

Korea Research Institute of Ships & Ocean  
Engineering (KRISO)  
63, Jungang-daero, Jung-gu, Busan, Republic of Korea

Attn: Mr. Jung-Joong Kim  
Director of Mid-size Initial Ship Design Unit

**Lloyd's Register Asia**  
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Your ref -  
Our ref BTS/PAG/SGJ/LT201140

25 October 2021

**APPROVAL IN PRINCIPLE (AiP)**

**Korea Research Institute of Ships & Ocean Engineering (KRISO)'s  
Advanced Design for LNG Fueled 13K DWT Class Chemical Tanker**

1. Lloyd's Register Asia has undertaken design appraisal of Korea Research Institute of Ships & Ocean Engineering (KRISO), advanced design 13K DWT Class Chemical Tanker, with a view to granting an "Approval in Principle (AiP)".
2. The Evaluation included an overall examination of fundamental aspects of the design and general compliance with the following Rules and Regulations:
  - Lloyd's Register Rules and Regulation for the Classification of Ships dated July 2021
  - Lloyd's Register Rules and Regulation for the Construction and Classification of Ships for the Carriage of Liquid Chemicals in Bulk dated July 2020
  - Lloyd's Register Rules and Regulations for the Classification of Ships using Gases or other Low-Flashpoint Fuels, July 2021
  - SOLAS Regulation II-1/3-6, MSC Res. MSC 158 (78)
  - Chapter I General and Regulation 10(2) Annex I of the International Convention on Load Lines, 1966 as modified by the 1988 Protocol thereto, as amended
  - Regulation 27 of the Protocol 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocol of 1978 relating thereto (MARPOL 73/78)
  - International Code of Safety for Ships using Gases or Other Low-Flashpoint Fuels (IGF Code), June 2015
3. Lloyd's Register Asia considers that the proposed design concept of 13,000 dwt class chemical tanker is based on satisfactory standards and Rules and Regulations and it is Approved in Principle subject to final close out of the review findings of the submitted technical documentations detailed in the AiP Letter with ref. no. BTS/STL/S211476, no. BTS/SST/YRJ/L/H212474, no. BTS/ENG/M213348, and no. BTS/ETS/E212099.
4. The scope of this Approval in Principle is covered in paragraph 1 above. To gain Classification approval this design will have to meet all the detailed Classification requirements as the design is developed including close out of the review findings in AiP Letters.



**Young-Doo Kim**

Senior Principal Specialist & North East Asia Technical Support Office Manager  
Lloyd's Register Asia



# Design Appraisal Document

**Lloyd's Register Asia**  
**Busan Technical Support Office**  
**10th Floor, CJ Korea Express Bldg.**  
**119, Daegyo-ro, Jung-gu (2, 6-ga, Jungang-dong)**  
**Busan, 48943, Republic of Korea**

Date  
**18 October 2021**

Please quote the document number on all future communications

## **APPROVAL IN PRINCIPLE for MSDE of KRISO LNG Fueled 13K Class Chemical Tanker**

### **1. Preliminary Trim & Stability Calculation – Stability Aspect**

The captioned document has been examined for compliance with the following requirements for stability aspect and have been assigned an appraisal status, as indicated, in accordance with the following conditions:

- Chapter I General and Regulation 10(2) Annex I of the International Convention on Load Lines, 1966 as modified by the 1988 Protocol thereto, as amended
  - Regulation 27 of the Protocol 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocol of 1978 relating thereto (MARPOL 73/78)
- 1.1 At each departure loading condition all lubricating oil tanks are filled up to 90% not 98%.
- 1.2 The filling level (i.e. 96.11%) of cargo tanks for Cond. No. 16 arrival loading condition does not correspond to that (i.e. 96.18%) of the associated departure loading condition.

### **2. Preliminary Damage Stability Calculation (MARPOL/IBC Code)**

The captioned document has been examined for compliance with:

- Damage stability requirements of Chapter 2 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code)
- 2.1 The longitudinal bottom damage extent for any other part of ship is not correctly presented on page 9.
- 2.2 At final equilibrium after flooding, the emergency source of power should be capable of operating.
- 2.3 It is required to be examined for compliance with the damage stability requirements as stated in SOLAS Reg. II-1/12.2.

