappen van deze opdracht. Deze wordt later verdedigd in de vorm van een assessment.

## **7 Projectorganisatie**

In dit hoofdstuk wordt de projectorganisatie beschreven van de afstudeeropdracht. Hierbij is Michel de afstudeerder, Taco de begeleider uit het bedrijf en de gegevens van de andere spelende zijn nog niet bekend.

Michel van der Niet  
[michelvdniet@hotmail.com](mailto:michelvdniet@hotmail.com)  
0642729887

Afstudeerder

Taco Straathof  
[tst@allseas.com](mailto:tst@allseas.com)  
+31152681614

Begeleider vanuit bedrijf

## **8 Pakket van eisen**

*In dit hoofdstuk wordt het pakket van eisen opgesteld. Omdat het project nog niet van start gegaan is, is deze lijst nog heel gering. Deze wordt gedurende het project aangevuld.*

### **Eisen**

- Het systeem moet toepasbaar zijn op de Audacia.
- Het systeem moet in te bouwen zijn.
- Het systeem moet aan-en uit gezet kunnen worden.
- Het systeem moet voldoen aan de eisen van Lloyds.
- Het systeem moet voldoen aan de eisen van NMD.
- De terugverdiëntijd is een periode van 5 jaar.
- Er moet genoeg ruimte blijven rondom het systeem voor onderhoud
- De gewichtstoename moet zo laag mogelijk zijn.

### **Wensen**

- Er moet een brandstof besparing komen
- Het systeem moet zo laag mogelijk ingebouwd worden i.v.m. de stabiliteit van het schip.

## **9 Projectactiviteiten**

Tijdens de opdrachten worden er een aantal beroepsproducten opgeleverd. Hierbij is het eindrapport het belangrijkste onderdeel. De andere rapporten dienen als een soort van voortgangscontrole.

### **Plan van aanpak**

In het plan van aanpak wordt de aanpak van de opdracht beschreven. De opdracht wordt hier toegelicht en daarvan wordt er een probleemstelling opgesteld. Het project wordt hierbij ook afgebakend en er wordt een duidelijk einddoel opgesteld.

### **Analyserapport**

Het analyserapport wordt opgesteld na het plan van aanpak. Hier wordt de huidige situatie van het schip beschreven en er wordt alvast gekeken naar verdere oplossingen die in het conceptrapport aanbod komen.

### **Conceptrapport**

In het conceptrapport worden verschillende mogelijkheden van de oplossingen tegen elkaar gewogen, zodat er een paar concepten ontstaan, die mogelijk een oplossing bieden voor het bestaande probleem.

### **Ontwerprapport**

In dit rapport wordt het beste concept verder uitgewerkt. Dit ontwerp is de basis van het investeringsvoorstel en hier worden alle berekeningen op toegepast.

### **Investeringsvoorstel**

Het investeringsvoorstel is het doel vanuit het bedrijf. Dit voorstel gaat naar het management en zij bepalen of en wanneer dit van kracht wordt. In het voorstel staan onder andere, de terugverdientijd, de betrokken partijen en de andere voordelen die hierbij te pas komen.

### **Eindrapport**

Het eindrapport is het laatste rapport en de scriptie van de afstudeerder. Hierin staan de conclusies van de bevindingen die in het ontwerprapport staan beschreven. Ook is hier het investeringsvoorstel in meegenomen en worden er aanbevelingen geschreven over hoe deze het beste toegepast kan worden.

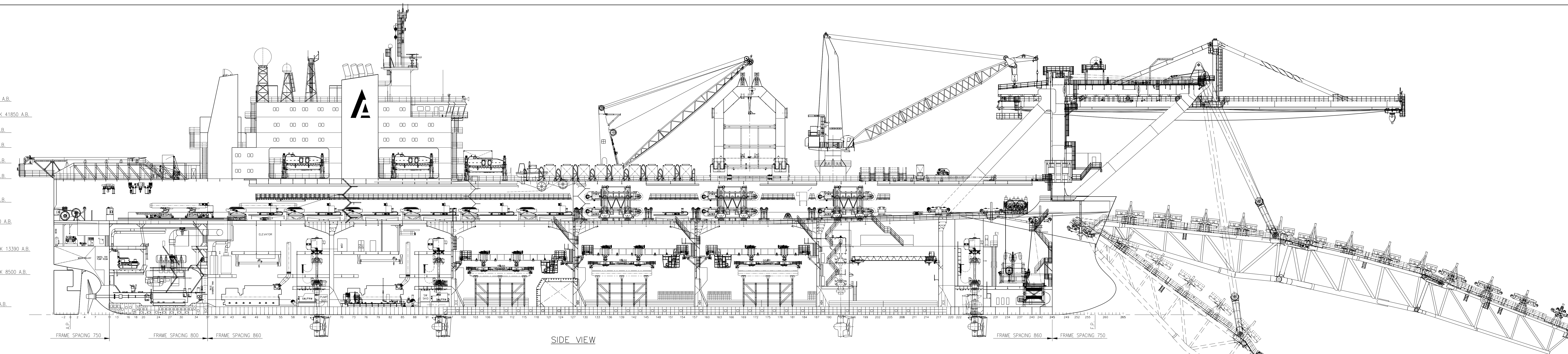
### **Presentatie/verdediging**

De bevindingen die in het eindrapport staan, dienen in de presentatie naar voren te komen. Hier wordt in een zitting de afstudeeropdracht verdedigd.

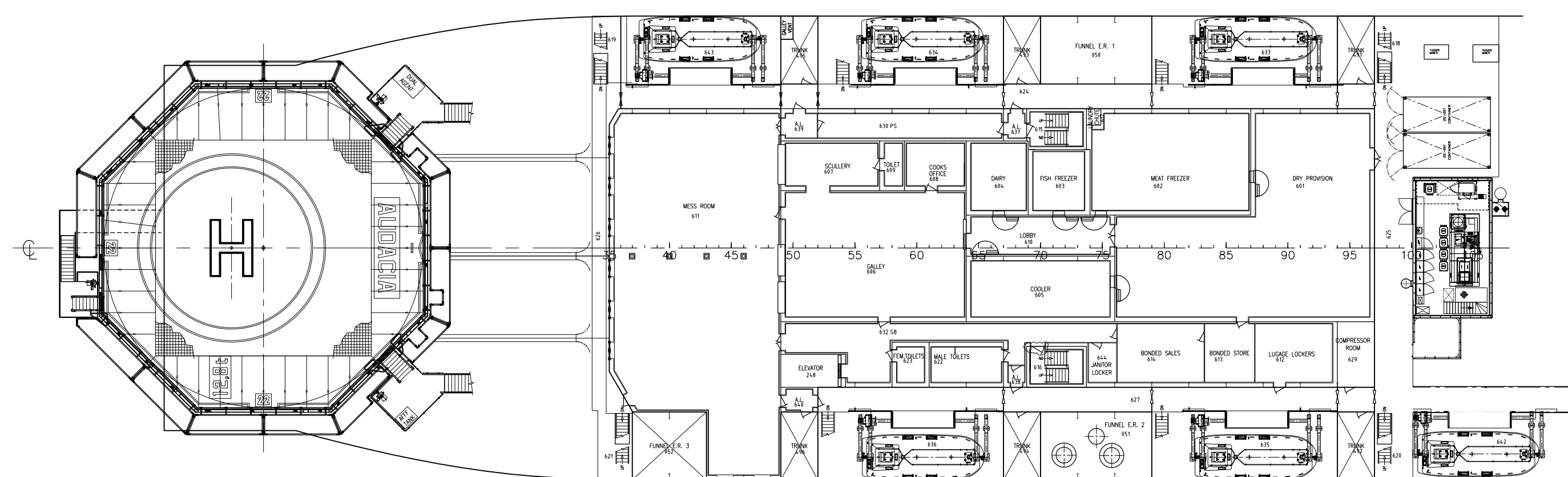
**Bijlage II      General Arrangement van de Audacia**

AU-10130-01-01

TOP DECK 45150 A.B.  
NAV. BRIDGE DECK 41850 A.B.  
F-DECK 38550 A.B.  
E-DECK 35450 A.B.  
D-DECK 32100 A.B.  
C-DECK 28800 A.B.  
B-DECK 23800 A.B.  
MAIN DECK 19200 A.B.  
UPPER TWINDOCK 13300 A.B.  
LOWER TWINDOCK 8000 A.B.  
TANK TOP 1580 A.B.  
BASE LINE



SIDE VIEW



PLAN VIEW D-DECK  
(32100 A.B.)



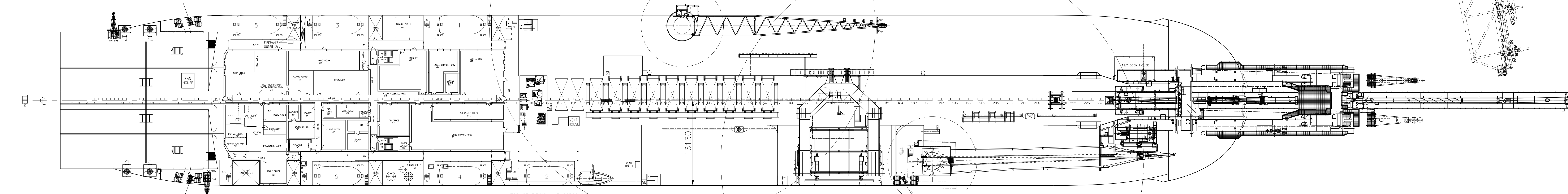
PLAN VIEW E-DECK  
(35450 A.B.)



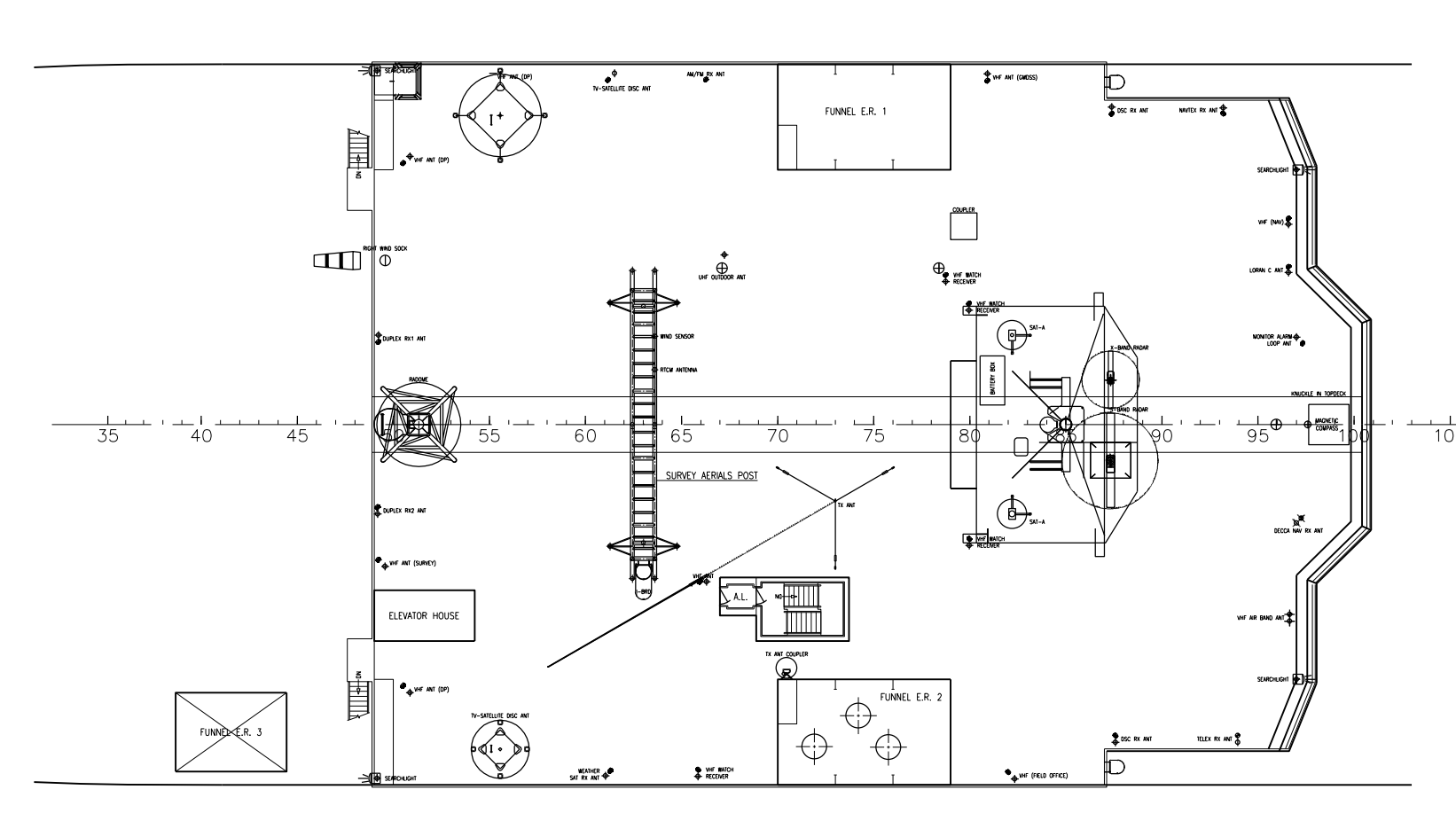
PLAN VIEW F-DECK  
(38550/39181 A.B.)



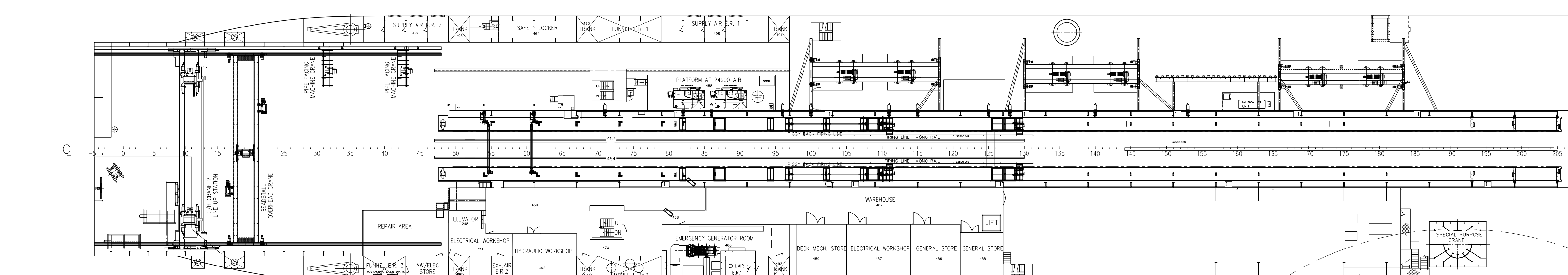
PLAN VIEW NAVIGATION BRIDGE DECK  
(41850 A.B.)



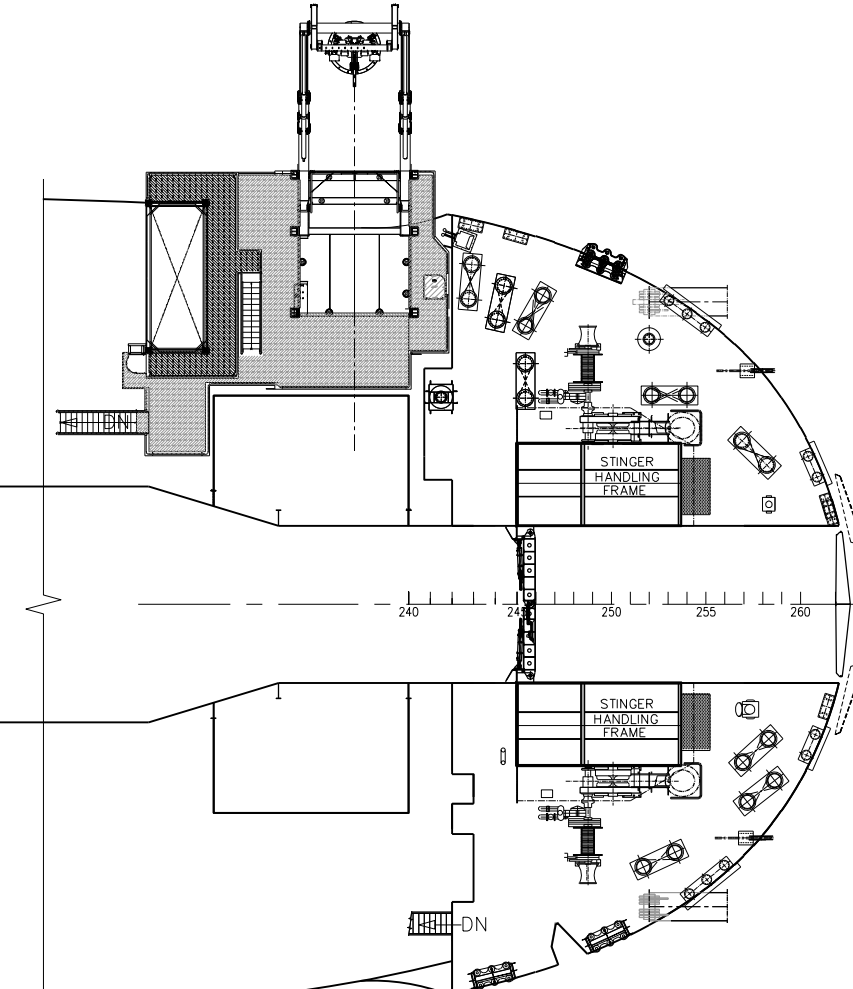
PLAN VIEW SUPER STRUCTURE DECK / C-DECK / TOP OF FIRING LINE  
(28800 A.B. / 28300 A.B.)



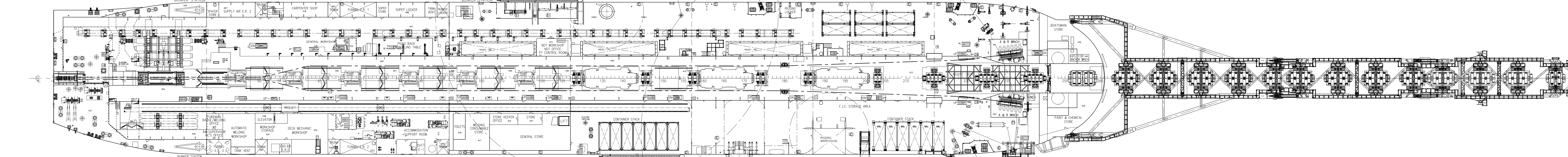
PLAN VIEW TOPDECK  
(45150 A.B.)



VIEW ON B DECK AND BIGGY BACK FIRING LINE  
(23800 A.B. / 24225 A.B.)



PLAN VIEW FORECASTLE DECK  
(24030 A.B.)



VIEW ON MAIN DECK  
(19200 A.B.)

REFERENCE DRAWINGS  
AU-10130-01-02 PIPELAY VESSEL AUDACIA  
GENERAL ARRANGEMENT - SHEET 2

MAIN DIMENSIONS

LENGTH (OVERALL) 225,000 m.  
LENGTH (BETWEEN P.P.) 217,000 m.  
BREADTH (MOULDED) 32,260 m.  
DEPTH (MOULDED) 19,200 m.  
LENGTH (INC. STINGER) 321,950 m.  
TRANSIT DRAFT 8.00-11.15 m.  
SCANTLING DRAFT 14.058 m.

CLASS NOTATION

100A1 OU, MULTIPURPOSE SUPPORT UNIT  
PIPELAYING UNIT, OWS, LA, LI  
LHC, DP(AAA), PQR (97.93)  
HELIDECK, SHIPRIGHT (SMC)

GRAPHIC SCALE 0 5 10 15 20 25 30 35 m  
1 : 300

|     |             |       |                 |          |          |          |          |
|-----|-------------|-------|-----------------|----------|----------|----------|----------|
| K   | 30 Jun 2014 | RMI   | FOR INFORMATION | CPJ      | MRS      | MDI      | RHA      |
| J   | 28 Oct 2011 | CPU   | FOR INFORMATION | eWML     | XoMDI    | JvR      |          |
| H   | 07 Jan 2009 | CPU   | FOR INFORMATION | GKU      | FGI      | MDI      | ALJS     |
| G   | 22 Nov 2007 | HvJ   | TOTAL REVISED   | VBuJ     | VBuJ     | MS       | MS       |
| F   | 15 Nov 2006 | GRO   | FOR INFORMATION | STH      | BP       | KEH      | Jg M     |
| E   | 02 Dec 2006 | GRO   | FOR INFORMATION | STH      | BP       | MS       | Jg M     |
| D   | 16 Jun 2006 | CT    | FOR INFORMATION | CTa      | BP       | MS       | LJM      |
| C   | 13 Mar 2006 | TvH   | FOR INFORMATION | STH      | MJOI     | MS       | LJM      |
| REV | DATE        | DRAWN | DESCRIPTION     | APPROVED | APPROVED | APPROVED | APPROVED |

PROJECT D.P. PIPELAY VESSEL "AUDACIA"

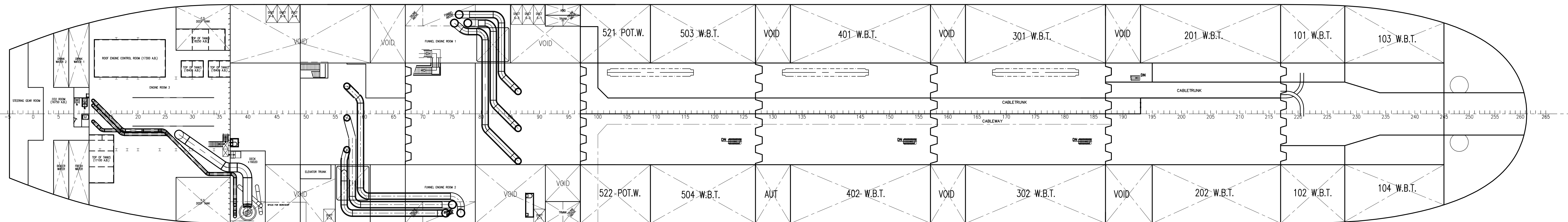
SUBJECT PIPELAY VESSEL AUDACIA  
GENERAL ARRANGEMENT - SHEET 1

|           |        |                     |      |            |       |
|-----------|--------|---------------------|------|------------|-------|
| THE SHEET |        | DRAWING             |      | SCALE      |       |
| NR        | 570001 | ORIGINATOR          | TvdH | SIZE       | A0    |
| AC        |        | UNITS               | mm   | SCALE      | 1:300 |
| JOB NO.   |        | JOB DESCRIPTION     |      | PROJECTION |       |
| 570001    |        |                     |      |            |       |
| FILE NO.  |        | ALLSEAS DRAWING NO. |      | MARK       |       |
| 570001    |        | AU-10130-01-01      |      | K          |       |

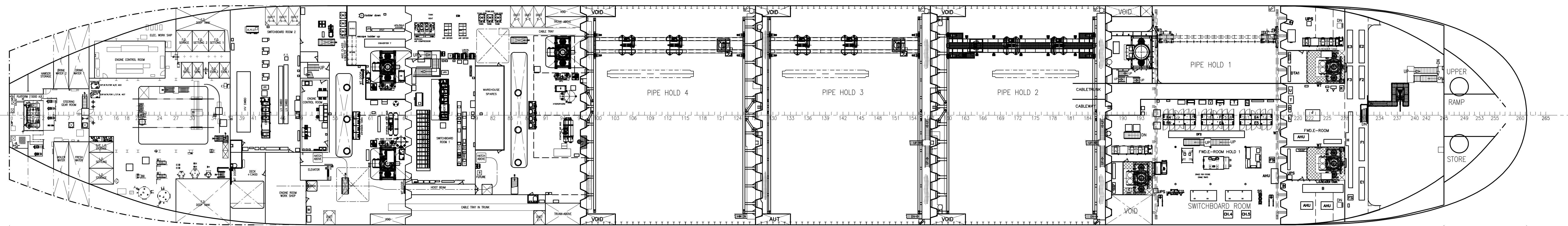
© Copyright Allseas. This document is the property of Allseas and may contain confidential and proprietary information. It may not be used for any purpose other than the one for which it is supplied. This document may not be wholly or partly disclosed, copied, reproduced or in any way made use of without prior written approval of Allseas.

SIGNED ON ORIGINAL

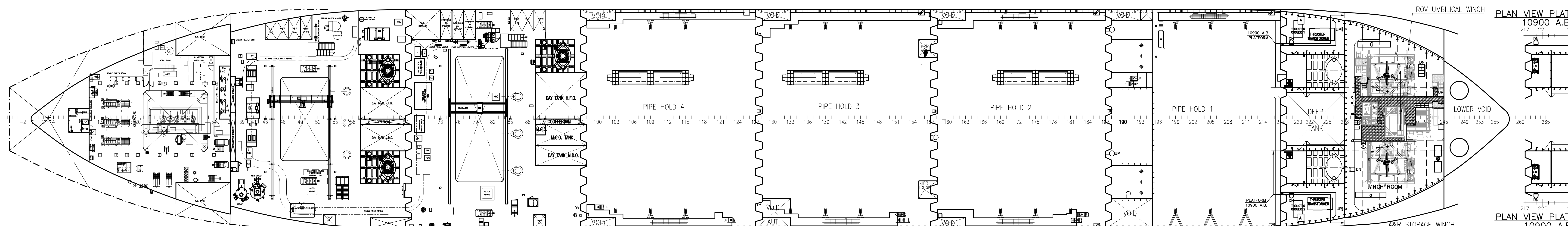
01-02  
AU-10130-01-02



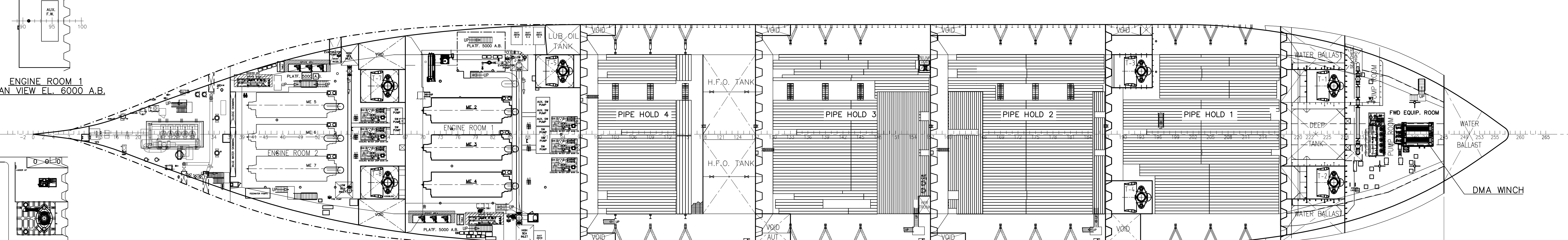
PLAN VIEW TOP WINGTANKS



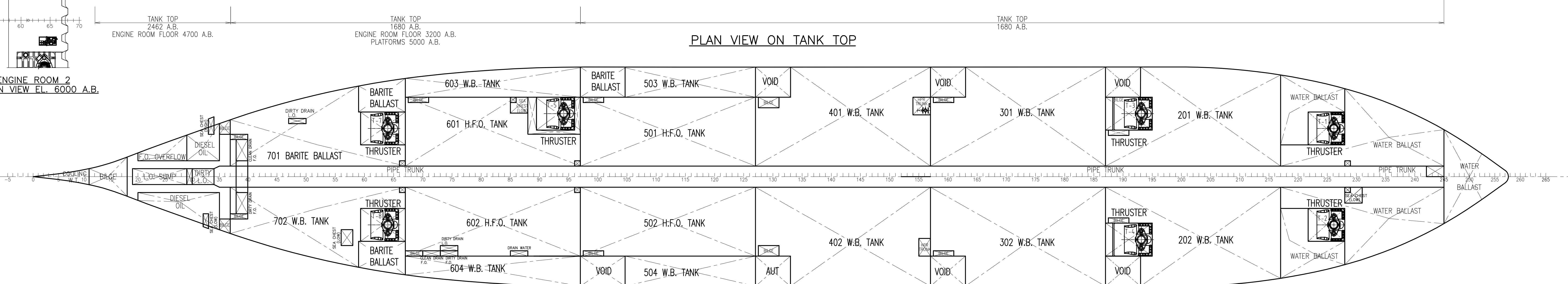
PLAN VIEW UPPER TWEENDECK



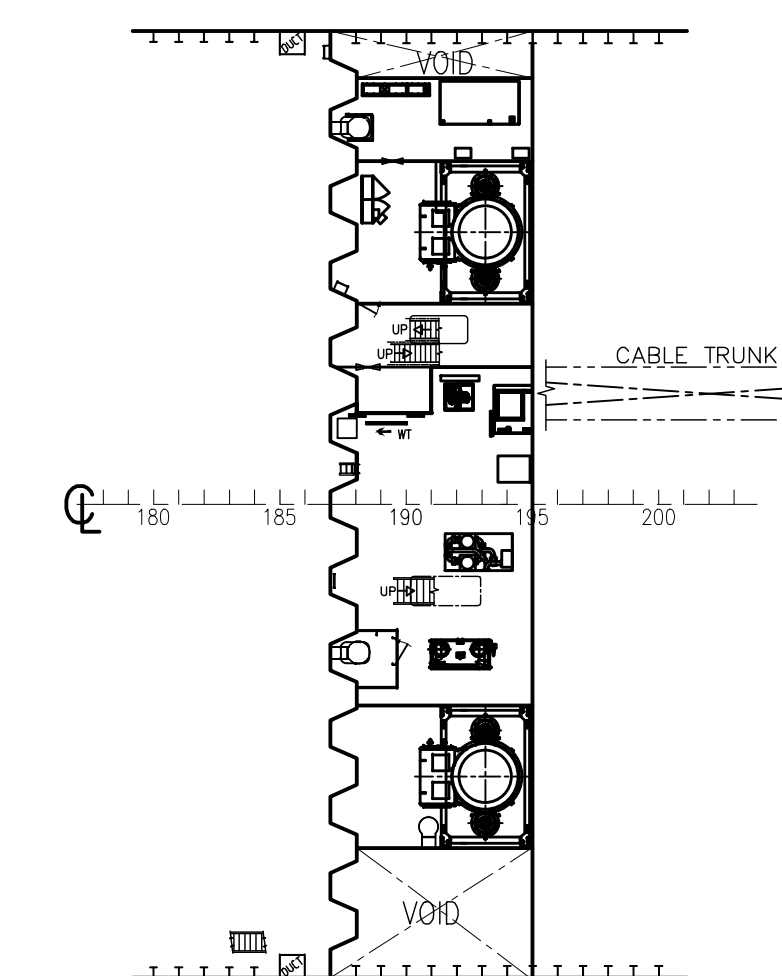
PLAN VIEW LOWER TWEENDECK



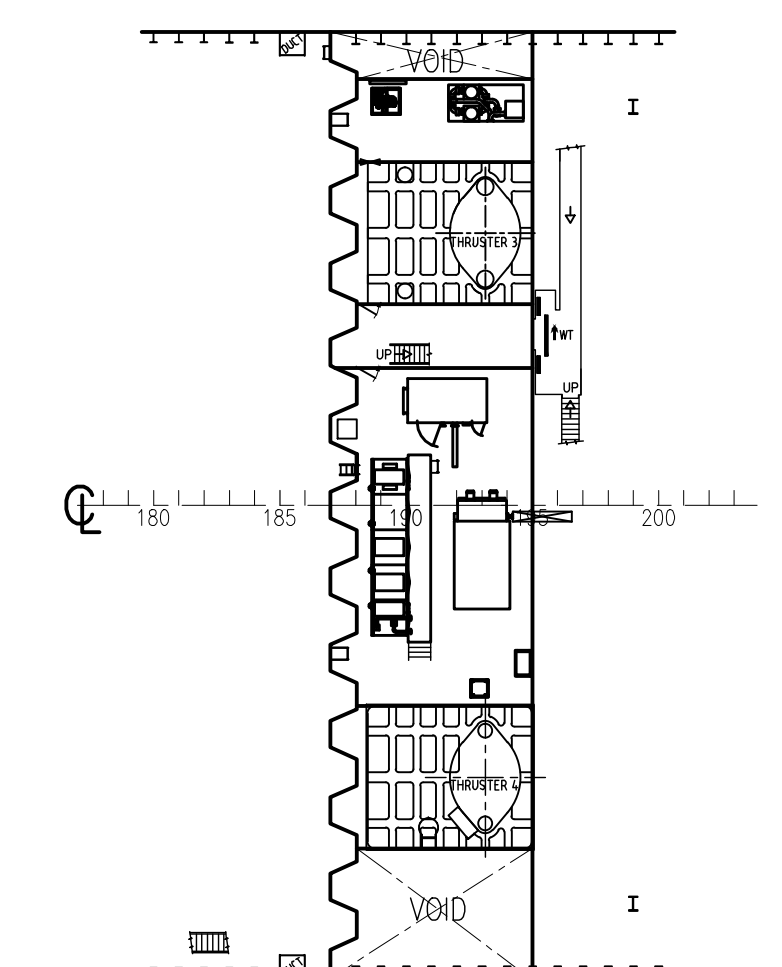
PLAN VIEW ON TANK TOP



PLAN VIEW BELOW TANK TOP



VIEW ON PLATFORM/STRINGER  
(10900 A.B.)



PLAN VIEW PLATFORM 10900 A.B.

| MAIN DIMENSIONS       |               |
|-----------------------|---------------|
| LENGTH (OVERALL)      | 225,000 m.    |
| LENGTH (BETWEEN P.P.) | 217,000 m.    |
| BREADTH (MOULDED)     | 32,260 m.     |
| DEPTH (MOULDED)       | 19,200 m.     |
| LENGTH (INC. STINGER) | 321,950 m.    |
| TRANSIT DRAFT         | 8.00-11.15 m. |
| SCANTLING DRAFT       | 14,058 m.     |

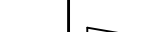
| CLASS NOTATION                        |  |
|---------------------------------------|--|
| \ 100A1 OU, MULTIPURPOSE SUPPORT UNIT |  |
| PIPELAYING UNIT, OIWS, LA, LI         |  |
| \ LMC, DP(AAA), PCR (97, 93)          |  |
| HELIDECK, SHIPRIGHT (SMC)             |  |

GRAPHIC SCALE 0 5 10 15 20 25 30 m  
1 : 250

|               |                     |                  |
|---------------|---------------------|------------------|
| H 30 Jun 2014 | RMt FOR INFORMATION | CPu MRg MDj RHe  |
| G 28 Oct 2011 | CPu FOR INFORMATION | eWM LVo MDj JvR  |
| F 07 Jan 2009 | CPu FOR INFORMATION | GKU FGI MDJ ALJS |
| E 22 Nov 2007 | HV TOTAL REVISED    | VBu VBu MS MS    |
| D 26 Sep 2006 | GRO FOR INFORMATION | STh BP MS pp MS  |
| REV.          | DATE                | DRAWN            |
|               |                     | DESCRIPTION      |
|               |                     | APPROVED         |
|               |                     | ENGINEERING      |
|               |                     | APPR. PROJ.      |

PROJECT D.P. PIPELAY VESSEL "AUDACIA"

SUBJECT PIPELAY VESSEL AUDACIA  
GENERAL ARRANGEMENT - SHEET 2

|           |        |                     |  |            |  |                                                                                       |  |       |  |
|-----------|--------|---------------------|--|------------|--|---------------------------------------------------------------------------------------|--|-------|--|
| TIMESHEET |        | ORIGINATOR          |  | SIZE       |  | DRAWING                                                                               |  | SCALE |  |
| NR        | 570001 | AudJMi              |  | AO         |  | mm                                                                                    |  | 1:250 |  |
| AC        |        |                     |  |            |  |                                                                                       |  |       |  |
| JOB No.   |        | JOB DESCRIPTION     |  | PROJECTION |  |                                                                                       |  |       |  |
| 570001    |        |                     |  |            |  |  |  |       |  |
| FILE No.  |        | ALLSEAS DRAWING No. |  |            |  |                                                                                       |  |       |  |
| 570001    |        | AU-10130-01-02      |  |            |  |                                                                                       |  |       |  |
|           |        |                     |  |            |  |                                                                                       |  |       |  |



© Copyright Allseas. This document is the property of Allseas and may contain confidential and proprietary information. It may not be copied, reproduced, or distributed in any form without the prior written consent of Allseas. The information contained herein is for internal use only and is not to be used for any other purpose. If this document is to be used for any other purpose, it must be duplicated or in any way made use of without the prior written consent of Allseas.

RESIDUAL

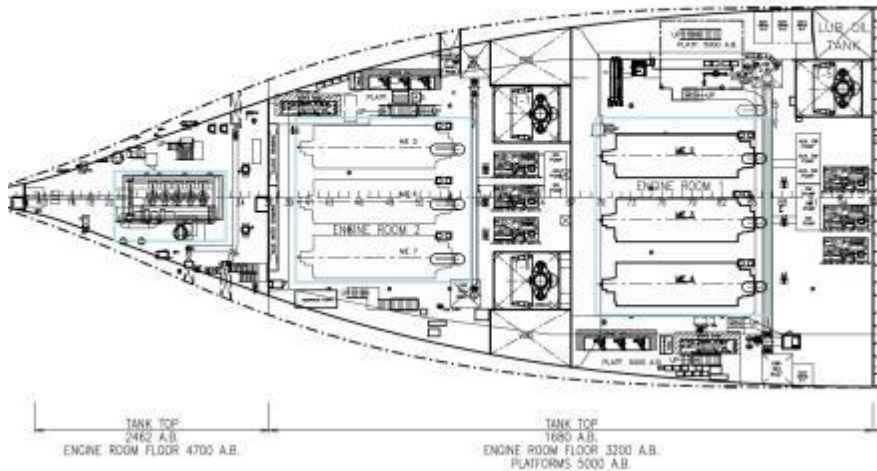
© Copyright Allseas. This document is the property of Allseas and may contain confidential and proprietary information. It may not be used for any purpose other than that for which it is supplied. This document may not be wholly or partly disclosed, copied, duplicated or in any way made use of without prior written approval of Allseas.

SIGNED ON ORIGINAL



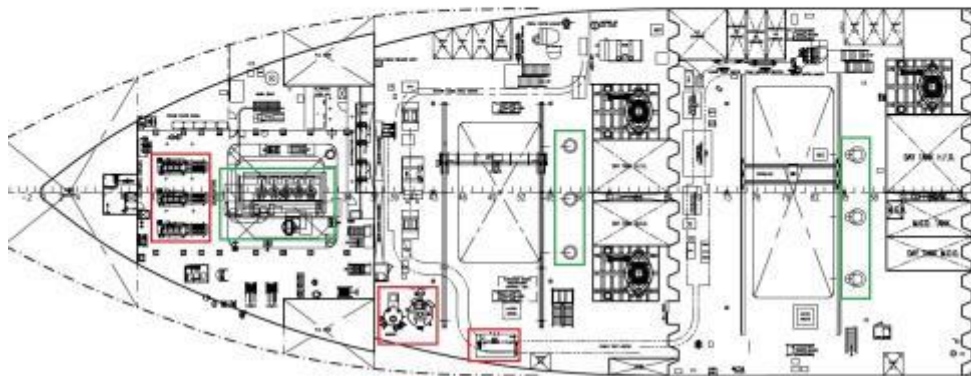
## Tank Top

De Tank Top bevindt zich op 1680 A.B. Het is het laagst liggende dek van de Audacia. Tussen de Base Line en de Tank Top zijn voornamelijk ballast tanks en opslagtanks te vinden. Dit niveau is laagste dek wat in beslag wordt genomen door de machinekamer. Op dit niveau staan onder andere de hoofdmotoren te vinden. Op de afbeelding is de verdeling te zien van de machinekamers. 10 tot 37 geeft machinekamer 3 (Engine Room, ER1) aan. 37 tot 67 geeft ER2 aan en 67 tot 97 geeft ER1 aan. Deze verdeling is vrijwel over de gehele hoogte van het schip te zien (Tot aan het Main Deck.) Iedere machinekamer is van elkaar afgescheiden door een dikke wand. Dit is goed te zien op Framelijns 97 (grens ER1).