### **3. Freeboard Calculation**

The captioned document has been examined for compliance with:

FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

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**Busan, 48943, Republic of Korea**

Date  
**18 October 2021**

Please quote the document number on all future communications

- The requirements of Convention on the International Convention on Load Line, 1966, Protocol of 1988 and 2003 amendments Annex I "Regulations for Determining Load Lines", Chapter III "Freeboards"
- 3.1 Utilizing the information contained within the drawing "Freeboard Calculation", a draught check has been carried out with  $C_b=0.793$  and the result indicate that a maximum geometric summer load draught of 9.136 metre is obtainable as a Type "A" ship and 8.885 metre as a Type "B" ship under the terms of the International Convention on Load Line, 1966, Protocol of 1988 and 2003 amendments.
- 3.2 It is noted, however, that a moulded scantling draught of 8.70 metre is required and consequently these freeboard could be assigned in due course.

#### 4. Preliminary EEDI Calculation

The captioned document has been examined for compliance with the requirements of:

- MARPOL 73/78, Annex VI, Chapter 4, Regulations 20 and 21 on Energy Efficiency for Ship
  - RESOLUTION MEPC.308(73) "2018 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY DESIGN INDEX (EEDI) FOR NEW SHIPS"
  - RESOLUTION MEPC.254(67) "2014 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI)", AS AMENDED BY RESOLUTIONS MEPC.261(68) AND MEPC.309(730)
- 4.1 The Required EEDI of MARPOL Reg. VI/21 incl. minimum propulsion power is not applicable as the ship's capacity is below the minimum capacity in Table 1 of Reg. VI/21.2 (i.e. 20,000 DWT).



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Busan Technical Support Office  
**Lloyd's Register Asia**  
Y. C. Park

LR031.1.2016.06

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FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

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119, Daegyo-ro, Jung-gu (2, 6-ga, Jungang-dong)  
Busan, 48943, Republic of Korea

Date  
**18 October 2021**

Please quote the document number on all future communications

## Appendix

1. The documents listed below have been examined.

Dwg. No.	Rev.	Title	Status	Date
-	0	Preliminary Trim & Stability Calculation	SI	18 October 2021
-	0	Preliminary Damage Stability Calculation	SI	18 October 2021
-	0	Preliminary EEDI Calculation	SI	18 October 2021
-	0	Freeboard Calculation	SI	18 October 2021

### Appraisal Status Key

SI Retained as supporting documentation for information only.

FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

Lloyd's Register Asia  
Is a member of Lloyd's Register group

## PLAN HISTORY

REV. NO	DATE	DESCRIPTION	REMARK
0	2021.08.27	Prepared by basic design team	

### APPROVAL IN PRINCIPLE



This plan has been appraised for compliance with the Rules and Regulations stated in the letter referenced below.

Letter reference:  
**BTS/STL/S211476**

Date: 18 October 2021

Initials: YCP

Marine and Offshore  
Busan Technical Support Office  
Statutory Group  
Lloyd's Register Asia

LR034.1.2016.07

**For stability aspect only**

(153) SHEETS WITH COVER

본 도면은 대한민국 정부의 "중형선박 설계경쟁력 강화사업"의 일환으로 작성된 문서입니다.

MANAGER	K.D. OK	DATE : 2021 . 08 . 27	SCALE
APPROVED	S.S. JEONG	LNG Fueled 13K Class Chemical Tanker	NONE
CHECKED	B.J. JUNG	<b>PRELIMINARY TRIM &amp; STABILITY CALCULATION</b>	TEAM
DRAWN	H.J. SON		BASIC DESIGN
TEL.	051-260-7827		REV. 0



**중형선박설계사업단**  
SHIP DESIGN & ENGINEERING

## PLAN HISTORY

REV. NO	DATE	DESCRIPTION	REMARK
0	2021.08.31	Prepared by basic design team	

### APPROVAL IN PRINCIPLE



This plan has been appraised for compliance with the Rules and Regulations stated in the letter referenced below.

Letter reference:  
**BTS/STL/S211476**

Date: 18 October 2021 Initials: YCP

Marine and Offshore  
Busan Technical Support Office  
Statutory Group  
Lloyd's Register Asia

LR034.1.2016.07

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MANAGER	K.D. OK	DATE : 2021. 08. 31	SCALE
APPROVED	S.S. JEONG	LNG Fueled 13K Class Chemical Tanker	NONE
CHECKED	B.J. JUNG	PRELIMINARY DAMAGE STABILITY CALCULATION	TEAM
DRAWN	H.J. SON		BASIC DESIGN
TEL.	051-260-7827		REV. 0



**중형선박설계사업단**  
SHIP DESIGN & ENGINEERING

## PLAN HISTORY

REV. NO	DATE	DESCRIPTION	REMARK
0	2021.08.27	Prepared by basic design team	

### APPROVAL IN PRINCIPLE



This plan has been appraised for compliance with the Rules and Regulations stated in the letter referenced below.