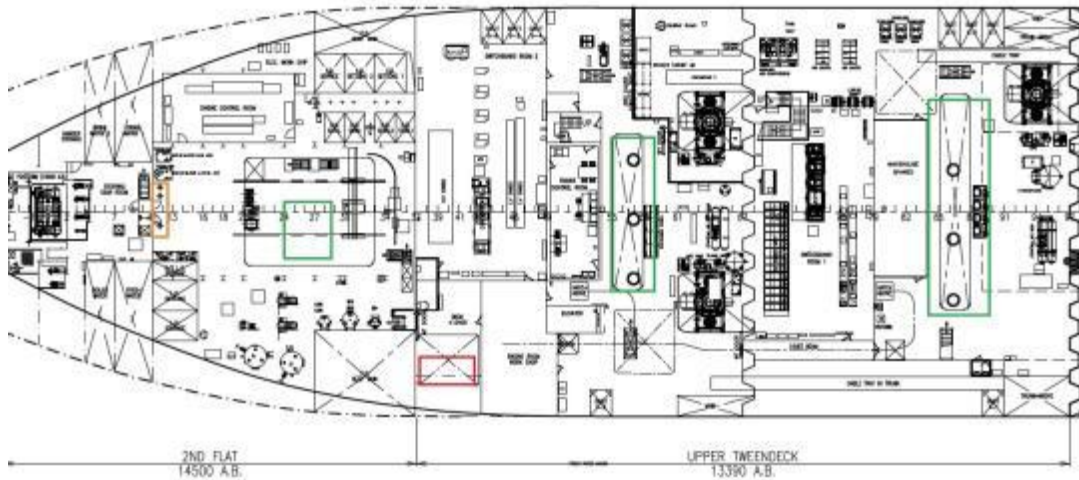
## Lower Tweendeck

Dit dek staat op 8,5 meter A.B. en is de laagste van de twee tweendecken. Hier zijn in ER2 de ketels en de Hotwell te zien. De uitlaten zijn hier ook weergegeven. In ER3 zijn ook de generators weergegeven. Dit omdat hun uitlaten bij de schoorsteen van de hoofdmotor van machinekamer 3 gooien.



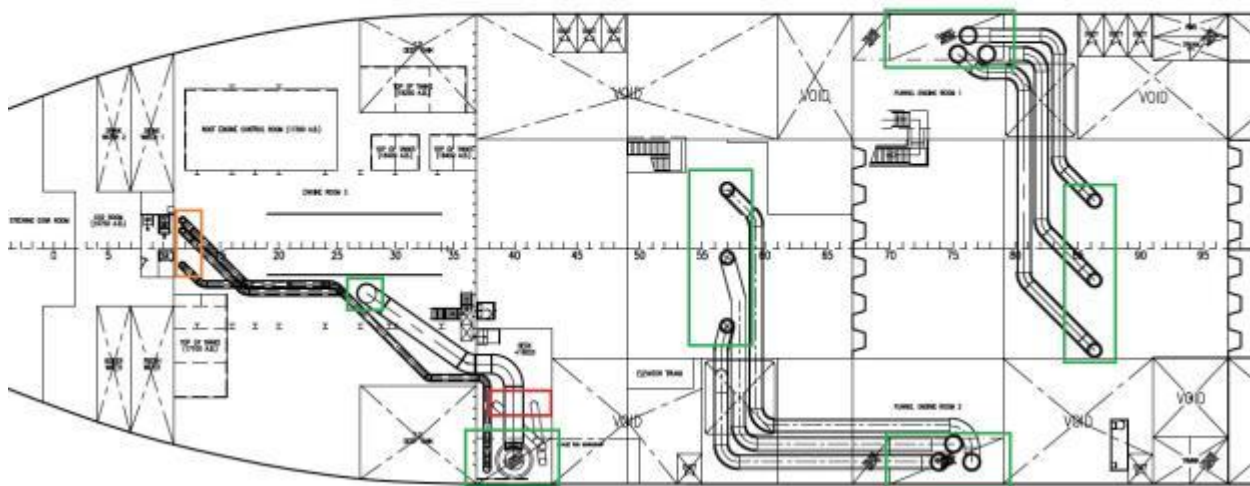
### Upper tweendeck

Bevindt zich op 13,4 meter A.B. Is de hoogst gelegen van de Tweendekken. Hier staan de uitlaatpijpen van de hoofdmotoren, de generators en de stoomketels weergegeven.



### Top Wingtanks

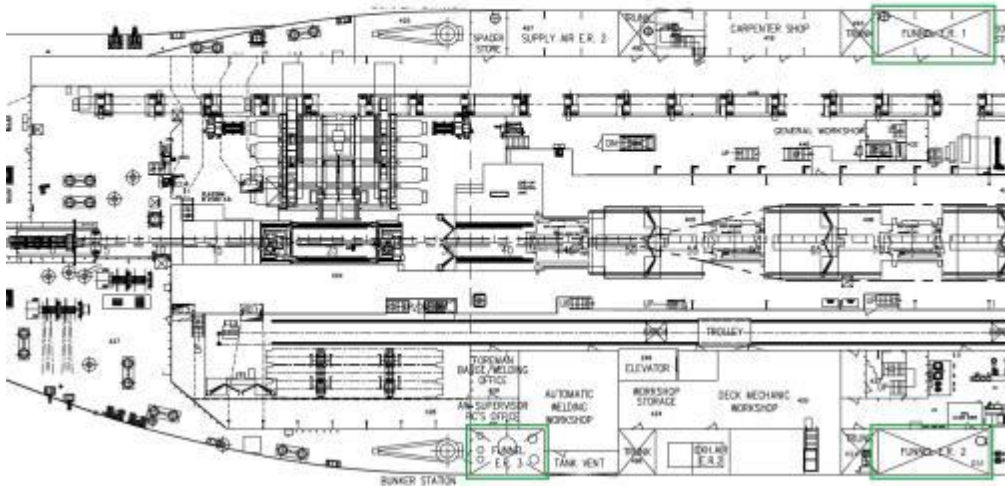
Hier staan de vorming van uitaalpijpen naar de schoorstenen weergegeven. De generator, stoomketels en de hoofdmotor komen in de zelfde schoorsteen terecht.



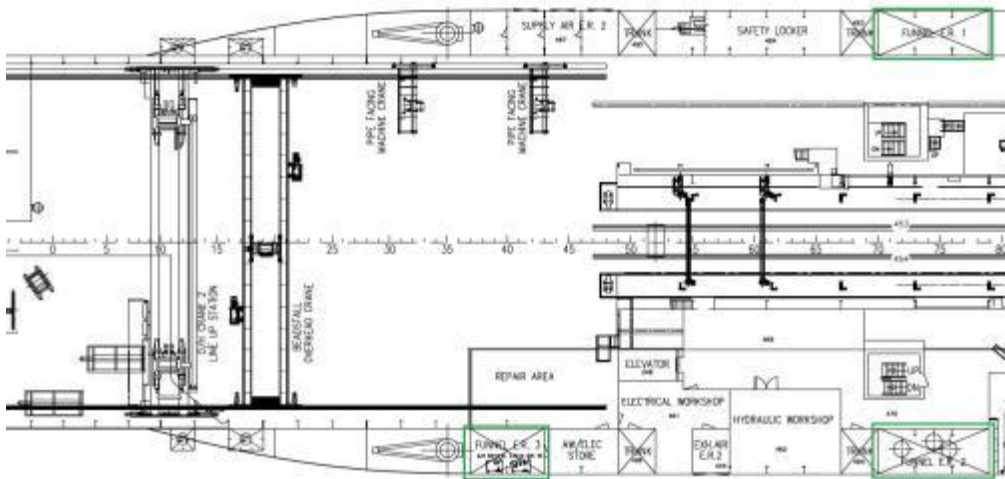
## Main deck

Op het main deck staat de Firing Line (pijpproductieproces.). Vanaf het main deck zijn de uitlaten vervangen door schoorstenen. Schoorsteen 1 en 2 zijn in afmetingen gelijk aan elkaar (7,7m x 4,6m) en blijft deze afmetingen hebben tot de verlating naar de atmosfeer.

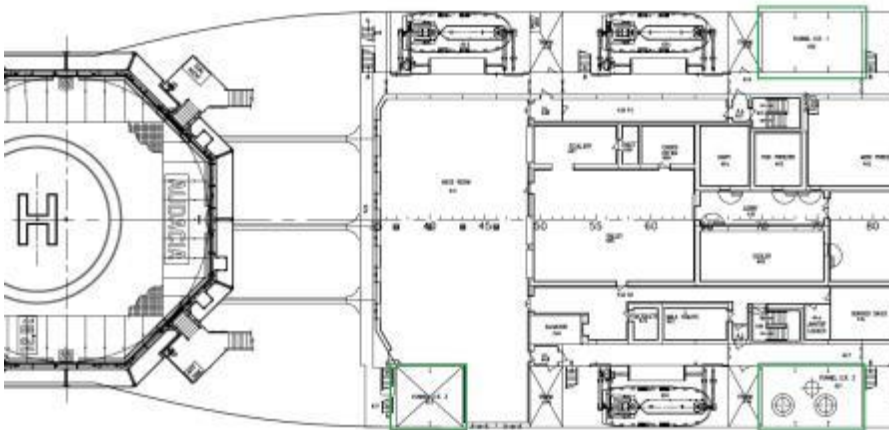
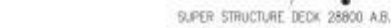
De schoorsteen van ER3 is 5,1m x 3,4m en verandert een aantal keer van afmetingen terwijl het naar de atmosfeer gaat. Deze wijzigingen staan aangegeven in de opvolgende tekeningen.



## B-Deck

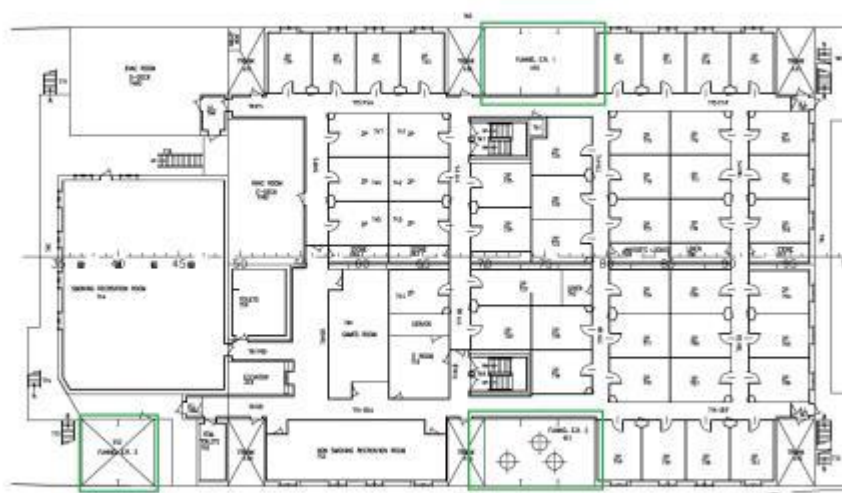


Op Het CDeck wordt de afmeting van schoorsteen 3 veranderd. De afmetingen zijn hier 5,1m x 4,6m.



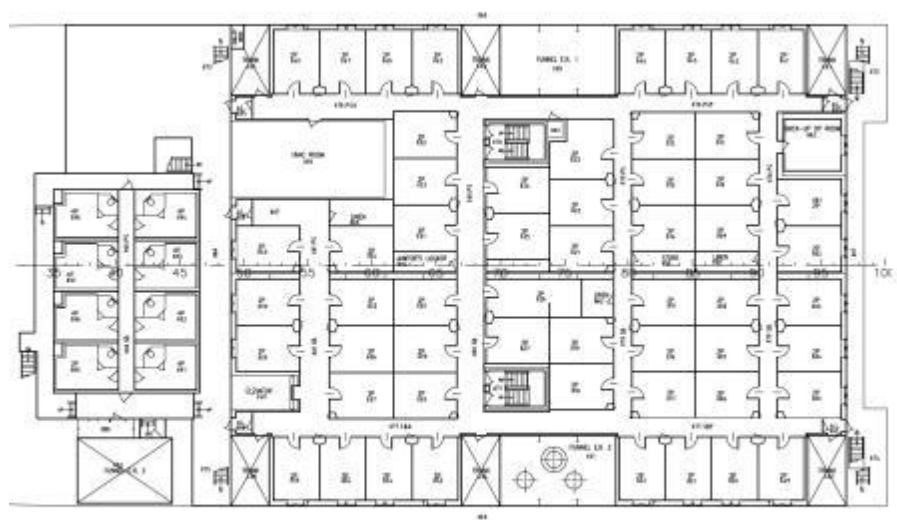
## E-Deck

Afmetingen schoorsteen 3 gaan naar 6,4mx4,6m



PLAN VIEW E-DECK  
(35400 A.B.)

## F-Deck



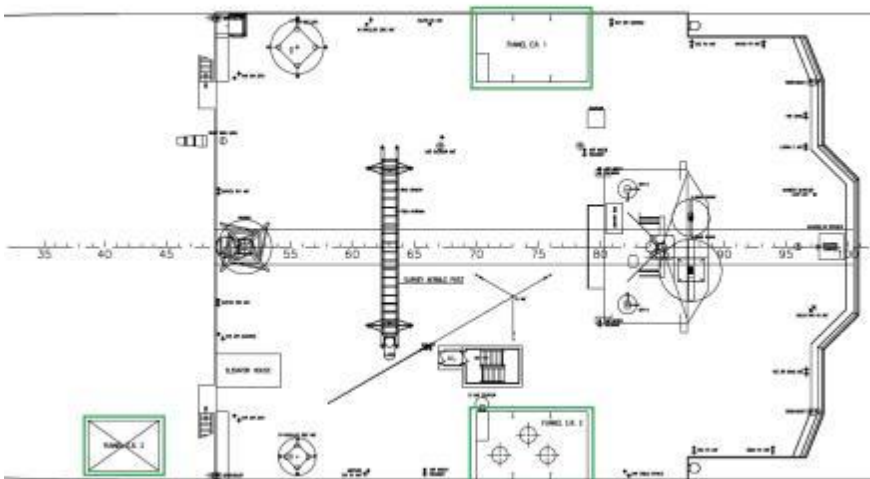
PLAN VIEW F-DECK  
(38550/39181 A.B.)

## Navigatiebrug Deck



PLAN VIEW NAVIGATION BRIDGE DECK  
(41850 A.B.)

## Topdeck



PLAN VIEW TOPDECK  
(45150 A.B.)

De installaties dienen in de machinekamer geplaatst te worden. Huidige onderdelen uitlaat, leidingen.  
Groen = funnels, hier lopen de schoorstenen door richting de atmosfeer.



| HFO operation | Item                          | Location | Number | kW | Max steam (kg/h) | Total (kg/h) | Transit/DP (HFO) |      | DP winter (MGO) with evaporators |      | DP summer (MGO) with evaporators |      | DP winter (MGO) without evaporators |      | DP summer (MGO) without evaporators |      | Comments  | Used formula: m <sub>h</sub> =q/h <sub>o</sub> |
|---------------|-------------------------------|----------|--------|----|------------------|--------------|------------------|------|----------------------------------|------|----------------------------------|------|-------------------------------------|------|-------------------------------------|------|-----------|------------------------------------------------|
|               |                               |          |        |    |                  |              | %                | kg/h | %                                | kg/h | %                                | kg/h | %                                   | kg/h | %                                   | kg/h |           |                                                |
| yes           | 640, clean fuel tank          | ER1      | 1      |    | 80               | 80           | 15%              | 12   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           | m <sub>h</sub> (kg/s)                          |
|               | Tracing drain oil pipe        | ER1      | 1      |    | 80               | 80           | 15%              | 12   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           | q (kW)                                         |
|               | 636, F.O. dirty oil tank      | ER1      | 1      |    | 20               | 20           | 15%              | 3    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       | h <sub>o</sub> (kJ/kg)                         |
|               | 634, L.O. dirty tank          | ER1      | 1      |    | 20               | 20           | 15%              | 3    | 10%                              | 2    | 0%                               | 0    | 10%                                 | 2    | 0%                                  | 0    | EMS       | Afgeleid uit spiralen overzicht Aalbo          |
| yes           | Heaters, purifier             | ER1      | 3      |    | 200              | 600          | 100%             | 600  | 80%                              | 480  | 80%                              | 480  | 80%                                 | 480  | 80%                                 | 480  |           | Loss energie piping                            |
|               | Fuel booster heater           | ER1      | 1      |    | 200              | 200          | 15%              | 30   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | UHS Tank top                  | ER1      | 2      | 36 | 52               | 105          | 15%              | 16   | 10%                              | 10   | 0%                               | 0    | 10%                                 | 10   | 0%                                  | 0    |           |                                                |
|               | UHS low er deck               | ER1      | 1      | 23 | 33               | 33           | 15%              | 5    | 10%                              | 3    | 0%                               | 0    | 10%                                 | 3    | 0%                                  | 0    |           |                                                |
|               | UHS switchboard Rm1 aft       | ER1      | 1      | 12 | 17               | 17           | 15%              | 3    | 10%                              | 2    | 0%                               | 0    | 10%                                 | 2    | 0%                                  | 0    |           |                                                |
|               | UHS tw eendeck                | ER1      | 1      | 17 | 25               | 25           | 15%              | 4    | 10%                              | 2    | 0%                               | 0    | 10%                                 | 2    | 0%                                  | 0    |           |                                                |
|               | UHS low er T deck             | ER1      | 1      | 23 | 33               | 33           | 15%              | 5    | 10%                              | 3    | 0%                               | 0    | 10%                                 | 3    | 0%                                  | 0    |           |                                                |
|               | UHS tweendeck                 | ER1      | 1      | 17 | 25               | 25           | 15%              | 4    | 10%                              | 2    | 0%                               | 0    | 10%                                 | 2    | 0%                                  | 0    |           |                                                |
|               | Wartsila pre heater           | ER1      | 3      |    | 80               | 240          | 15%              | 36   | 33%                              | 79   | 33%                              | 79   | 33%                                 | 79   | 33%                                 | 79   |           |                                                |
|               | 611, HFO tank PS              | ER1      | 1      |    | 450              | 450          | 15%              | 68   | 15%                              | 68   | 10%                              | 45   | 15%                                 | 68   | 10%                                 | 45   | EMS       |                                                |
|               | Evaporator                    | ER1      | 1      |    | 1500             | 1500         | 15%              | 225  | 55%                              | 825  | 50%                              | 750  | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | Heating acc. 1                | ACC      | 1      |    | 1450             | 1450         | 15%              | 218  | 33%                              | 479  | 0%                               | 0    | 33%                                 | 479  | 0%                                  | 0    | EMS       |                                                |
|               | Heating acc. 2                | ACC      | 1      |    | 1450             | 1450         | 15%              | 218  | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
|               | Portable calorifier           | ACC      | 1      |    | 668              | 668          | 100%             | 668  | 40%                              | 267  | 30%                              | 200  | 40%                                 | 267  | 30%                                 | 200  | EMS       |                                                |
|               | Incinerator                   | C&D      | 1      |    | 120              | 120          | 15%              | 18   | 15%                              | 18   | 10%                              | 12   | 15%                                 | 18   | 10%                                 | 12   |           |                                                |
|               | Tracing drain oil pipe        | ER2      | 1      |    | 80               | 80           | 15%              | 12   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | 735, dirty oil tank           | ER2      | 1      |    | 20               | 20           | 15%              | 3    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
|               | 714, bilge skimming           | ER2      | 1      |    | 40               | 40           | 15%              | 6    | 20%                              | 8    | 15%                              | 6    | 20%                                 | 8    | 15%                                 | 6    | EMS       |                                                |
|               | 739, clean fuel tank          | ER2      | 1      |    | 80               | 80           | 15%              | 12   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | 712, sludge tank              | ER2      | 1      |    | 10               | 10           | 15%              | 2    | 20%                              | 2    | 15%                              | 2    | 20%                                 | 2    | 15%                                 | 2    | EMS       |                                                |
|               | Fuel booster heater           | ER2      | 1      |    | 200              | 200          | 15%              | 30   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | UHS Tank top                  | ER2      | 2      | 36 | 52               | 105          | 15%              | 16   | 10%                              | 10   | 0%                               | 0    | 10%                                 | 10   | 0%                                  | 0    |           |                                                |
|               | UHS switchboard Rm2           | ER2      | 1      | 46 | 67               | 67           | 15%              | 10   | 10%                              | 7    | 0%                               | 0    | 10%                                 | 7    | 0%                                  | 0    |           |                                                |
|               | 733, dirty oil tank           | ER2      | 1      |    | 20               | 20           | 15%              | 3    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
|               | 711, lube oil renovation tank | ER2      | 1      |    | 80               | 80           | 15%              | 12   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | Heaters, purifier             | ER2      | 3      |    | 200              | 600          | 15%              | 90   | 80%                              | 480  | 80%                              | 480  | 80%                                 | 480  | 80%                                 | 480  |           |                                                |
|               | Evaporator                    | ER2      | 1      |    | 1500             | 1500         | 15%              | 225  | 55%                              | 825  | 50%                              | 750  | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | UHS upper tw eendeck          | ER2      | 1      | 23 | 33               | 33           | 15%              | 5    | 10%                              | 3    | 0%                               | 0    | 10%                                 | 3    | 0%                                  | 0    |           |                                                |
|               | UHS low er tw eendeck         | ER2      | 1      | 23 | 33               | 33           | 15%              | 5    | 10%                              | 3    | 0%                               | 0    | 10%                                 | 3    | 0%                                  | 0    |           |                                                |
|               | Wartsila pre heater           | ER2      | 3      |    | 80               | 240          | 15%              | 36   | 33%                              | 79   | 33%                              | 79   | 33%                                 | 79   | 33%                                 | 79   |           |                                                |
| yes           | 713, HFO tank PS              | ER2      | 1      |    | 20               | 20           | 15%              | 3    | 15%                              | 3    | 10%                              | 2    | 15%                                 | 3    | 10%                                 | 2    | EMS       |                                                |
|               | Calorifier                    | ER3      | 1      |    |                  | 0            | 100%             | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           | removed                                        |
|               | Platform 2 FW                 | ER3      | 1      |    |                  | 0            | 15%              | 0    | 10%                              | 0    | 0%                               | 0    | 10%                                 | 0    | 0%                                  | 0    |           |                                                |
|               | Platform 2 AFT                | ER3      | 1      |    |                  | 0            | 15%              | 0    | 10%                              | 0    | 0%                               | 0    | 10%                                 | 0    | 0%                                  | 0    |           |                                                |
|               | Cleaning sea chest & steam    | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | Cleaning emer. Fire pump      | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | Steaming floor                | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | 852, gen lub oil sett tank    | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | 826, lub oil sett tank        | ER3      | 1      |    | 40               | 40           | 15%              | 6    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
|               | Tracing drain oil pipe        | ER3      | 1      |    | 80               | 80           | 15%              | 12   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | estimated |                                                |
| yes           | 821, HFO service tank         | ER3      | 1      |    | 93               | 93           | 15%              | 14   | 15%                              | 14   | 10%                              | 9    | 15%                                 | 14   | 10%                                 | 9    | EMS       |                                                |
| yes           | 823, HFO sett tank            | ER3      | 1      |    | 93               | 93           | 15%              | 14   | 15%                              | 14   | 10%                              | 9    | 15%                                 | 14   | 10%                                 | 9    | EMS       |                                                |
| yes           | 825, MDO sett tank            | ER3      | 1      |    | 5                | 5            | 15%              | 1    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
| yes           | 851, sett tank                | ER3      | 1      |    | 93               | 93           | 15%              | 14   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
|               | Main engine jacket w ater     | ER3      | 1      |    | 130              | 130          | 15%              | 20   | 25%                              | 33   | 20%                              | 26   | 25%                                 | 33   | 20%                                 | 26   | EMS       |                                                |
|               | Main engine fuel oil filter   | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | Generator fuel oil filter     | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
| yes           | F.O. supply unit              | ER3      | 1      |    | 130              | 130          | 15%              | 20   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | Tracing drain oil pipe        | ER3      | 2      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | Fuel oil purifier             | ER3      | 3      |    | 174              | 522          | 15%              | 78   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
|               | Lube oil purifier             | ER3      | 1      |    | 93               | 93           | 15%              | 14   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
|               | 814, sludge tank              | ER3      | 1      |    | 20               | 20           | 15%              | 3    | 30%                              | 6    | 25%                              | 5    | 30%                                 | 6    | 25%                                 | 5    | EMS       |                                                |
| yes           | 811, HFO deep tank            | ER3      | 1      |    | 223              | 223          | 15%              | 33   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
|               | 812, HFO deep tank            | ER3      | 1      |    | 223              | 223          | 15%              | 33   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
|               | Tracing drain oil pipe        | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
| yes           | 501, HFO tank                 | ER3      | 1      |    | 540              | 540          | 15%              | 81   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
| yes           | 502, HFO tank                 | ER3      | 1      |    | 540              | 540          | 15%              | 81   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
| yes           | 601, HFO tank                 | ER3      | 1      |    | 450              | 450          | 15%              | 68   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
| yes           | 602, HFO tank                 | ER3      | 1      |    | 450              | 450          | 15%              | 68   | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    | EMS       |                                                |
|               | 800, bilge tank               | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | 860, dirty lube oil tank      | ER3      | 1      |    |                  | 0            | 15%              | 0    | 30%                              | 0    | 25%                              | 0    | 30%                                 | 0    | 25%                                 | 0    | EMS       |                                                |
|               | Bilge w ater sepp             | ER3      | 1      |    |                  | 0            | 15%              | 0    | 10%                              | 0    | 5%                               | 0    | 10%                                 | 0    | 5%                                  | 0    |           |                                                |
|               | 125, fuel oil drain           | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | Chemical clean tank           | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | Stuff box                     | ER3      | 1      |    |                  | 0            | 15%              | 0    | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
| yes           | 801, fuel oil over/low tank   | ER3      | 1      |    | 20               | 20           | 15%              | 3    | 5%                               | 1    | 5%                               | 1    | 5%                                  | 1    | 5%                                  | 1    | EMS       |                                                |
|               | 802, lube oil sump            | ER3      | 1      |    | 25               | 25           | 15%              | 4    | 30%                              | 8    | 25%                              | 6    | 30%                                 | 8    | 25%                                 | 6    | EMS       |                                                |
| yes           | HFO Booster unit ER1          | ER1      | 2      |    | 230              | 460          | 50%              | 230  | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | HFO Booster unit ER2          | ER2      | 2      |    | 230              | 460          | 50%              | 230  | 0%                               | 0    | 0%                               | 0    | 0%                                  | 0    | 0%                                  | 0    |           |                                                |
|               | Deck heaters 3kW              | AFT      | 19     | 3  | 4                | 83           | 15%              | 12   | 15%                              | 12   | 0%                               | 0    | 15%                                 | 12   | 0%                                  | 0    |           |                                                |
|               | Deck heaters 5kW              | AFT      | 1      | 5  | 7                | 7            | 15%              | 1    | 15%                              | 1    | 0%                               | 0    | 15%                                 | 1    | 0%                                  | 0    |           |                                                |
|               | Deck heaters 9kW              | AFT      | 1      | 9  | 13               | 13           | 15%              | 2    | 15%                              | 2    |                                  |      |                                     |      |                                     |      |           |                                                |

[illegible]

General information:

|                                            |         |         |               |                        |             |
|--------------------------------------------|---------|---------|---------------|------------------------|-------------|
| Price fuel HFO, 3.5% sulpher, 380cSt       | 350     | \$/ton  | 17-Jun-15     | source: bunkerworld    |             |
| Price fuel MGO, 0.1% sulpher               | 544     | \$/ton  | 17-Jun-15     | source: bunkerworld    |             |
| Exchange rate dollar to euro               | 0.89    |         | 17-Jun-15     | source: wisselkoers.nl |             |
| Percentage sailing warm area               | 80      | [%]     | week 42, 2014 | source: Allseas        |             |
| Percentage sailing cold area               | 20      | [%]     | week 42, 2014 | source: Allseas        | 3.277564821 |
| MGO caloric value                          | 42.3    | [MJ/kg] |               |                        |             |
| HFO caloric value                          | 40.2    | [MJ/kg] |               |                        |             |
| HFO (LS) caloric value                     | 40.5    | [MJ/kg] |               |                        |             |
| amount of engines                          | 6       |         |               |                        |             |
| amount of engines online                   | 4       |         |               |                        |             |
| avg power output                           | 25      | [%]     |               |                        |             |
| Estimated investment Aalborg               | 1059000 | [€]     |               |                        |             |
| Estimated investment Heatmaster            | 1159000 | [€]     |               |                        |             |
| Estimated investment Saacke                | 800000  | [€]     |               |                        |             |
| Average fuel consumption Audacia 2008-2012 | 10000   | [ton]   |               |                        |             |

Boiler specifications OS1600

|                          |         |         |
|--------------------------|---------|---------|
| p systeem (absolute)     | 8bar    | [bar]   |
| p return (absolute)      | 1 bar   | [bar]   |
| S (1 bar,50° C)          | 200     | [kJ/kg] |
| S (8bar saturated steam) | 2767    | [kJ/kg] |
| Air consumption          | 1944.63 | [kg/h]  |
| ηtot % (calculated)      | 85      | [%]     |

|                                            |                 |             |                     |
|--------------------------------------------|-----------------|-------------|---------------------|
| <b>Fuel oil reduction per year</b>         | <b>[€/year]</b> | <b>[%]</b>  | <b>Payback time</b> |
| <b>Worst case using boiler Aalborg</b>     | <b>330042</b>   | <b>10.1</b> | <b>3.2</b>          |
| <b>Best case using boiler Aalborg</b>      | <b>487512</b>   | <b>10.6</b> | <b>2.2</b>          |
| <b>Worst case using exhaust gas boiler</b> | <b>353616</b>   | <b>10.8</b> | <b>3.3</b>          |
| <b>Best case using exhaust gas boiler</b>  | <b>522334</b>   | <b>11.4</b> | <b>2.2</b>          |

Steam consumer figures (calculated)

|                                      |      |        |             |
|--------------------------------------|------|--------|-------------|
| HFO, with evaporators                | 4070 | [kg/h] |             |
| HFO, without evaporators             | 3620 | [kg/h] |             |
| MGO, with evaporators (cold area)    | 4291 | [kg/h] | 2.748224793 |
| MGO, without evaporators (cold area) | 2398 | [kg/h] |             |
| MGO, with evaporators (warm area)    | 3119 | [kg/h] |             |
| MGO, without evaporators (warm area) | 1442 | [kg/h] | 1050000     |

Steam consumer figures (measured)

|                                                     |      |        |
|-----------------------------------------------------|------|--------|
| HFO, with evaporator (warm area)                    | 3329 | [kg/h] |
| HFO, with without evaporator, estimated (warm area) | 1829 | [kg/h] |

Calculation fuel consumption based on specs OS1600

|                                     | HFO with<br>calculated | HFO without<br>calculated | HFO with<br>measured | HFO without<br>measured | MGO with<br>calc (cold) | MGO without<br>calc (cold) | MGO with<br>calc (warm) | MGO without<br>calc (warm) |
|-------------------------------------|------------------------|---------------------------|----------------------|-------------------------|-------------------------|----------------------------|-------------------------|----------------------------|
| Q consumed [kW/h]                   | 2902                   | 2581                      | 2374                 | 1304                    | 3060                    | 1710                       | 2224                    | 1028                       |
| Q generated [kW/h]                  | 3414                   | 3036                      | 2792                 | 1534                    | 3600                    | 2012                       | 2616                    | 1210                       |
| MGO fuel consumption [ton/day]      | 6.97                   | 6.20                      | 5.70                 | 3.13                    | 7.35                    | 4.11                       | 5.34                    | 2.47                       |
| HFO fuel consumption [ton/day]      | 7.34                   | 6.53                      | 6.00                 | 3.30                    | 7.74                    | 4.32                       | 5.62                    | 2.60                       |
| HFO (LS) fuel consumption [ton/day] | 7.28                   | 6.48                      | 5.96                 | 3.27                    | 7.68                    | 4.29                       | 5.58                    | 2.58                       |

Exhaust gas boiler specs

|                                  |       |       |       |       |       |       |     |    |
|----------------------------------|-------|-------|-------|-------|-------|-------|-----|----|
| Engine load [%]                  | 100   | 85    | 75    | 50    | 40    | 30    | 20  | 10 |
| Exh. Gas mass flow [kg/h]        | 43200 | 37080 | 32868 | 22320 | 17280 | 12960 |     |    |
| Exh. Gas inlet temp [°C]         | 359   | 366   | 378   | 421   | 400   | 400   |     |    |
| Steam capacity solution 1 [kg/h] | 0     | 0     | 0     | 0     | 0     | 0     | 700 | 0  |
| Steam capacity solution 2 [kg/h] | 1390  | 0     | 1075  | 1120  | 0     | 0     | 750 | 0  |
| Steam capacity solution 3 [kg/h] | 0     | 0     | 0     | 0     | 0     | 0     | 400 | 0  |

Avg.

Running hours engines, source: oracle

|     | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | Average |
|-----|------|------|------|------|------|------|---------|
| DG2 | 3778 | 3204 | 2692 | 2928 | 4175 | 3660 | 3406    |
| DG3 | 4541 | 3319 | 2857 | 3375 | 2259 | 4184 | 3423    |
| DG4 | 4130 | 3877 | 4017 | 2865 | 5970 | 2549 | 3901    |
| DG5 | 4800 | 3895 | 3775 | 2520 | 5785 | 2660 | 3906    |
| DG6 | 3593 | 2456 | 2405 | 2684 | 2583 | 2536 | 2710    |
| DG7 | 3576 | 3031 | 1954 | 1745 | 2903 | 3624 | 2806    |
|     |      |      |      |      |      |      | 3358    |

Total with  
avallible  
engines

|                                        |     |      |
|----------------------------------------|-----|------|
| Per engine                             | 700 | 2800 |
| Maximum steam output solution 1 [kg/h] | 750 | 3000 |
| Maximum steam output solution 2 [kg/h] | 400 | 1600 |

|                                                        | HFO with<br>calculated | HFO without<br>calculated | HFO with<br>measured | HFO without<br>measured | MGO with<br>calc (cold) | MGO without<br>calc (cold) | MGO with<br>calc (warm) | MGO without<br>calc (warm) |
|--------------------------------------------------------|------------------------|---------------------------|----------------------|-------------------------|-------------------------|----------------------------|-------------------------|----------------------------|
| Total steam consumption [kg/year]                      | 35649657               | 31707657                  | 29159444             | 16019444                | 37589872                | 21008143                   | 27319628                | 12633234                   |
| Maximum produced steam by boilers solution 1 [kg/year] | 14103600               | 14103600                  | 14103600             | 14103600                | 14103600                | 14103600                   | 14103600                | 14103600                   |
| Maximum produced steam by boilers solution 2 [kg/year] | 15111000               | 15111000                  | 15111000             | 15111000                | 15111000                | 15111000                   | 15111000                | 15111000                   |
| Maximum produced steam by boilers solution 3 [kg/year] | 8059200                | 8059200                   | 8059200              | 8059200                 | 8059200                 | 8059200                    | 8059200                 | 8059200                    |
| Diff solution 1 [kg/year]                              | 21546057               | 17604057                  | 15055844             | 1915844                 | 23486272                | 6904543                    | 13216028                | -1470366                   |
| Diff solution 2 [kg/year]                              | 20538657               | 16596657                  | 14048444             | 908444                  | 22478872                | 5897143                    | 12208628                | -2477766                   |
| Diff solution 3 [kg/year]                              | 27590457               | 23648457                  | 21100244             | 7960244                 | 29530672                | 12948943                   | 19260428                | 4574034                    |

|                                                    |       |       |       |       |        |       |       |       |
|----------------------------------------------------|-------|-------|-------|-------|--------|-------|-------|-------|
| Total steam consumption [kg/day]                   | 97670 | 86870 | 79889 | 43889 | 102986 | 57557 | 74848 | 34612 |
| Maximum produced steam by boilers XS-TC7A [kg/day] | 38640 | 38640 | 38640 | 38640 | 38640  | 38640 | 38640 | 38640 |
| Maximum produced steam by boilers XS-2V [kg/day]   | 41400 | 41400 | 41400 | 41400 | 41400  | 41400 | 41400 | 41400 |
| Maximum produced steam by boilers 3                | 22080 | 22080 | 22080 | 22080 | 22080  | 22080 | 22080 | 22080 |
| Diff solution 1 [kg/year]                          | 59030 | 48230 | 41249 | 5249  | 64346  | 18917 | 36208 | -4028 |
| Diff solution 2 [kg/day]                           | 56270 | 45470 | 38489 | 2489  | 61586  | 16157 | 33448 | -6788 |
| Diff solution 3 [kg/year]                          | 75590 | 64790 | 57809 | 21809 | 80906  | 35477 | 52768 | 12532 |

Calculation fuel consumption with use of solution 2

|                                     | HFO with<br>calculated | HFO without<br>calculated | HFO with<br>measured | HFO without<br>measured | MGO with<br>calc (cold) | MGO without<br>calc (cold) | MGO with<br>calc (warm) | MGO without<br>calc (warm) |
|-------------------------------------|------------------------|---------------------------|----------------------|-------------------------|-------------------------|----------------------------|-------------------------|----------------------------|
| Q consumed [kW/h]                   | 1672                   | 1351                      | 1144                 | 74                      | 1830                    | 480                        | 994                     | -202                       |
| Q generated [kW/h]                  | 1967                   | 1589                      | 1345                 | 87                      | 2153                    | 565                        | 1169                    | -237                       |
| MGO fuel consumption [ton/day]      | 4.02                   | 3.25                      | 2.75                 | 0.18                    | 4.40                    | 1.15                       | 2.39                    | -0.48                      |
| HFO fuel consumption [ton/day]      | 4.23                   | 3.42                      | 2.89                 | 0.19                    | 4.63                    | 1.21                       | 2.51                    | -0.51                      |
| HFO (LS) fuel consumption [ton/day] | 4.20                   | 3.39                      | 2.87                 | 0.19                    | 4.59                    | 1.20                       | 2.49                    | -0.51                      |

|                                                          |        |        |        |        |         |        |        |        |
|----------------------------------------------------------|--------|--------|--------|--------|---------|--------|--------|--------|
| Fuel oil consumption [€/year]                            | 834246 | 741999 | 682367 | 374875 | 1299351 | 726178 | 944344 | 436687 |
| Fuel oil consumption with solution 1 assistants [€/year] | 504205 | 411957 | 352325 | 44833  | 811838  | 238666 | 456832 | -50825 |
| Fuel oil consumption with solution 2 assistants [€/year] | 480630 | 388382 | 328751 | 21259  | 777016  | 203844 | 422010 | -85648 |
| Fuel oil consumption with solution 3 assistants [€/year] | 645651 | 553403 | 493772 | 186280 | 1020772 | 447600 | 665766 | 158108 |

Fuel oil reduction per year

|                                |        |        |        |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Price diff solution 1 [€/year] | 330042 | 330042 | 330042 | 330042 | 487512 | 487512 | 487512 | 487512 |
| Price diff solution 2 [€/year] | 353616 | 353616 | 353616 | 353616 | 522334 | 522334 | 522334 | 522334 |
| Price diff solution 3 [€/year] | 188595 | 188595 | 188595 | 188595 | 278578 | 278578 | 278578 | 278578 |

|                                     |      |      |      |      |      |      |      |      |
|-------------------------------------|------|------|------|------|------|------|------|------|
| Fuel reduction solution 1 [ton/day] | 2.90 | 2.90 | 2.90 | 2.90 | 2.76 | 2.76 | 2.76 | 2.76 |
| Fuel reduction solution 2 [ton/day] | 3.11 | 3.11 | 3.11 | 3.11 | 2.96 | 2.96 | 2.96 | 2.96 |
| Fuel reduction solution 3 [ton/day] | 1.60 | 1.66 | 1.66 | 1.66 | 1.58 | 1.58 | 1.58 | 1.58 |