Letter reference:  
**BTS/STL/S211476**

Date: 18 October 2021

Initials: YCP

Marine and Offshore  
Busan Technical Support Office  
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Lloyd's Register Asia

LR034.T.2016.07

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MANAGER	K.D. OK	DATE : 2021. 08. 27	SCALE
APPROVED	S.S. JEONG	LNG Fueled 13K Class Chemical Tanker	NONE
CHECKED	B.J. JUNG	<b>PRELIMINARY EEDI CALCULATION</b>	TEAM
DRAWN	H.J. SON		BASIC DESIGN
TEL.	051-260-7827		REV. 0
		<b>중형선박설계사업단</b> SHIP DESIGN & ENGINEERING	

## PLAN HISTORY

REV. NO	DATE	DESCRIPTION	REMARK
0	2021.08.27.	Prepared by basic design team.	

### APPROVAL IN PRINCIPLE



This plan has been appraised for compliance with the Rules and Regulations stated in the letter referenced below.

Letter reference:  
**BTS/STL/S211476**

Date: 18 October 2021

Initials: YCP

Marine and Offshore  
Busan Technical Support Office  
Statutory Group  
Lloyd's Register Asia

LR034.T.2016.07

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<b>MANAGER</b>	K.D.OK	<b>DATE : 2021. 08. 27.</b>	<b>SCALE</b>
<b>APPROVED</b>	S.S.JEONG	<b>LNG Fueled 13K Class Chemical Tanker</b>	NONE
<b>CHECKED</b>	B.J.JUNG	<b>Freeboard Calculation</b>	<b>TEAM</b>
<b>DRAWN</b>	H.J.SON		BASIC DESIGN
<b>TEL.</b>	051-260-7826		<b>REV.</b> 0



**중형선박설계사업단**  
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KRISO

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Attn: S.S. Jeong

Our ref BTS/SST/YRJ/L/H212474

18 October 2021

### **APPROVAL IN PRINCIPLE**

**KRISO**

#### **LNG FUELED 13K CLASS CHEMICAL TANKER**


1. Lloyd's Register has undertaken the evaluation of KRISO's LNG FUELED 13K LCASS CHEMICAL TANKER, with a view to granting "Approval in Principle (AiP)".
2. "Approval in Principle (AiP)" recognizes that the submitted plan is capable of being applied to the future project, however please be advised that we reserve the right for additional comments in actual design phase of future projects.
3. The documents listed in Paragraph 1 of the attached Appendix have been examined for compliance with the rules and regulations for the "Construction and Classification of Ships for the Carriage of Liquid Chemicals in Bulk", and have been assigned the appraisal status as indicated, subject to the followings.
4. The scantlings and arrangements as shown are suitable for a summer moulded draught of 8.7 metres measured above the top of keel plate. The minimum freeboard will, however, be determined on completion of the ship by the Regulations of the 1966 Load Line Convention as amended by 1988 protocol.

5. The longitudinal strength has been based on the scantling length of 119.8 metres and associated block coefficient of 0.78. The scantlings and arrangements as shown are approved and on the understanding that the maximum still water bending moment at amidships will not exceed the following value. The required minimum still water bending moment values at amidships will not be less than the following value.

Permissible Still Water Bending Moment (KN-M)		
Sea-Going		
amidship	Hogging	Sagging
	408,000	-408,000

Assignment values of shear force, bending moment along the length of the vessel will be given upon completion of the review of the actual design phase.


6. Following items are will be verified with in actual design phase.
- The scantling of double bottom structure against "High Density Cargoes"
  - The sloshing aspects for cargo and M.G.O tanks
  - Welding Throat Thickness
7. The amendments in the plan are will be reflected in actual design phase.
8. The primary structures are subject to verification in accordance with LR's *ShipRight* SDA Procedures for Tanker (May 2004 version) in actual design phase.
9. With regard to PMA arrangement in ballast tanks and cargo holds, the proposed PMA arrangement shown on the "Midship Section" for compliance with SOLAS Regulation II-1/3-6, MSC Res. MSC 158 (78) has been examined and found to be in order. It is, however, advised that "Ship's structure access manual" is to be submitted for our approval in actual design phase.