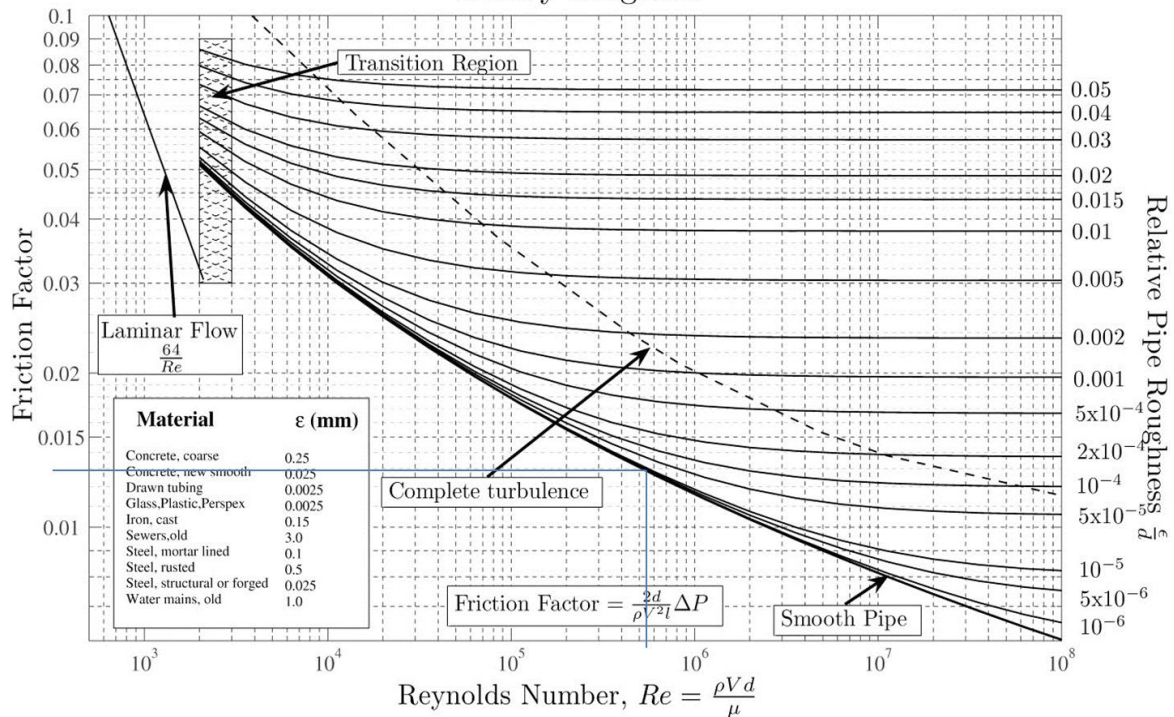
## Theoretical

|                               |        |        |        |        |         | <u>Parameters</u>  |           | Percentage in |                             |
|-------------------------------|--------|--------|--------|--------|---------|--------------------|-----------|---------------|-----------------------------|
|                               |        |        |        |        |         | soortelijk gewicht |           | uitlaatgas    |                             |
|                               |        |        |        |        |         |                    | [kg/m3]   | [%]           | Comments                    |
| Load                          | 50     | 75     | 85     | 100    | [%]     |                    |           |               |                             |
| Exhaust gas flow              | 6.2    | 9.13   | 10.3   | 12     | [kg/s]  | N2                 | 1.25      | 76%           |                             |
| Exhaust gas temperature       | 346    | 328    | 346    | 369    | [°C]    | O2                 | 1.43      | 12%           |                             |
|                               |        |        |        |        |         | CO2                | 1.98      | 6%            |                             |
|                               |        |        |        |        |         | H2O                | 0.598     | 6%            | by 100°C                    |
| <u>Total mass exhaust gas</u> |        |        |        |        |         | u gas              | 0.0000334 | [Pa/s]        |                             |
| N2                            | 0.419  | 0.432  | 0.419  | 0.404  | [kg/m³] |                    |           |               |                             |
|                               |        |        |        |        |         | Length             |           |               |                             |
| O2                            | 0.076  | 0.078  | 0.076  | 0.073  | [kg/m³] | exhaust pipe       | 299       | [m]           |                             |
| CO2                           | 0.052  | 0.054  | 0.052  | 0.051  | [kg/m³] |                    |           |               |                             |
| H2O                           | 0.022  | 0.022  | 0.022  | 0.021  | [kg/m³] |                    |           |               |                             |
|                               | 0.569  | 0.586  | 0.569  | 0.548  | [kg/m³] |                    |           |               |                             |
| <u>Volume exhaust gas</u>     |        |        |        |        |         |                    |           |               |                             |
| M=V*p -> V=M/p                | 10.90  | 15.59  | 18.11  | 21.89  | [m3/s]  |                    |           |               |                             |
| <u>Speed exhaust gas</u>      |        |        |        |        |         |                    |           |               |                             |
| Nominale diameter [900]       | 17.1   | 24.5   | 28.5   | 34.4   | [m/s]   |                    |           |               |                             |
| Silencer diameter [800]       | 21.7   | 31.0   | 36.0   | 43.5   | [m/s]   |                    |           |               |                             |
| <u>Reynolds number</u>        |        |        |        |        |         |                    |           |               |                             |
| Re=(p*V*D)/u gas [900]        | 262611 | 386716 | 436273 | 508279 |         |                    |           |               |                             |
| Re=(p*V*D)/u gas [800]        | 295437 | 435055 | 490807 | 571814 |         |                    |           |               |                             |
| <u>Moody chart</u>            |        |        |        |        |         |                    |           |               |                             |
| Diameter pipe 900             | 0.015  | 0.014  | 0.014  | 0.013  |         |                    |           |               |                             |
| Diameter pipe 800             | 0.014  | 0.014  | 0.013  | 0.0125 |         |                    |           |               |                             |
| <u>Pressure drop</u>          |        |        |        |        |         |                    |           |               |                             |
| p=F*(L/D)*(p/2)*V^2           | 416    | 818    | 1072   | 1401   | [Pa]    |                    |           |               |                             |
| Pressure drop silencer        | 367    | 721    | 946    | 1236   | [Pa]    |                    |           |               | (estimated for 50 till 85%) |
|                               | 783    | 1539   | 2017   | 2637   | [Pa]    |                    |           |               |                             |
|                               | 78     | 154    | 202    | 264    | [mm/Wc] |                    |           |               | (max backpressure = 300)    |

## Actual, 23-06-'13

|                                 | 0%  | 41% | 80% | 84% | 100% | theoretical |                                                 |
|---------------------------------|-----|-----|-----|-----|------|-------------|-------------------------------------------------|
| Load                            |     |     |     |     |      |             |                                                 |
| Backpressure turbine            | -13 | 12  | 116 | -   | 139  | [mmWc]      | (over pressure inside ER causes negative value) |
| Backpressure silencer           | -   | 26  | -   | 110 | 132  | [mmWc]      |                                                 |
| Backpressure turbine, corrected | -   | 25  | 129 | -   | 152  | [mmWc]      | (corrected for over pressure ER)                |
| Pressure drop exhaust pipe      | -1  |     | 19  |     | 20   | [mmWc]      |                                                 |

## Moody Diagram



**AlfaLaval**

**Heatmaster**

**Saacke**

## E-mail



**To:**  
Taco Straathof

**Company:**  
Allseas Engineering BV

**E-mail:**  
tst@allseas.com

**Cc.:**

**From:**  
Bram Provoost

**E-mail / Direct Tel No:**  
Bram.provoost@alfalaval.com  
+31 765791573

**Date:**  
22-05-2015

**Page:**  
1 of 4

Alfa Laval Benelux BV  
Baarschot 2  
4817 ZZ Breda

Tel: +31 76 5791200  
Fax: +31 76 5791211

www.alfalaval.com

## Quotation

Dear Mr.Straathof,

**Subject : M/V AUDACIA – Retrofit project for installation of WHR economizer after aux. engines.**

Our ref. no.: RQ322556  
Boiler type: Aalborg XCs

Thank you for your inquiry, we hereby have the pleasure to submit our proposal for the delivery Waste Heat Recovery economizers type Aalborg XCs installed after Wärtsilä aux. engines, as follows:

### **Boiler Hardware Package – Waste Heat Recovery Economizer type Aalborg XCs.**

- 1 - WHR Economizer, type Aalborg XCs with internal by-pass, a vertical water tube exhaust gas economizer with forced circulation, intended to operate in conjunction with the steam drum of the oil fired boiler or separate steam drum.

The XC is designed for waste heat recovery from auxiliary engines, having a compact design convection section built up as bare tubes, connected to the in- and outlet headers. The heating surface is designed for max 30% engine load whereas the exhaust gas for increased engine load will be by-passed utilizing the internal by-pass.

### **Technical Data for Exhaust Gas**

|                                      |         |                 |
|--------------------------------------|---------|-----------------|
| Main engine(s)                       | :       | Wärtsilä 9L 38D |
| Nos. of engine(s)                    | :       | 1               |
| Load on engine                       | % MCR : | 25              |
| Exhaust gas quantity                 | kg/h :  | 12320           |
| Exhaust gas temperature, inlet       | °C :    | 359             |
| Exhaust gas pressure loss            | mmWG :  | 115             |
| Steam output, saturated 25% MCR load | kg/h :  | 700             |
| Max engine load via internal by pass | % MCR : | 75              |
| Exhaust gas quantity by-passed       | kg/h :  | 30880           |

**Common Data**

|                                   |      |   |      |
|-----------------------------------|------|---|------|
| Normal working pressure           | barg | : | 7    |
| Max. permissible working pressure | barg | : | 12   |
| Feed water temperature            | °C   | : | 80   |
| Diameter excluding insulation     | mm   | : | 1252 |
| Height including smoke boxes      | mm   | : | 3100 |
| Weight excl. of water             | t    | : | 3,9  |
| Operational weight                | t    | : | 4,5  |

We kindly ask you to note that the exhaust gas data are all estimated values. Accordingly, the performance data shall be considered for guidance only. In case this quotation will lead to an order, we kindly ask you to reconfirm the exhaust gas data.

**Included in the scope of supply are:**

- 1 - Painting of pressure part with heat resistant paint.
- 1 set - Inlet and outlet boxes with flanges size DN900.
- 1 set - Boiler valves, fittings and gauges.
- 1 - Safety valve including expansion joint.
- 1 set - Counter flanges, gaskets, bolts and nuts.
- 1 - Standard circulation pump including system globe valves and local control panel with start / stop box.
- 1 - Internal by-pass with damper and pneumatic actuator.
- 1 - Control panel
  
- 1 set - Spare parts and tools according to maker's standard and the requirements of the classification society BV.
- 1 set - Project services necessary to undertake design and supply of the scope including engineering, Project Management, Drafting and Quality Assurance.
- 1 set - Alfa Laval Aalborg standard documentation and instruction manual. All documentation will be delivered in searchable PDF (3 CD's) and 3 hard copies.

Equipment for installation to oil fired boiler or steam receiver:

- 1 unit - Standard circulation socket - boiler outlet.
- 1 unit - Globe valve – boiler outlet.
- 1 unit - Standard circulation socket – boiler inlet.
- 1 unit - Globe valve – boiler inlet.
- 1 set - counter flanges, gaskets, bolts and nuts.

All accessories and equipment mentioned above is supplied loose.

Further requirements, either from the owners or the shipyard as to alterations and traditional parts in proportion to the supply stated in the above technical specification, will be quoted against additional/reduced price(s).

**Classification**

The plant quoted will be designed and manufactured to comply with today's requirements of BV.

Certificates from the mentioned classification society are, after tests in our workshop, included in the price and will be delivered to the extent required by the classification society.

**Items not included in scope of supply – can be included against an additional price:**

- Insulation and cladding - standard is galvanized steel plate.
- Installation materials, such as pipes, fittings, supports and insulation etc.
- Boiler flow control unit including instrument- and reduction valves.
- Manpower for installation.
- Commissioning

**Price**

Total price, FOB Alfa Laval Aalborg, Qingdao, China for delivery as stated above:

**For one (1) unit Boiler Hardware Package, as specified above: EUR 69,900,00**

**For subsequent boiler sets:**

**Total price for four (4) units Boiler Hardware Package, as specified above: EUR 225,000,00**

The prices stated are excl. of VAT, customs and customs clearance. Further, refer to the “conditions” below.

We reserve the right to adjust our price in case of delivery later than stated and after expiry of the validity of our quotation.

**Conditions:**

|                   |   |                                                                                                                                                                                                                                                                                                            |
|-------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Validity          | : | Until the end of August 2015                                                                                                                                                                                                                                                                               |
| Terms of delivery | : | <b>Pressure part:</b><br>FOB Alfa Laval Aalborg, Qingdao, China incl. packing (for ship transportation under deck) and according to Incoterms 2010<br><br><b>Boiler accessories:</b><br>FOB Alfa Laval Aalborg, Denmark incl. packing (for ship transportation under deck) and according to Incoterms 2010 |
| Freight           | : | Freight arranged by Aalborg Industries at the request of the customer is at the customer's expenses and risk. Aalborg Industries will take out insurance for customer's risk and at its expenses. For this, Aalborg Industries will charge an administration fee of 15% of the cost.                       |
| Time of delivery  | : | <b>Pressure part and accessories:</b><br>Standard is 20 to 24 working weeks from date of order.                                                                                                                                                                                                            |
| Terms of payment  | : | 30% on order – 14 days from date of invoice<br>70% Prior to delivery of the equipment                                                                                                                                                                                                                      |
| Scope of supply   | : | Items not mentioned are not included                                                                                                                                                                                                                                                                       |

Classification : BV

Guarantee : 12 months from date of installation, however, max. 18 months from date of delivery.

Property : The equipment quoted remains the property of Alfa Laval Aalborg until full payment has been made according to contract

Other conditions : According to the "Terms and Conditions" of Alfa Laval Aalborg, January 2012.

We trust our quotation is according to your requirements and should be pleased to be at your service with further information, if required.

Yours sincerely  
**Alfa Laval Benelux bv**



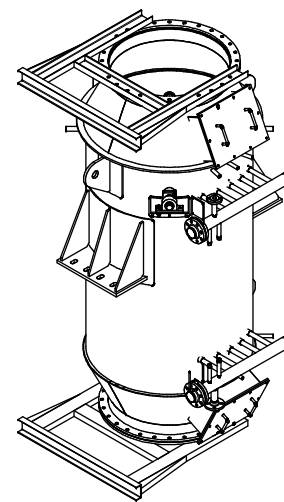
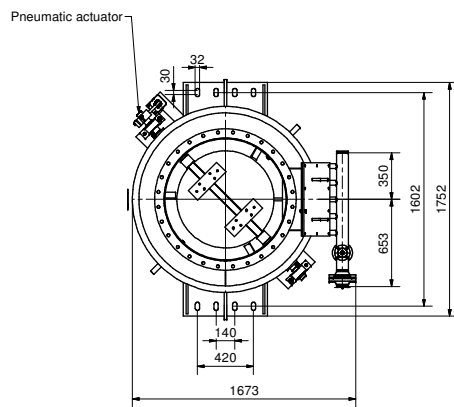
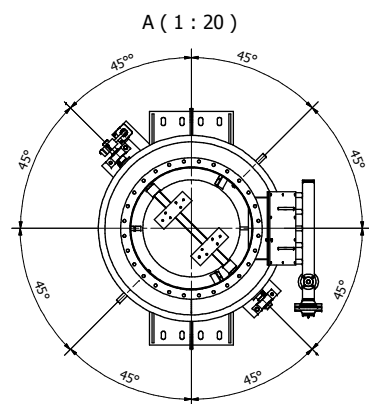
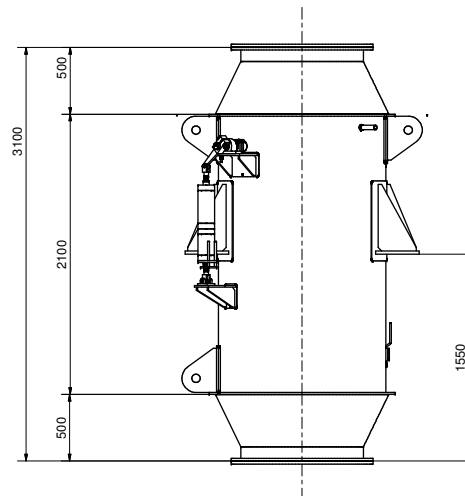
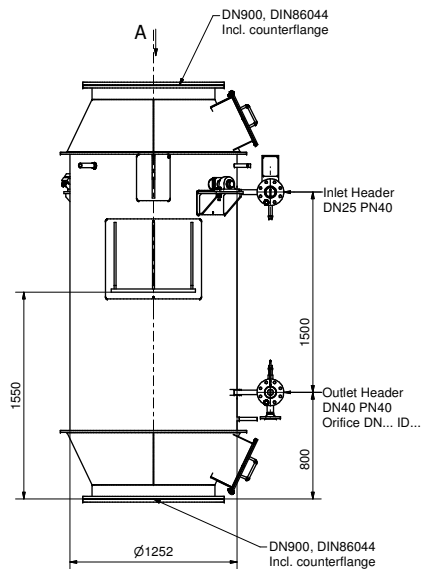
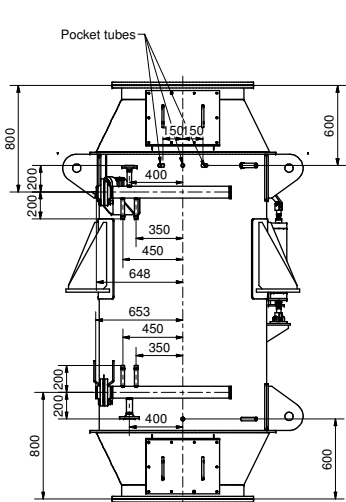
Bram Provoost  
Senior Marine and Diesel Engineer.



Anders Jensen  
Area Sales Manager

Enclosures: Alfa Laval Aalborg "Terms and Conditions" January 2012

FOR INFORMATION ONLY



|                 |  |              |               |
|-----------------|--|--------------|---------------|
| YARD            |  |              |               |
| At              |  |              |               |
| Class           |  |              |               |
| Aalborg project |  | New building | Boiler number |
| RQ322556        |  | Audacia      |               |
|                 |  |              |               |
|                 |  |              |               |

Dimensions shown without tolerances shall be according to:  
Machine: DS/EN 22768-1, Table 1-m, Table 3-c  
Welding: DS/EN ISO 13920, Table 1-B, Table 2-B

|  |                                                                                                                                       |                                 |                           |
|--|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------------|
|  | <b>Title:</b><br>Aalborg EXV<br>Exhaust Gas Economizer                                                                                | <b>Drawn:</b><br>---            | <b>Date:</b><br>21MAY2015 |
|  | <b>General arrangement - sales drawing</b>                                                                                            | <b>Appr.:</b><br>---            | <b>Date:</b><br>---       |
|  | <b>Article/Drawing No:</b><br>12Y:075554                                                                                              | <b>Type of drawing:</b><br>1:20 | <b>Size:</b><br>A1        |
|  | <small>THIS DRAWING AND DESIGN HEREIN ARE THE PROPERTY OF AALBORG AND MUST NOT BE USED IN OR FOR REPRODUCTION FOR THIRD PARTY</small> |                                 |                           |

Date : 08-06-2014  
 Client : Allseas Engineering B.V.  
 Reference : Audacia pipe laying vessel  
 Subject : Steam generators for generators sets - **2 X 2 pumps total**  
 Quotation : 15.8133 Rev. A

# **ITEM 1 THREE + THREE EXHAUST GAS STEAM GENERATORS**

Exhaust gas heater type : HTX 4-52-42-800  
 Design Pressure coil : 12 Bar(g)  
 Design temperature coil : 200 °C  
 Design : vertical  
 Main engine : Wärtsila 938B – 6.525 kw  
 Feed water temperature : 90 °C

|                                             |                |                          |               |                |
|---------------------------------------------|----------------|--------------------------|---------------|----------------|
| Conditions                                  | : 100 %        | : 75%                    | : 50 %        | : 25 %         |
| Steam generation kg/h.                      | : 1.390 kg/h.  | : 1.075 kg/h.            | : 1.120 kg/h. | : 750 kg/h.    |
| Generated power                             | : 930 kW       | : 720 kW                 | : 750 kW      | : 500 kW       |
| Exh. gas flow total                         | : 43.200 kg/h. | : 32,868 kg/h.           | : 22,320 kg/h | : 11.160 kg/h. |
| Exh. gas flow total                         | : 12 kg/s      | : 9,13 kg/s.             | : 6,2 kg/h    | : 3,1 kg/s     |
| Exh. gas flow through by-pass               | : 6,0 kg/s     | : 3,0 kg/s.              | : 0 kg/h      | : 0 kg/s       |
| Exh. gas flow through HEX                   | : 6,0 kg/s     | : 6,1 kg/s.              | : 6,2 kg/h    | : 3,1 kg/s     |
| Exh. gas inlet temperature                  | : 369°C        | : 328°C                  | : 346°C       | : 359 °C       |
| Exh. gas outlet temp. HEX.                  | : 228 °C       | : 220 °C                 | : 233 °C      | : 207 °C       |
| Exh. gas outlet temp. after eco             | : 299 °C       | : 255 °C                 | : 233 °C      | : 207 °C       |
| Gas speed between coils                     | : 30 m/s.      | : 30 m/s                 | : 30 m/s      | : 15 m/s.      |
| Pressure loss gas - by-pass open            | : 1800 Pa      | : 1800 Pa                | : 1800 Pa     | : 502 Pa       |
| Gas speed in the by-pass                    | : 18 m/s.      | : 9 m/s                  | : 0 m/s       | : 0 m/s.       |
| Circulation rate of water                   |                | : 6 m³/h                 |               |                |
| By-pass diameter                            |                | : 800 mm.                |               |                |
| Gas speed at 100 % load in by-pass pipe     |                | : 36 m/s. ( calculated ) |               |                |
| Pressure loss gas - by-pass channel (100 %) |                | : 1100 Pa ( calculated ) |               |                |

## **Dimensions & weights**

Diameter pipe in generator : 42 mm  
 Outer diameter without insulation, approx : 1.345 mm  
 Height, incl. connection piece, approx : 4.700 mm  
 Boiler contents : 750 litres.  
 Weight, empty : 3.500 kg.  
 Inlet and outlet header connection : DN 80

## ITEM 1.1 ONE WATER INLET CONTROL SET FOR EACH STEAM GENERATOR

- |                                                                                   |             |
|-----------------------------------------------------------------------------------|-------------|
| 1 two way control valve.                                                          |             |
| Bore                                                                              | : 25        |
| 1 One differential pressure transmitter for flow control, with insulating valves. |             |
| outlet signal                                                                     | : 4 – 20 mA |
| 1 flow controller                                                                 |             |
| inlet signal                                                                      | : 4 – 20 mA |
| outlet signal                                                                     | : 3 step    |

## ITEM 1.2 ONE SET OF SAFETY DEVICES FOR EACH STEAM GENERATOR

Each consisting of (loose delivery) :

- One temperature limiter for steam outlet.
  - One temperature limiter for exhaust gas temperature. (system alarm)
  - Two safety valve.
- set point : 13 bar(g)

## ITEM 1.3 ONE INTERNAL SINGLE FLAP BY-PASS SYSTEM FOR EACH STEAM GENERATOR

The heater is provided with a pneumatic actuated flap system on top of the by-pass channel. The construction design is for marine use. Our delivery is including a control system. The pneumatic actuator is spring loaded, in case of electric or air pressure failure the by-pass valve will go to open position.

The flap is provided **with a special throttling plate in order to create a smooth opening for better control of** the flow in the by-pass channel based on the pressure loss over the heater.

### ITEM 1.3.1 ONE CONTROL SYSEM FOR EACH BY\_PASS FLAP

Consisting of:

- |                                                                                                 |                  |
|-------------------------------------------------------------------------------------------------|------------------|
| 1 pneumatic actuator,                                                                           |                  |
| supply pressure                                                                                 | : spring loaded, |
|                                                                                                 | : 4 – 8 bar.     |
| 1 air filter pressure reducing unit.                                                            |                  |
| 1 pressure controller for flap control, based on differential pressure over the heat exchanger. |                  |
| 1 differential pressure transmitter                                                             | : 0 – 4000 Pa    |

## ITEM 1.4 ONE SET OF FITTINGS AND ACCESSORIES FOR STEAM GENERATOR

- |                 |                                           |
|-----------------|-------------------------------------------|
| Valves material | : GGG 40.3                                |
| Valves sealing  | : bellow sealing with safety stuffing box |
| Pressure rating | : PN 16                                   |

Each consisting off :

- |                                                   |         |
|---------------------------------------------------|---------|
| 1 stop valve for steam outlet                     | : DN 80 |
| 1 stop valve for water inlet with regulating cone | : DN 50 |
| 1 vent valve                                      | : DN 25 |
| 1 drain valve                                     | : DN 25 |

## ITEM 2 TWO+TWO CIRCULATION PUMPS, FOR THREE + THREE STEAM GENERATORS

The pumps are constructed for pumping hot water up to a temperature of 180 °C  
The sealing is with mechanical seal.

|                                               |                              |
|-----------------------------------------------|------------------------------|
| Make                                          | : KSB / Allweiler            |
| Pump type                                     | : block pump                 |
| Capacity                                      | : 18 m <sup>3</sup> /h       |
| Delivery head                                 | : 30 m.l.c.                  |
| Electric motor                                | : 3,0 kW                     |
| Operating voltage                             | : 3 x 440 Volt - 50 Hz.      |
| Motor speed                                   | : 3.600 min <sup>-1</sup>    |
| Protective system acc. To DIN 40050 (IEC 144) | : IP 54                      |
| Shaft sealing                                 | : mechanical seal (uncooled) |

### ITEM 2.1 FITTINGS AND ACCESSORIES FOR 2 + 2 PUMPS

|   |                                                |                |
|---|------------------------------------------------|----------------|
| 2 | stop valve suction side ( full flow ball type) | : DN 65, PN 16 |
| 2 | strainers in Y-form                            | : DN 65, PN 16 |
| 4 | manometer with siphon and valve                | : 0/10 bar     |
| 1 | keep hot valve                                 | : DN 15, PN 16 |
| 2 | none return valves, disk type                  | : DN 50        |
| 2 | stop valve with regulating cone                | : DN 50, PN 16 |
| 1 | stand-by switch                                |                |

### ITEM 2.2 ASSEMBLY OF THE CIRCULATING PUMPS AND FITTINGS TO 2 PUMP SETS

Each assembly of the following items:

- Circulating pumps (Item 2)
- 1 pressure switches
- Fitting around the pumps (item 2.1)

## ITEM 3 ONE STEAM DRUM, FOR ALL HEAT RECOVERY UNITS

In the drum the water/steam mixture from the boilers is separated.

|                                       |               |
|---------------------------------------|---------------|
| Content approx                        | : 5.000 Ltrs. |
| Design pressure                       | : 9 bar(g)    |
| Design temperature                    | : 180 °C      |
| Steam production at full load approx. | : 6.000 kg/h. |

The tank is provided with:

|   |                                            |                    |
|---|--------------------------------------------|--------------------|
| 1 | magnetic float level indicator             |                    |
| 2 | Level switch reed type.                    | : feed pump ON/OFF |
| 2 | Level switch reed type.                    | : high / low alarm |
| 1 | level indicator, reflex type with valves   |                    |
| 2 | Safety valve.                              | : DN               |
| 1 | Main steam valve.                          | : DN 125           |
| 1 | Pressure indicator (glycerine filled).     | : 0 – 10 bar(g)    |
| 1 | Pressure switch.                           | : 0 – 13 bar.      |
| 1 | Overflow steam trap                        | : DN 40            |
| 1 | Feed water non return valve and stop valve | : DN 25            |
| 1 | blow down valve                            | : DN 32            |

### ITEM 3.1 INSULATION OF THE STEAM DRUM

#### ITEM 4 TWO FEED WATER PUMPS.

The pumps are multi stage vertical pumps  
One pump is running one pump is stand-by

|                   |                         |
|-------------------|-------------------------|
| Make              | : KSB or equal          |
| Capacity          | : 7 M3/h.               |
| Delivery head     | : 90 m lc               |
| Electric motor    | : 3,0 kW                |
| Operating voltage | : 3 x 440 Volt - 60 Hz. |
| Motor speed       | : 3.600 min-1           |

#### ITEM 4.1 FITTINGS AND ACCESSORIES FOR THE FEED WATER PUMPS

|                                                  |                                               |
|--------------------------------------------------|-----------------------------------------------|
| 2 stop valve suction side ( full flow ball type) | : DN 50, PN 16                                |
| 2 strainers in Y-form                            | : DN 50, PN 16                                |
| 2 manometer glycerine filled                     | : -1 /+3 bar, with manometer valve and U-tube |
| 2 manometer glycerine filled                     | : 0/16 bar, with manometer valve and U-tube   |
| 1 keep hot valve                                 | : 1/2"                                        |
| 2 none return valves, disk type                  | : DN 40                                       |
| 2 stop valve with regulating cone                | : DN 40, PN 16                                |

#### ITEM 4.2 ASSEMBLY OF THE FEED WATER PUMPS AND FITTINGS ON ONE SKID

#### ITEM 5 TWO SWITCHBOARDS.

##### TECHNICAL DATA:

|                                                 |                                                                                                                  |
|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Design                                          | : acc. to VDE 0100 and VDE 0116                                                                                  |
| Protective system acc. to DIN 40050 and IEC 529 | : IP 54                                                                                                          |
| Voltage supply                                  | : 3 x 440 Volt – 60 Hz.                                                                                          |
| Kind of current                                 | : 3 phases with fourth wire                                                                                      |
| Control voltage                                 | : 230 VAC – 60 hz.                                                                                               |
| Voltage transformer                             | : 440 V / 230 V                                                                                                  |
| Inscription                                     | : English                                                                                                        |
| Motor starters                                  | : direct starting                                                                                                |
| Indications                                     | : operation hour counters for circ. pumps and for burners optical process and trouble indication by signal lamps |
| Emergency shut-off switch                       | : manually.                                                                                                      |

##### **Summary of each panel.**

- Supervision of safeties of three heat recoveries
- Switches and protectors for 2 x 2 circulation pumps.
- Stand-by function for circulation pumps.
- Switches and protectors for 2 feed water pumps.
- Stand-by function of the feed water pump..
- Level control of the steam drum
- Supervision of all safeties of the steam drum

**ITEM 6 ONE DUMP CONDENSOR.**

Capacity to be fixed in detail engineering.

Capacity : 3.000 kg/h.  
Execution : horizontal / vertical

Shell side : Steam  
Steam quantity : 3.000 kg/h.  
Steam pressure : 7 bar  
Condensate outlet temperature : < 100 °C

Tube side : Freshwater  
Quantity of fresh water : 85 m<sup>3</sup>/h  
Water inlet temperature : 38 °C  
Water outlet temperature : 58 °C

Materials and dimensions.  
Material of tubes : Cuni or equal  
Othe materials of the cooler : all steel  
Diameter : 600/320 mm.  
Length : 1,800 mm.

**ITEM 6.1 ONE CONTROL VALVE FOR DUMP CONDENSOR.**

Consisting of :  
1 pressure controller fitted in the control panel.  
1 pressure sensor.  
1 two way valve

**ITEM 7 COMMISSIONING**

Not included.

**RULES AND REGULATIONS.**

All equipment is offered according : LRS  
Certificates : included.  
Voltage : 3 x 440 Volt – 60 Hz.  
Kind of current : 3 phases without fourth wire  
Control voltage : 230 Volt - 60 Hz.  
Air pressure : 8 bar(g)





SAACKE GmbH · Postfach 21 02 61 · 28222 · Bremen

Allseas Engineering B.V.  
Mr. Straathof  
Poortweg 12  
2612 PA Delft

Email: TSt@allseas.com

## Q U O T A T I O N

Date: 25.1.2015

Quotation No.: **N 13643300/2NL**  
Project No.: 197721  
Our ref.:

Processing: Mr. Axel Frieze  
Phone: +49-421-6495-5137  
Fax: +49-421-6495-5363  
E-Mail: A.Frieze@saacke.de

**SAACKE GmbH**  
Südweststraße 13  
28237 Bremen  
Germany  
Tel.: +49 421 6495-0

**Your inquiry for exhaust gas boilers/waste heat recovery  
MV AUDACIA**

Material receipt:  
Reiherstraße 86  
28239 Bremen

Dear Mr. Straathof,

We thank you for your recent inquiry and take pleasure in submitting our quotation for equipment suitable for your project.

Please refer to the following list to verify the technical data we have taken as a basis for the proposal.

As the offer is still subject to final clarification, we would appreciate hearing from you at your convenience as to whether our specification fulfills your requirements down to the last detail.

Yours sincerely,  
SAACKE GmbH

i.A. A. Frieze

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Friese to Allseas Engineering B.V.

**Technical Data****Infrastructure data**

|                                               |                   |
|-----------------------------------------------|-------------------|
| Country                                       | NL                |
| Installation                                  | ship              |
| Shipyard                                      | Jiangnan Shipyard |
| Yard Number                                   | - please confirm  |
| Classification Society                        | LRS               |
| IMO number                                    | 9305130           |
| Number of oil fired boilers                   | 2                 |
| number of exhaust gas boilers in the system   | 2                 |
| Thermal fluid                                 | saturated steam   |
| Power supply voltage/frequency                | 440V/60Hz         |
| mains voltage                                 | 440 V             |
| power line frequency                          | 60 Hz             |
| Anti-condensation-heating for electric motors | not required      |
| Combustion air temperature                    | 25 °C             |
| Combustion air temperature min.               | 15 °C             |
| Combustion air temperature max.               | 45 °C             |
| Efficiency class                              | IE1               |

**FWD engine room - Dual pass exhaust gas boiler EME-2VST 0,5+0,5/7**

|                                     |                 |              |
|-------------------------------------|-----------------|--------------|
| Exhaust gas boiler steam production | 534 kg/h        | per pass     |
| Thermal fluid                       | saturated steam |              |
| Working pressure (g)                | 7,0 bar         |              |
| Safety valve setting pressure (g)   | 9,0 bar         |              |
| Design pressure (g)                 | 9,0 bar         |              |
| Feed water temperature              | 60 °C           | heat balance |
| Enthalpy of feed water              | 252 kJ/kg       |              |
| steam temperature (sat)             | 170,4 °C        |              |
| Enthalpy of saturated steam         | 2768 kJ/kg      |              |
| EME/EMB heat output                 | 0,37 MW         |              |

**EE - Exhaust gas economizer EME-VST**

|                                                |             |
|------------------------------------------------|-------------|
| Boiler type                                    | EME-2VST    |
| Design of smoke tubes                          | plain tubes |
| Option exhaust gas temperature monitoring      | included    |
| Option exhaust gas differential pressure gauge | included    |

**CW - Hot water circulation system**

|             |          |
|-------------|----------|
| Boiler type | EME-2VST |
|-------------|----------|

**CS - Control system for economizer EME****Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Friese to Allseas Engineering B.V.

|                      |       |
|----------------------|-------|
| mains voltage        | 440 V |
| power line frequency | 60 Hz |
| control voltage      | 230 V |
| Control frequency    | 60 Hz |

**FWD engine room - Dual pass exhaust gas boiler EME-2VST 0,5+0,5/7**

|                                     |                 |              |
|-------------------------------------|-----------------|--------------|
| Exhaust gas boiler steam production | 534 kg/h        | per pass     |
| Thermal fluid                       | saturated steam |              |
| Working pressure (g)                | 7,0 bar         |              |
| Safety valve setting pressure (g)   | 9,0 bar         |              |
| Design pressure (g)                 | 9,0 bar         |              |
| Feed water temperature              | 60 °C           | heat balance |
| Enthalpy of feed water              | 252 kJ/kg       |              |
| steam temperature (sat)             | 170,4 °C        |              |
| Enthalpy of saturated steam         | 2768 kJ/kg      |              |
| EME/EMB heat output                 | 0,37 MW         |              |

**EE - Exhaust gas economizer EME-VST**

|                                                |             |
|------------------------------------------------|-------------|
| Boiler type                                    | EME-2VST    |
| Design of smoke tubes                          | plain tubes |
| Option exhaust gas temperature monitoring      | included    |
| Option exhaust gas differential pressure gauge | included    |

**CW - Hot water circulation system**

|             |          |
|-------------|----------|
| Boiler type | EME-2VST |
|-------------|----------|

**CS - Control system for economizer EME**

|                      |       |
|----------------------|-------|
| mains voltage        | 440 V |
| power line frequency | 60 Hz |
| control voltage      | 230 V |
| Control frequency    | 60 Hz |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).



**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

## **Sales Conditions**

### **Validity**

Prices and conditions of this offer are valid for 6 month after issue.

### **Delivery Time**

The time of delivery is 6-7 months after receipt of order and after clarification of all technical details.

### **Delivery Terms**

EXW Bremen/Zagreb, INCOTERMS 2010

### **Shipping Condition**

By Truck

### **Warranty**

The warranty period covers 12 months after delivery of the ship to the Owners, however latest 18 months after delivery of the plant. Wear and tear parts are excepted from warranty.

### **Payment Condition**

50 % at placement of order

40 % at delivery, payable 30 days after invoicing

10 % after commissioning, latest 90 days after delivery

**Managing Directors: Frank-Uwe Schulz, Stefan Lumpert | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).



Quotation N 13643300/2NL

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item                                                                              | Description                                                                   | Quantity | Unit-Price<br>Euro | Price of item<br>Euro |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------|--------------------|-----------------------|
| Prices „FWD engine room - Dual pass exhaust gas boiler EME-2VST 0,5+0,5/7“        |                                                                               |          |                    |                       |
| 1.1                                                                               | EE - Exhaust gas economizer<br>EME-VST                                        | 1 piece  |                    |                       |
| 1.2                                                                               | EM - Mounting set for economizer                                              | 1 piece  |                    |                       |
| 1.4                                                                               | CW - Hot water circulation system                                             | 1 piece  |                    |                       |
| 1.5                                                                               | CWM - Mounting set for<br>circulation system                                  | 1 piece  |                    |                       |
| 1.6                                                                               | CS - Control system for<br>economizer EME                                     | 1 piece  |                    |                       |
| 1.7                                                                               | SP/TO - Spare parts and tools kit<br>for exhaust gas boiler EMB/EME-<br>HS/VS | 1 piece  |                    |                       |
| Total price FWD engine room - Dual pass exhaust gas boiler EME-2VST<br>0,5+0,5/7: |                                                                               |          |                    | 76.747,80             |

Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).



Quotation N 13643300/2NL

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item | Description | Quantity | Unit-Price<br>Euro | Price of item<br>Euro |
|------|-------------|----------|--------------------|-----------------------|
|------|-------------|----------|--------------------|-----------------------|

Prices „FWD engine room - Dual pass exhaust gas boiler EME-2VST 0,5+0,5/7“

|     |                                                                               |         |
|-----|-------------------------------------------------------------------------------|---------|
| 2.1 | EE - Exhaust gas economizer<br>EME-VST                                        | 1 piece |
| 2.2 | EM - Mounting set for economizer                                              | 1 piece |
| 2.3 | CW - Hot water circulation system                                             | 1 piece |
| 2.4 | CWM - Mounting set for<br>circulation system                                  | 1 piece |
| 2.5 | CS - Control system for<br>economizer EME                                     | 1 piece |
| 2.6 | SP/TO - Spare parts and tools kit<br>for exhaust gas boiler EMB/EME-<br>HS/VS | 1 piece |

|                                                                                   |           |
|-----------------------------------------------------------------------------------|-----------|
| Total price FWD engine room - Dual pass exhaust gas boiler EME-2VST<br>0,5+0,5/7: | 76.747,80 |
|-----------------------------------------------------------------------------------|-----------|

Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item                                                                                          | Description                           | Quantity | Unit-Price<br>Euro | Price of item<br>Euro |
|-----------------------------------------------------------------------------------------------|---------------------------------------|----------|--------------------|-----------------------|
| <b>Prices „OPTION: Exhaust gas distribution system for flexible use of all 3 engines“</b>     |                                       |          |                    |                       |
| 3.1                                                                                           | EGD - Exhaust gas distribution system | 2 sets   | 31.750,00          | 63.500,00             |
| <b>Total price OPTION: Exhaust gas distribution system for flexible use of all 3 engines:</b> |                                       |          |                    | <b>63.500,00</b>      |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Friese to Allseas Engineering B.V.

| Item            | Description                                                              | Quantity             |
|-----------------|--------------------------------------------------------------------------|----------------------|
| Scope of supply |                                                                          |                      |
| <b>1</b>        | <b>FWD engine room - Dual pass exhaust gas boiler EME-2VST 0,5+0,5/7</b> |                      |
| <b>1.1</b>      | <b>EE - Exhaust gas economizer EME-VST</b>                               | <b>1 piece</b>       |
| <b>1.1.1</b>    | <b>EE 001 - Smoke tube economizer EME-VST</b>                            | <b>1 piece</b>       |
|                 | Boiler type                                                              | EME-2VST             |
|                 | Design of smoke tubes                                                    | plain tubes          |
|                 | Exhaust gas boiler steam production                                      | 534 kg/h             |
|                 | MCR                                                                      | per pass @ 75%       |
|                 | Main engine exhaust gas temp. (inlet)                                    | 307 °C @ 75% MCR     |
|                 | Main engine exhaust gas temp. (outlet)                                   | 273,7 °C @ 75% MCR   |
|                 | Working pressure (g)                                                     | 7,0 bar              |
|                 | Design pressure (g)                                                      | 9,0 bar              |
|                 | Safety valve setting pressure (g)                                        | 9,0 bar              |
|                 | Hydraulic test pressure (g)                                              | 13,5 bar             |
|                 | Overall height                                                           | 4000 mm              |
|                 | Outer diameter without insulation                                        | 2100 mm              |
|                 | Thickness of Insulation                                                  | 80 mm                |
|                 | Weight                                                                   | 5500 kg              |
|                 | volume                                                                   | 2,66 m <sup>3</sup>  |
|                 | Manufacturing and pressure test acc. to                                  | LR                   |
|                 | Item number                                                              | EE 001               |
| <b>1.1.2</b>    | <b>EE 002 - Steam/water mixture outlet valve</b>                         | <b>1 piece</b>       |
|                 | function                                                                 | shut-off/check valve |
|                 | design                                                                   | straight form        |
|                 | nominal pressure                                                         | PN 25                |
|                 | nominal bore                                                             | DN 100               |
|                 | Certificate                                                              | LRS                  |
|                 | Weight                                                                   | 36,0 kg              |
|                 | Item number                                                              | EE 002               |
| <b>1.1.3</b>    | <b>EE 005 - Safety valve</b>                                             | <b>2 pieces</b>      |
|                 | design                                                                   | angle form           |
|                 | Safety valve dimension                                                   | DN 32/50             |
|                 | nominal pressure                                                         | PN 40/16             |
|                 | Safety valve setting pressure (g)                                        | 9,0 bar              |
|                 | Certificate                                                              | LRS                  |
|                 | Weight                                                                   | 14 kg                |
|                 | Item number                                                              | EE 005               |
| <b>1.1.4</b>    | <b>EE 006 - Water inlet valve</b>                                        | <b>1 piece</b>       |
|                 | design                                                                   | straight form        |

Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item  | Description                                                                                                                                                                                                                                                                                                                              | Quantity |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
|       | function shut-off/check valve<br>nominal bore DN 65<br>nominal pressure PN 25<br>Certificate LRS<br>Item number EE 006<br>Weight 18,4 kg                                                                                                                                                                                                 |          |
| 1.1.5 | <b>EE 009 - Drain valve</b><br>design straight form<br>function shut-off/check valve<br>nominal bore DN 25<br>nominal pressure PN 25<br>Certificate LRS<br>Item number EE 009<br>Weight 5,4 kg                                                                                                                                           | 2 pieces |
| 1.1.6 | <b>EE 011 - Soot drain gate valve</b><br>nominal bore DN 40<br>nominal pressure PN 10<br>length 190 mm<br>Material 0.6025 / GG-25-Cr1<br>Item number BO 011                                                                                                                                                                              | 2 pieces |
| 1.1.7 | <b>EE 016 - Economizer vent valve</b><br>function shut-off valve<br>design straight form<br>nominal bore DN 15<br>nominal pressure PN 25<br>Material EN-JS1025 / EN-GJS-400-18-LT<br>Certificate LRS                                                                                                                                     | 1 piece  |
| 1.1.8 | <b>EE 018 - Pressure gauge/Gauge board valve</b><br>nominal pressure PN 400<br>connection screw joint<br>thread G 1/2<br>Material 1.0402 / C22<br>Certificate 3.1 EN 10204<br>Item number EE 018                                                                                                                                         | 1 piece  |
| 1.1.9 | <b>EE 030 - Gauge board for double pass exhaust gas boiler</b><br>Boiler type EME/EMB<br>Boiler pressure gauge included<br>Gauge pressure range 0...16 bar<br>Gauge red marked at 9,0 bar<br>Steam pressure monitor max. included<br>Flue pressure range -25..25 mbar<br>Number of thermometers 4 pieces<br>Temperature range 0...500 °C | 1 piece  |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Friese to Allseas Engineering B.V.

| Item   | Description                                                                                                                                                                                                                                            | Quantity |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
|        | Thermometer connection G 1/2                                                                                                                                                                                                                           |          |
|        | EE 030                                                                                                                                                                                                                                                 |          |
| 1.1.10 | <b>EE 042 - Exhaust gas inlet temperature transmitter</b><br>Type TR201<br>Process connection G 1/2<br>Mounting length U1 250 mm<br>Temperature range 0...500 °C<br>Signal 4-20 mA, twin<br>Material 1.4571 / X6CrNiMoTi17-12-2<br>Item number EE 042  | 2 pieces |
| 1.1.11 | <b>EE 043 - Exhaust gas outlet temperature transmitter</b><br>Type TR201<br>Process connection G 1/2<br>Mounting length U1 250 mm<br>Temperature range 0...500 °C<br>Signal 4-20 mA, twin<br>Material 1.4571 / X6CrNiMoTi17-12-2<br>Item number EE 043 | 2 pieces |
| 1.1.12 | <b>EE 071 - U-tube differential pressure gauge</b><br>Item number EE 071                                                                                                                                                                               | 2 pieces |
| 1.2    | EM - Mounting set for economizer                                                                                                                                                                                                                       | 1 piece  |
| 1.2.1  | <b>EM 002 - Mounting set for economizer body</b>                                                                                                                                                                                                       | 1 piece  |
| 1.2.2  | <b>EM 002 - Mounting set for steam/water outlet valve</b><br>Nominal bore DN 100<br>nominal pressure PN 25                                                                                                                                             | 1 piece  |
| 1.2.3  | <b>EM 005 - Mounting set for economizer safety valves</b><br>Nominal bore DN 32/50<br>nominal pressure PN 40/16                                                                                                                                        | 2 pieces |
| 1.2.4  | <b>EM 006 - Mounting set for water inlet valve</b><br>Nominal bore DN 65<br>nominal pressure PN 25                                                                                                                                                     | 1 piece  |
| 1.2.5  | <b>EM 009 - Mounting set for blow down/drain valves</b><br>Nominal bore DN 25<br>nominal pressure PN 25                                                                                                                                                | 2 pieces |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item   | Description                                                                                                                                                                                                                                                                                                                                                                                                                               | Quantity |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1.2.6  | <b>EM 011 - Mounting set for soot water drain valve</b>                                                                                                                                                                                                                                                                                                                                                                                   | 2 pieces |
| 1.2.7  | <b>EE 016 - Mounting set for EGE vent valve</b><br>Nominal bore DN15<br>nominal pressure PN 25                                                                                                                                                                                                                                                                                                                                            | 1 piece  |
| 1.2.8  | <b>EE 030 - Mounting set for EGE gauge board</b>                                                                                                                                                                                                                                                                                                                                                                                          | 1 piece  |
| 1.2.9  | <b>EM 042 - Mounting set for inlet gas temperature transmitter</b>                                                                                                                                                                                                                                                                                                                                                                        | 2 pieces |
| 1.2.10 | <b>EM 043 - Mounting set for outlet gas temperature transmitter</b>                                                                                                                                                                                                                                                                                                                                                                       | 2 pieces |
| 1.2.11 | <b>EM 090 - Fitting accessories for safety valves remote actuation</b><br>number of safety valves 1 piece<br>Weight 15,0 kg<br>Item number EM 090                                                                                                                                                                                                                                                                                         | 2 pieces |
| 1.4    | <b>CW - Hot water circulation system</b>                                                                                                                                                                                                                                                                                                                                                                                                  | 1 piece  |
| 1.4.1  | <b>CW 001 - Hot water circulation pump</b><br>Medium temperature, max. 180 °C<br>Operating volume flow 5,0 m³/h<br>delivery head at operating point 2,5 bar<br>Nominal bore inlet DN 50<br>Nominal bore outlet DN 32<br>Motor rated power at 50 Hz 1,75 kW<br>Motor manufacturer Siemens<br>Supply voltage 440 V<br>Frequency 60 Hz<br>speed 3460 1/min<br>IC IC according EN 10204 / 3.2<br>Workshop inspection and certification by LRS | 2 pieces |
| 1.4.2  | <b>CW 007 - Differential pressure sensor for circulation pumps</b><br>Type DMD 331<br>Pressure range 0...6 bar<br>Fluid pressure max. 20 bar<br>Medium temperature, max. 125 °C<br>connection male/male thread<br>thread G 1/2                                                                                                                                                                                                            | 1 piece  |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Friese to Allseas Engineering B.V.

| Item  | Description                                                                                                                                                                                                             | Quantity |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
|       | Material 1.4571<br>Supply voltage 24 V<br>Signal 4-20 mA, twin<br>Item number CW 007                                                                                                                                    |          |
| 1.4.3 | <b>CW 010 - EGE circulation flow regulating valve</b>                                                                                                                                                                   | 1 piece  |
|       | Attention, the size of this valve does not resemble the necessary size of the circulation pipe but is adapted to the flow characteristics of this valve and the required KVS value.                                     |          |
|       | function restrictor valve<br>Design straight form<br>nominal bore DN 32<br>nominal pressure PN 25<br>Valve type 23.046<br>Weight 6,6 kg<br>Certificate 3.1 EN 10204<br>Classification Society LRS<br>Item number CW 010 |          |
| 1.5   | CWM - Mounting set for circulation system                                                                                                                                                                               | 1 piece  |
| 1.5.1 | <b>CWM 001 - Mounting set for circulation pump</b>                                                                                                                                                                      | 2 pieces |
| 1.5.2 | <b>CWM 007 - Mounting set for differential pressure transmitter</b>                                                                                                                                                     | 1 piece  |
| 1.5.3 | <b>CWM 010 - Mounting set for circulation flow adjustment valve</b>                                                                                                                                                     | 1 piece  |
|       | Nominal bore DN 32<br>nominal pressure PN 25                                                                                                                                                                            |          |
| 1.6   | CS - Control system for economizer EME                                                                                                                                                                                  | 1 piece  |
| 1.6.1 | <b>CS 010 - Exhaust gas boiler control cabinet</b>                                                                                                                                                                      | 1 piece  |
|       | Boiler type EMB-VST<br>Supply voltage 440 V<br>Supply frequency 60 Hz<br>Boiler controls Conventional relay based<br>control voltage 230 V<br>Dimensions (wxhxd) 600x760x300 mm                                         |          |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumpert | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item  | Description                                                                                                                                                                                                                                                                                                                                                                                                             | Quantity       |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|       | Colour pattern RAL 7035<br>Workshop inspection and certification by LRS                                                                                                                                                                                                                                                                                                                                                 |                |
| 1.6.2 | <b>Engineering hours for electrical control system</b>                                                                                                                                                                                                                                                                                                                                                                  | 12 h           |
| 1.6.3 | <b>Drawings approval and shop test for electrical control system</b><br>Classification Society LRS                                                                                                                                                                                                                                                                                                                      | 1 piece        |
| 1.7   | SP/TO - Spare parts and tools kit for exhaust gas boiler<br>EMB/EME-HS/VS<br><br>Boiler type EME-2VST<br>Construction year of the boiler 2015<br>Classification Society LRS<br>Design pressure (g) 9,0 bar<br>DN of main steam valve DN 100<br>DN of safety valve DN 32/50<br>Safety valve setting pressure (g) 9,0 bar<br>DN of feed valves DN 65<br>DN of blow down valves DN 25<br>Nominal bore BO 016/017/018 DN 15 | <b>1 piece</b> |
| 1.7.1 | <b>SP 001 - Main steam pressure gauge 9 bar(g)</b>                                                                                                                                                                                                                                                                                                                                                                      | 1 piece        |
| 1.7.2 | <b>SP 002/032 - Spring for safety valve</b>                                                                                                                                                                                                                                                                                                                                                                             | 2 pieces       |
| 1.7.3 | <b>SP 006 - Manhole gasket</b>                                                                                                                                                                                                                                                                                                                                                                                          | 5 pieces       |
| 1.7.4 | <b>SP 007 - Handhole gasket</b>                                                                                                                                                                                                                                                                                                                                                                                         | 16 pieces      |
| 1.7.5 | <b>SP 015 - Plug for smoke tube, for temporary repair (EG part)</b>                                                                                                                                                                                                                                                                                                                                                     | 20 pieces      |
| 1.7.6 | <b>SP 016 - Repair plug for stay tube (EG part)</b>                                                                                                                                                                                                                                                                                                                                                                     | 10 pieces      |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).



Quotation N 13643300/2NL

dated 25.1.2015 by Mr. Friese to Allseas Engineering B.V.

| Item            | Description                                                              | Quantity             |
|-----------------|--------------------------------------------------------------------------|----------------------|
| Scope of supply |                                                                          |                      |
| 2               | <b>FWD engine room - Dual pass exhaust gas boiler EME-2VST 0,5+0,5/7</b> |                      |
| 2.1             | EE - Exhaust gas economizer EME-VST                                      | 1 piece              |
| 2.1.1           | <b>EE 001 - Smoke tube economizer EME-VST</b>                            | 1 piece              |
|                 | Boiler type                                                              | EME-2VST             |
|                 | Design of smoke tubes                                                    | plain tubes          |
|                 | Exhaust gas boiler steam production                                      | 534 kg/h             |
|                 | MCR                                                                      | per pass @ 75%       |
|                 | Main engine exhaust gas temp. (inlet)                                    | 307 °C @ 75% MCR     |
|                 | Main engine exhaust gas temp. (outlet)                                   | 273,7 °C @ 75% MCR   |
|                 | Working pressure (g)                                                     | 7,0 bar              |
|                 | Design pressure (g)                                                      | 9,0 bar              |
|                 | Safety valve setting pressure (g)                                        | 9,0 bar              |
|                 | Hydraulic test pressure (g)                                              | 13,5 bar             |
|                 | Overall height                                                           | 4000 mm              |
|                 | Outer diameter without insulation                                        | 2100 mm              |
|                 | Thickness of Insulation                                                  | 80 mm                |
|                 | Weight                                                                   | 5500 kg              |
|                 | volume                                                                   | 2,66 m³              |
|                 | Manufacturing and pressure test acc. to                                  | LR                   |
|                 | Item number                                                              | EE 001               |
| 2.1.2           | <b>EE 002 - Steam/water mixture outlet valve</b>                         | 1 piece              |
|                 | function                                                                 | shut-off/check valve |
|                 | design                                                                   | straight form        |
|                 | nominal pressure                                                         | PN 25                |
|                 | nominal bore                                                             | DN 100               |
|                 | Certificate                                                              | LRS                  |
|                 | Weight                                                                   | 36,0 kg              |
|                 | Item number                                                              | EE 002               |
| 2.1.3           | <b>EE 005 - Safety valve</b>                                             | 2 pieces             |
|                 | design                                                                   | angle form           |
|                 | Safety valve dimension                                                   | DN 32/50             |
|                 | nominal pressure                                                         | PN 40/16             |
|                 | Safety valve setting pressure (g)                                        | 9,0 bar              |
|                 | Certificate                                                              | LRS                  |
|                 | Weight                                                                   | 14 kg                |
|                 | Item number                                                              | EE 005               |
| 2.1.4           | <b>EE 006 - Water inlet valve</b>                                        | 1 piece              |
|                 | design                                                                   | straight form        |

Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item  | Description                                                                                                                                                                                                                                                | Quantity                                                                                                      |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
|       | function<br>nominal bore<br>nominal pressure<br>Certificate<br>Item number<br>Weight                                                                                                                                                                       | shut-off/check valve<br>DN 65<br>PN 25<br>LRS<br>EE 006<br>18,4 kg                                            |
| 2.1.5 | <b>EE 009 - Drain valve</b><br>design<br>function<br>nominal bore<br>nominal pressure<br>Certificate<br>Item number<br>Weight                                                                                                                              | 2 pieces<br>straight form<br>shut-off/check valve<br>DN 25<br>PN 25<br>LRS<br>EE 009<br>5,4 kg                |
| 2.1.6 | <b>EE 011 - Soot drain gate valve</b><br>nominal bore<br>nominal pressure<br>length<br>Material<br>Item number                                                                                                                                             | 2 pieces<br>DN 40<br>PN 10<br>190 mm<br>0.6025 / GG-25-Cr1<br>BO 011                                          |
| 2.1.7 | <b>EE 016 - Economizer vent valve</b><br>function<br>design<br>nominal bore<br>nominal pressure<br>Material<br>Certificate                                                                                                                                 | 1 piece<br>shut-off valve<br>straight form<br>DN 15<br>PN 25<br>EN-JS1025 / EN-GJS-400-18-LT<br>LRS           |
| 2.1.8 | <b>EE 018 - Pressure gauge/Gauge board valve</b><br>nominal pressure<br>connection<br>thread<br>Material<br>Certificate<br>Item number                                                                                                                     | 1 piece<br>PN 400<br>screw joint<br>G 1/2<br>1.0402 / C22<br>3.1 EN 10204<br>EE 018                           |
| 2.1.9 | <b>EE 030 - Gauge board for double pass exhaust gas boiler</b><br>Boiler type<br>Boiler pressure gauge<br>Gauge pressure range<br>Gauge red marked at<br>Steam pressure monitor max.<br>Flue pressure range<br>Number of thermometers<br>Temperature range | 1 piece<br>EME/EMB<br>included<br>0...16 bar<br>9,0 bar<br>included<br>-25..25 mbar<br>4 pieces<br>0...500 °C |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item   | Description                                                                                                                                                                                                                                            | Quantity |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
|        | Thermometer connection G 1/2                                                                                                                                                                                                                           |          |
|        | EE 030                                                                                                                                                                                                                                                 |          |
| 2.1.10 | <b>EE 042 - Exhaust gas inlet temperature transmitter</b><br>Type TR201<br>Process connection G 1/2<br>Mounting length U1 250 mm<br>Temperature range 0...500 °C<br>Signal 4-20 mA, twin<br>Material 1.4571 / X6CrNiMoTi17-12-2<br>Item number EE 042  | 2 pieces |
| 2.1.11 | <b>EE 043 - Exhaust gas outlet temperature transmitter</b><br>Type TR201<br>Process connection G 1/2<br>Mounting length U1 250 mm<br>Temperature range 0...500 °C<br>Signal 4-20 mA, twin<br>Material 1.4571 / X6CrNiMoTi17-12-2<br>Item number EE 043 | 2 pieces |
| 2.1.12 | <b>EE 071 - U-tube differential pressure gauge</b><br>Item number EE 071                                                                                                                                                                               | 2 pieces |
| 2.2    | EM - Mounting set for economizer                                                                                                                                                                                                                       | 1 piece  |
| 2.2.1  | <b>EM 002 - Mounting set for economizer body</b>                                                                                                                                                                                                       | 1 piece  |
| 2.2.2  | <b>EM 002 - Mounting set for steam/water outlet valve</b><br>Nominal bore DN 100<br>nominal pressure PN 25                                                                                                                                             | 1 piece  |
| 2.2.3  | <b>EM 005 - Mounting set for economizer safety valves</b><br>Nominal bore DN 32/50<br>nominal pressure PN 40/16                                                                                                                                        | 2 pieces |
| 2.2.4  | <b>EM 006 - Mounting set for water inlet valve</b><br>Nominal bore DN 65<br>nominal pressure PN 25                                                                                                                                                     | 1 piece  |
| 2.2.5  | <b>EM 009 - Mounting set for blow down/drain valves</b><br>Nominal bore DN 25<br>nominal pressure PN 25                                                                                                                                                | 2 pieces |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item   | Description                                                                                                                                                                                                                                                                                                                                                                                                                               | Quantity |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 2.2.6  | <b>EM 011 - Mounting set for soot water drain valve</b>                                                                                                                                                                                                                                                                                                                                                                                   | 2 pieces |
| 2.2.7  | <b>EE 016 - Mounting set for EGE vent valve</b><br>Nominal bore DN15<br>nominal pressure PN 25                                                                                                                                                                                                                                                                                                                                            | 1 piece  |
| 2.2.8  | <b>EE 030 - Mounting set for EGE gauge board</b>                                                                                                                                                                                                                                                                                                                                                                                          | 1 piece  |
| 2.2.9  | <b>EM 042 - Mounting set for inlet gas temperature transmitter</b>                                                                                                                                                                                                                                                                                                                                                                        | 2 pieces |
| 2.2.10 | <b>EM 043 - Mounting set for outlet gas temperature transmitter</b>                                                                                                                                                                                                                                                                                                                                                                       | 2 pieces |
| 2.2.11 | <b>EM 090 - Fitting accessories for safety valves remote actuation</b><br>number of safety valves 1 piece<br>Weight 15,0 kg<br>Item number EM 090                                                                                                                                                                                                                                                                                         | 2 pieces |
| 2.3    | <b>CW - Hot water circulation system</b>                                                                                                                                                                                                                                                                                                                                                                                                  | 1 piece  |
| 2.3.1  | <b>CW 001 - Hot water circulation pump</b><br>Medium temperature, max. 180 °C<br>Operating volume flow 5,0 m³/h<br>delivery head at operating point 2,5 bar<br>Nominal bore inlet DN 50<br>Nominal bore outlet DN 32<br>Motor rated power at 50 Hz 1,75 kW<br>Motor manufacturer Siemens<br>Supply voltage 440 V<br>Frequency 60 Hz<br>speed 3460 1/min<br>IC IC according EN 10204 / 3.2<br>Workshop inspection and certification by LRS | 2 pieces |
| 2.3.2  | <b>CW 007 - Differential pressure sensor for circulation pumps</b><br>Type DMD 331<br>Pressure range 0...6 bar<br>Fluid pressure max. 20 bar<br>Medium temperature, max. 125 °C<br>connection male/male thread<br>thread G 1/2<br>Material 1.4571                                                                                                                                                                                         | 1 piece  |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Friese to Allseas Engineering B.V.

| Item  | Description                                                                                                                                                                                                                                                                                                                                                                                    | Quantity                                                                                                                            |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
|       | Supply voltage<br>Signal<br>Item number                                                                                                                                                                                                                                                                                                                                                        | 24 V<br>4-20 mA, twin<br>CW 007                                                                                                     |
| 2.3.3 | <b>CW 010 - EGE circulation flow regulating valve</b><br><br>Attention, the size of this valve does not resemble the necessary size of the circulation pipe but is adapted to the flow characteristics of this valve and the required KVS value.<br><br>function<br>Design<br>nominal bore<br>nominal pressure<br>Valve type<br>Weight<br>Certificate<br>Classification Society<br>Item number | 1 piece<br><br><br><br><br>restrictor valve<br>straight form<br>DN 32<br>PN 25<br>23.046<br>6,6 kg<br>3.1 EN 10204<br>LRS<br>CW 010 |
| 2.4   | CWM - Mounting set for circulation system                                                                                                                                                                                                                                                                                                                                                      | 1 piece                                                                                                                             |
| 2.4.1 | <b>CWM 001 - Mounting set for circulation pump</b>                                                                                                                                                                                                                                                                                                                                             | 2 pieces                                                                                                                            |
| 2.4.2 | <b>CWM 007 - Mounting set for differential pressure transmitter</b>                                                                                                                                                                                                                                                                                                                            | 1 piece                                                                                                                             |
| 2.4.3 | <b>CWM 010 - Mounting set for circulation flow adjustment valve</b><br>Nominal bore<br>nominal pressure                                                                                                                                                                                                                                                                                        | 1 piece<br>DN 32<br>PN 25                                                                                                           |
| 2.5   | CS - Control system for economizer EME                                                                                                                                                                                                                                                                                                                                                         | 1 piece                                                                                                                             |
| 2.5.1 | <b>CS 010 - Exhaust gas boiler control cabinet</b><br>Boiler type<br>Supply voltage<br>Supply frequency<br>Boiler controls<br>control voltage<br>Dimensions (wxhxd)<br>Colour pattern                                                                                                                                                                                                          | 1 piece<br>EMB-VST<br>440 V<br>60 Hz<br>Conventional relay based<br>230 V<br>600x760x300 mm<br>RAL 7035                             |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).

**Quotation N 13643300/2NL**

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item  | Description                                                            | Quantity       |
|-------|------------------------------------------------------------------------|----------------|
|       | Workshop inspection and certification by LRS                           |                |
| 2.5.2 | <b>Engineering hours for electrical control system</b>                 | 12 h           |
| 2.5.3 | <b>Drawings approval and shop test for electrical control system</b>   | 1 piece        |
|       | Classification Society LRS                                             |                |
| 2.6   | SP/TO - Spare parts and tools kit for exhaust gas boiler EMB/EME-HS/VS | <b>1 piece</b> |
|       | Boiler type EME-2VST                                                   |                |
|       | Construction year of the boiler 2015                                   |                |
|       | Classification Society LRS                                             |                |
|       | Design pressure (g) 9,0 bar                                            |                |
|       | DN of main steam valve DN 100                                          |                |
|       | DN of safety valve DN 32/50                                            |                |
|       | Safety valve setting pressure (g) 9,0 bar                              |                |
|       | DN of feed valves DN 65                                                |                |
|       | DN of blow down valves DN 25                                           |                |
|       | Nominal bore BO 016/017/018 DN 15                                      |                |
| 2.6.1 | <b>SP 001 - Main steam pressure gauge 9 bar(g)</b>                     | 1 piece        |
| 2.6.2 | <b>SP 002/032 - Spring for safety valve</b>                            | 2 pieces       |
| 2.6.3 | <b>SP 006 - Manhole gasket</b>                                         | 5 pieces       |
| 2.6.4 | <b>SP 007 - Handhole gasket</b>                                        | 16 pieces      |
| 2.6.5 | <b>SP 015 - Plug for smoke tube, for temporary repair (EG part)</b>    | 20 pieces      |
| 2.6.6 | <b>SP 016 - Repair plug for stay tube (EG part)</b>                    | 10 pieces      |

**Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke**

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).



Quotation N 13643300/2NL

dated 25.1.2015 by Mr. Frieze to Allseas Engineering B.V.

| Item            | Description                                                                                       | Quantity           |
|-----------------|---------------------------------------------------------------------------------------------------|--------------------|
| Scope of supply |                                                                                                   |                    |
| 3               | <b>OPTION: Exhaust gas distribution system for flexible use of all 3 engines</b>                  |                    |
| 3.1             | <b>EGD – Exhaust gas distribution control and monitoring system</b>                               | 2 pieces           |
|                 | System of gas dampers for interconnection of 3 engine exhaust gas ducts with 2 economizer passes. |                    |
| 3.1.1           | <b>EGD 001 – Exhaust gas damper</b>                                                               | 8 pieces           |
|                 | Nominal bore                                                                                      | DN 700             |
|                 | nominal pressure                                                                                  | PN 1               |
|                 | Connection                                                                                        | flange             |
|                 | Medium temperature, max.                                                                          | 550 °C             |
|                 | Control valve actuator type                                                                       | Pneumatic actuator |
|                 | Supply voltage                                                                                    | 230 V              |
|                 | Frequency                                                                                         | 50/60 Hz           |
| 3.1.2           | <b>EGD 010 - Exhaust gas distribution control and monitoring control panel</b>                    | 1 piece            |

Managing Directors: Frank-Uwe Schulz, Stefan Lumper | Chairman of the Advisory Board: Henning Saacke

SAACKE GmbH | Head office: Bremen | HRB 23625 | Place of jurisdiction: Bremen | VAT ID no.: DE814693565

Deutsche Bank AG, Bremen | (Bank code no.: 290 700 50) | Account no.: 2 664 555 | S.W.I.F.T.: DEUT DE HB XXX | IBAN: DE87 2907 0050 0266 4555 00

Bremer Landesbank | (Bank code no.: 290 500 00) | Account no.: 1 035 250 007 | S.W.I.F.T.: BRLA DE 22XXX | IBAN: DE05 2905 0000 1035 2500 07

Bankhaus Neelmeyer AG, Bremen | (Bank code no.: 290 200 00) | Account no.: 510 | S.W.I.F.T.: NEEL DE 22 | IBAN: DE42 2902 0000 0000 0005 10

The Standard Contract Conditions of SAACKE GmbH apply, insofar as individual agreements have not been or are not made. The current version is available at [www.saacke.com/imprint/](http://www.saacke.com/imprint/).



## Bijlage VII Competentieset

Deze bijlage bevat de Competentieset behorende bij mijn afstudeeropdracht. Naar deze bijlage is niet in het verslag verwezen, omdat deze geen echte bijdrage levert aan de inhoud van het verslag.

Tijdens het afstuderen heb ik een aantal taakrollen doorlopen, die ik gecombineerd met een aantal competenties uitgevoerd heb. Deze staan in tabel 8.1 weergegeven.

| Taakrollen                                                 |                                                                                                             | Onderzoeker | Ontwerper | Adviseur | Beheerder | Projectleider | Ondernemer |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------|-----------|----------|-----------|---------------|------------|
| <b>Competentieset werktuigbouwkunde &amp; HBO algemeen</b> |                                                                                                             |             |           |          |           |               |            |
| <b>Nr.</b>                                                 | <b>Competenties werktuigbouwkunde</b>                                                                       |             |           |          |           |               |            |
| 1                                                          | Projectmanagement uitvoeren (organiseren, plannen, uitvoeren, verslag opstellen)                            | 3           | 3         | 3        |           |               |            |
| 2                                                          | Een onderzoeksoopdracht uitvoeren                                                                           | 3           |           |          |           |               |            |
| 3                                                          | Het kunnen opstellen van productdefinitie, pva en pve voor een duurzaam product of proces                   | 3           |           |          |           |               |            |
| 4                                                          | Het realiseren van een functioneel duurzaam product of voortbrengingsproces                                 |             |           |          |           |               |            |
| 5                                                          | Het realiseren van een detailontwerp voor een duurzaam product of voortbrengingsproces                      |             |           |          |           |               |            |
| 6                                                          | Het realiseren van een prototype/model van een duurzaam product of voortbrengingsproces                     |             |           |          |           |               |            |
| 7                                                          | Het voorbereiden van een voortbrengingsproces                                                               |             | 3         |          |           |               |            |
| 8                                                          | Het produceren van een duurzaam product                                                                     |             |           |          |           |               |            |
| 9                                                          | Het beheren of onderhouden van een product of proces                                                        |             |           |          |           |               |            |
| <b>Nr.</b>                                                 | <b>Algemene HBO competenties</b>                                                                            |             |           |          |           |               |            |
| 10                                                         | Kritisch handelen (analytisch en probleemoplossend vermogen en het onderbouwen van keuzen, oordeelsvorming) | 3           | 3         | 3        |           |               |            |
| 11                                                         | Systematisch een probleem aanpakken (creatieve, plan- en projectmatige werkhouding)                         | 3           | 3         | 3        |           |               |            |
| 12                                                         | Samenwerken (sociaal communicatieve vaardigheden)                                                           | 3           | 3         | 3        |           |               |            |
| 13                                                         | Persoonlijke en professionele ontwikkeling                                                                  | 3           | 3         | 3        |           |               |            |
| 14                                                         | Zelfverantwoordelijk werken.                                                                                | 3           | 3         | 3        |           |               |            |
| 15                                                         | Kunnen functioneren in een internationale en/of multiculturele context.                                     | 3           | 3         | 3        |           |               |            |

Tabel 8.1, Competentieset

Het niveau van uitvoering van de opdracht wordt door twee factoren bepaald:

- De context van de opdracht.
- De uitvoerende taakrol.

In tabel 8.2 staan de taakrollen tegenover de context uitgeschreven. Hieruit volgen niveau 1 t/m 5. De taakrol wordt bepaald door het uitvoeren van de opdracht, geleid, zelfstandig of sturend. De context wordt bepaald door het niveau van de opdracht.

| overzicht competentieniveaus |         |         |             |         |
|------------------------------|---------|---------|-------------|---------|
|                              |         | taakrol |             |         |
|                              |         | geleid  | zelfstandig | sturend |
| context                      | simpel  | 1       | 2           | 3       |
|                              | lastig  | 2       | 3           | 4       |
|                              | complex | 3       | 4           | 5       |

Tabel 8.2, Overzicht competentieniveaus.

## Bepaling niveau van de opdracht:

Om zicht en grip te verkrijgen op de competentieniveaus in de relatie tot de context van de afstudeeropdracht en tot de bijbehorende taakrol, is hieronder een hulpmiddel uitgewerkt.

| niveau bepaling afstudeeropdracht  |                                                                                                  |                                                              |
|------------------------------------|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| opdrachtsituatie                   |                                                                                                  |                                                              |
|                                    |                                                                                                  | ja      nee                                                  |
| 1                                  | de opdracht heeft conflicterende (product)eisen in zich                                          | <input checked="" type="checkbox"/> <input type="checkbox"/> |
| 2                                  | de opdracht is niet binnen de gestelde afstudeerperiode goed onderbouwd af te ronden             | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 3                                  | zijn binnen de opdracht verschillende belanghebbenden (denk aan comakership, etc.)               | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 4                                  | de afstudeeropdracht moet aan vooraf vastgelegde kwaliteitscriteria voldoen                      | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 5                                  | de afstudeeropdracht ligt gevoelig op het gebied van concurrenten/politiek/anders.....           | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| mogelijke effecten van de opdracht |                                                                                                  |                                                              |
| 6                                  | deze opdracht is dermate belangrijk voor het bedrijf, dat deze met goed gevolg wordt afgerond    | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 7                                  | wanneer uitvoering van de opdracht mis loopt heeft dit duidelijke consequenties voor het bedrijf | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 8                                  | bij goede uitvoering van de opdracht levert het resultaat veel extra werk op voor het bedrijf    | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 9                                  | op basis van de resultaten uit het verslag worden managementbeslissingen genomen                 | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 10                                 | aan de uitvoering van deze opdracht zijn investeringen gebonden                                  | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 11                                 | er bestaat een kans dat er veranderingen zullen ontstaan binnen de organisatie tgv bevindingen   | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| analyse middelen en domein         |                                                                                                  |                                                              |
| 12                                 | de student dient nieuwe kennis en vaardigheden op te doen voor de uitvoering van de opdracht     | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 13                                 | de werkzaamheden liggen ruimer dan alleen de werktuigbouwkundige aspecten                        | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 14                                 | de student krijgt te maken met specifieke eigenaardigheden binnen het werkveld                   | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| 15                                 | de student krijgt te maken met een geheel nieuwe bedrijfscultuur                                 | <input type="checkbox"/> <input checked="" type="checkbox"/> |
| figuur 3                           |                                                                                                  |                                                              |

Tabel 3      Hulpmiddel bij bepaling competentieniveau afstudeeropdracht

Beantwoording van bovenstaande stellingen met 'ja' of 'nee' levert een beeld op van het competentieniveau, gekoppeld aan de afstudeeropdracht. Daarbij geldt de volgende score:

- 'simpele context' bij scores tot 2 keer 'ja'
- 'lastige context' bij scores van 2 tot en met 4 'ja'
- 'complexe context' bij scores 4 of meer keer 'ja'.

*De ervaring heeft geleerd dat de meeste opdrachten in de gecombineerde taakrol van onderzoeker en ontwerper zijn thuis te brengen, en het niveau bij aanvang op 2 of 3 uit zal komen. Aan het eind van de opdracht dienen alle van toepassing zijnde competenties op niveau 3 te liggen.*

Bij tabel 3 zijn er 5 vakjes met ja aangekruist, wat betekent dat deze opdracht als complex kan worden gezien. Deze opdracht wordt echter neergezet als een mix tussen lastig en complex, omdat er niet op alle stof diep in wordt gegaan.

| Taakrol:                                                                                                                                                                                                                                                                                                                                       | Competentienummer: | Competentieniveau:        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------|
| Onderzoeker                                                                                                                                                                                                                                                                                                                                    | 1                  | 3 (lastig en zelfstandig) |
| Het onderzochte voor deze opdracht is zo vastgelegd dat menig men het kan volgen. Zo kan de voortgang van het project goed gevolgd worden. Ook is de lijn door de opdracht goed verwoord, zodat er een logisch verhaal in zit. Mede hierdoor is er aan deze competentie voldaan.                                                               |                    |                           |
| Onderzoeker                                                                                                                                                                                                                                                                                                                                    | 2                  | 3 (lastig en zelfstandig) |
| Voor deze opdracht is er onderzoek gedaan naar verschillende dingen; naar het huidige stoomverbruik, wat de huidige situatie is op de Audacia en nog meer. Omdat het meeste onderzoek zelfstandig is gebeurd en de informatie verwerkt is in het verslag tot conclusies en kerncijfers, is er aan dit competentienummer voldaan.               |                    |                           |
| Onderzoeker                                                                                                                                                                                                                                                                                                                                    | 3                  | 3 (lastig en zelfstandig) |
| Voordat er met deze opdracht is begonnen is er een plan van aanpak opgesteld waarin de activiteiten beschreven staan. Ook is er een pakket van eisen opgesteld en gestuurd naar verscheidene leveranciers, zodat zij ook weten waar het product aan moet voldoen. Onder andere door deze activiteiten is er aan dit competentienummer voldaan. |                    |                           |
| Ontwerper                                                                                                                                                                                                                                                                                                                                      | 1                  | 3 (complex en geleid)     |
| Er is een concept/ontwerp gemaakt voor de uitlaatgassenketel. Dit is systematisch met verslaglegging vastgelegd. Hierbij is er een planning gemaakt van verschillende stappen die doorlopen moesten worden. Door deze activiteiten is er aan dit competentienummer voldaan.                                                                    |                    |                           |
| Ontwerper                                                                                                                                                                                                                                                                                                                                      | 7                  | 3 (complex en geleid)     |
| De opdracht viel niet in de aangewezen opdracht af te ronden. De opdracht kan nog veel verder gaan (tot het installeren van de uitlaatgassenketels). Er zijn wel aanbevelingen gedaan waar er in het                                                                                                                                           |                    |                           |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |    |                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---------------------------|
| vervolg van het project op gelet moet worden. Door deze aanbevelingen kan er voorbereid aan het vervolg worden begonnen, waardoor er aan deze competentie voldaan is.                                                                                                                                                                                                                                                                                                                                                                        |    |                           |
| Adviseur                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1  | 3 (lastig en zelfstandig) |
| Er is een advies (in het Engels) uitgebracht naar het management van Allseas. Hier staan in het kort de situatie, de bevindingen en een investeringsvoorstel in opgesteld. Mede door dit voorstel is er aan deze competentie voldaan.                                                                                                                                                                                                                                                                                                        |    |                           |
| Alle                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 10 | 3 (lastig en zelfstandig) |
| Er is kritisch gehandeld binnen deze opdracht. Bij het stoomverbruik op de Audacia is er nagegaan of alle onderdelen goed op de lijst stonden. Er is vooruitgedacht en gekeken of meerdere oplossingen mogelijk zijn, waar uiteindelijk het beste ontwerp goed onderbouwd is gekozen. De concepten zijn getoetst op hun opbrengst, inpasbaarheid, kosten en andere praktische redenen. Het investeringsvoorstel is mede op basis van deze onderbouwingen goedgekeurd door afdelingshoofd TD.                                                 |    |                           |
| Alle                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 11 | 3 (lastig en zelfstandig) |
| Er is duidelijke structuur aan de opdracht toegepast. De opbouw is logisch gegaan en er is pas doorgedaan als de problemen en vragen van het vorige hoofdstuk beantwoord zijn. Zo is er out of the box gedacht en is er met mogelijkheden gekomen waar ze binnen de afdeling niet op komen. (Het is niet een juiste oplossing omdat het niet kan in deze situatie, maar leuk bedacht). En er is een systematische aanpak verricht, zoals te zien in de scriptie. Door deze werkhouding heb ik laten zien dat ik aan deze competentie voldoe. |    |                           |
| Alle                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 12 | 3 (lastig en zelfstandig) |
| Ik heb goed met de collega's samengewerkt. Vergaderingen inplannen, met leveranciers van buiten om de tafel zitten, naar Duitsland geweest voor een internationale klant is allemaal goed verlopen. Verder is Taco een fijne begeleider geweest en heb ik ook mijn opdracht overgebracht aan meerdere mensen via een presentatie in het Engels. Ik heb ook aan deze competentie voldaan.                                                                                                                                                     |    |                           |
| Alle                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 13 | 3 (lastig en zelfstandig) |
| Het kantoorleven is wel even wennen, maar de uitstapjes naar klanten en schepen maakt het werk leuk en afwisselend. Hiermee hanteren we een respectvolle en professionele behandeling. In vergelijking met mijn vroegere bijbaan (badmeester in een zwembad), is dit toch wel anders werken. Waar daar het overzicht op het zwembad makkelijk te bewaren was, begin je weer onderaan bij werklakken waar mensen al expert op zijn en je leert veel van ze. Dit is een leuke ontwikkeling.                                                    |    |                           |
| Alle                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 14 | 3 (lastig en zelfstandig) |
| Ik ben altijd op tijd geweest. Ik ben mijn afspraken nagekomen en als er iets niet goed ging probeerde ik het zelf op te lossen en anders vroeg ik om hulp bij collega's. ik heb problemen niet verborgen en hielp altijd met meedenken voor een oplossing. Hierom vind ik dat ik verantwoordelijk aan het werk ben en dat ik andere collega's mij een aanwinst vinden in een bedrijf.                                                                                                                                                       |    |                           |
| Alle                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 15 | 3 (lastig en zelfstandig) |
| Tijdens werk heb ik met meerdere mensen samengewerkt. Met Italianen, Grieken, Cubanen en Hollanders. Hierbij is er goed samengewerkt en heb ik de benodigde informatie verkregen waar ik om vroeg. En verder ook nog wat met ze gelachen.                                                                                                                                                                                                                                                                                                    |    |                           |