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LR031.1.2016.06

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## Appendix

1. The document(s) listed below have been examined

Document No.	Rev.	Title	Status	Date
	-	<b>MIDSHIP</b>	<b>AiP</b>	<b>18-Oct-2021</b>

2. The documents listed below have been considered together with the submitted documents in the appraisal

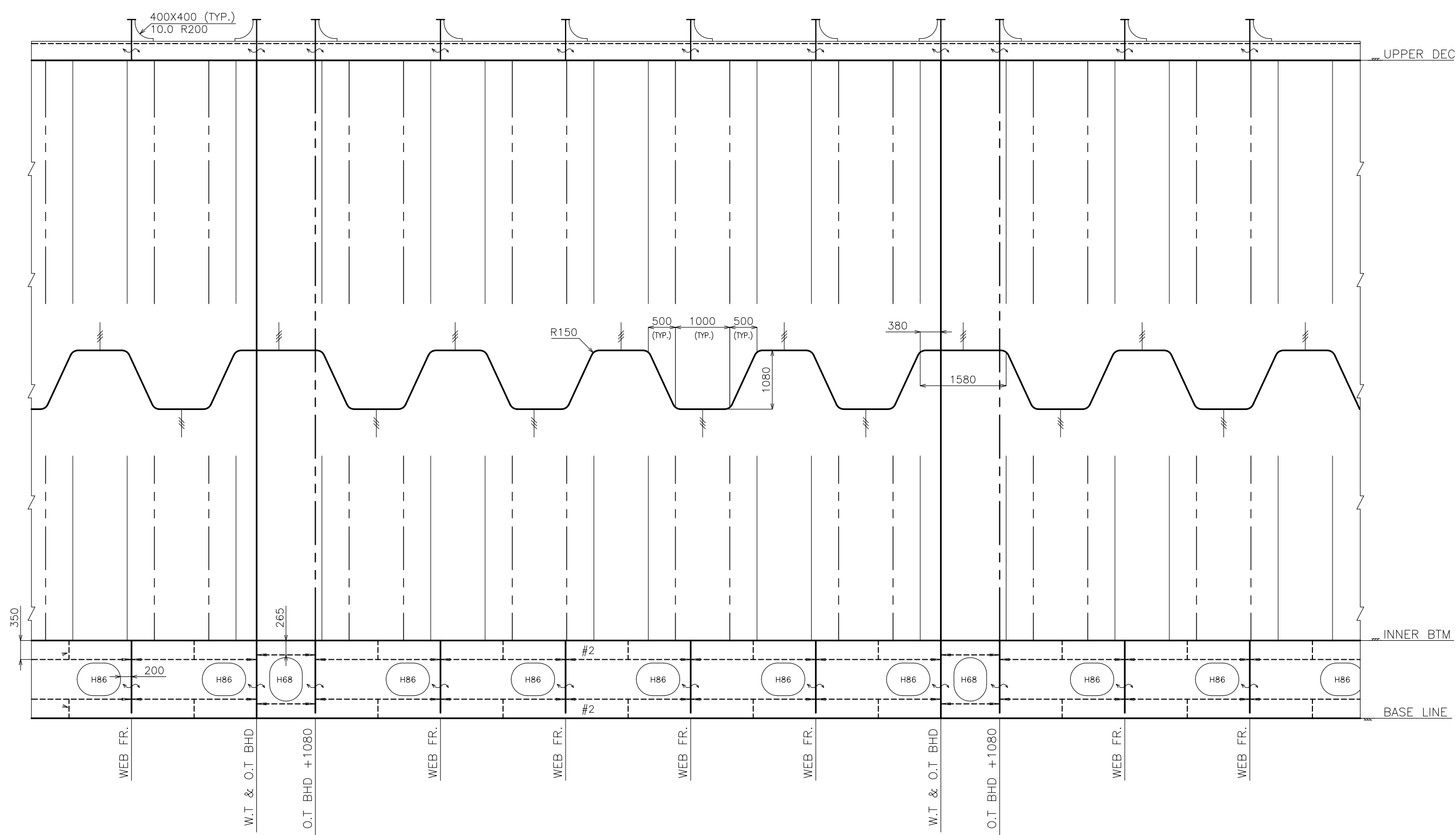
Document No.	Rev.	Title
	<b>0</b>	<b>MIDSHIP SECTION RULE SCANTLING REPORT</b>

## Appraisal Status Key

AiP      Approved in Principle. Drawings submitted have been examined for compliance with Lloyd's Register's procedure for 'Approval in Principle'.

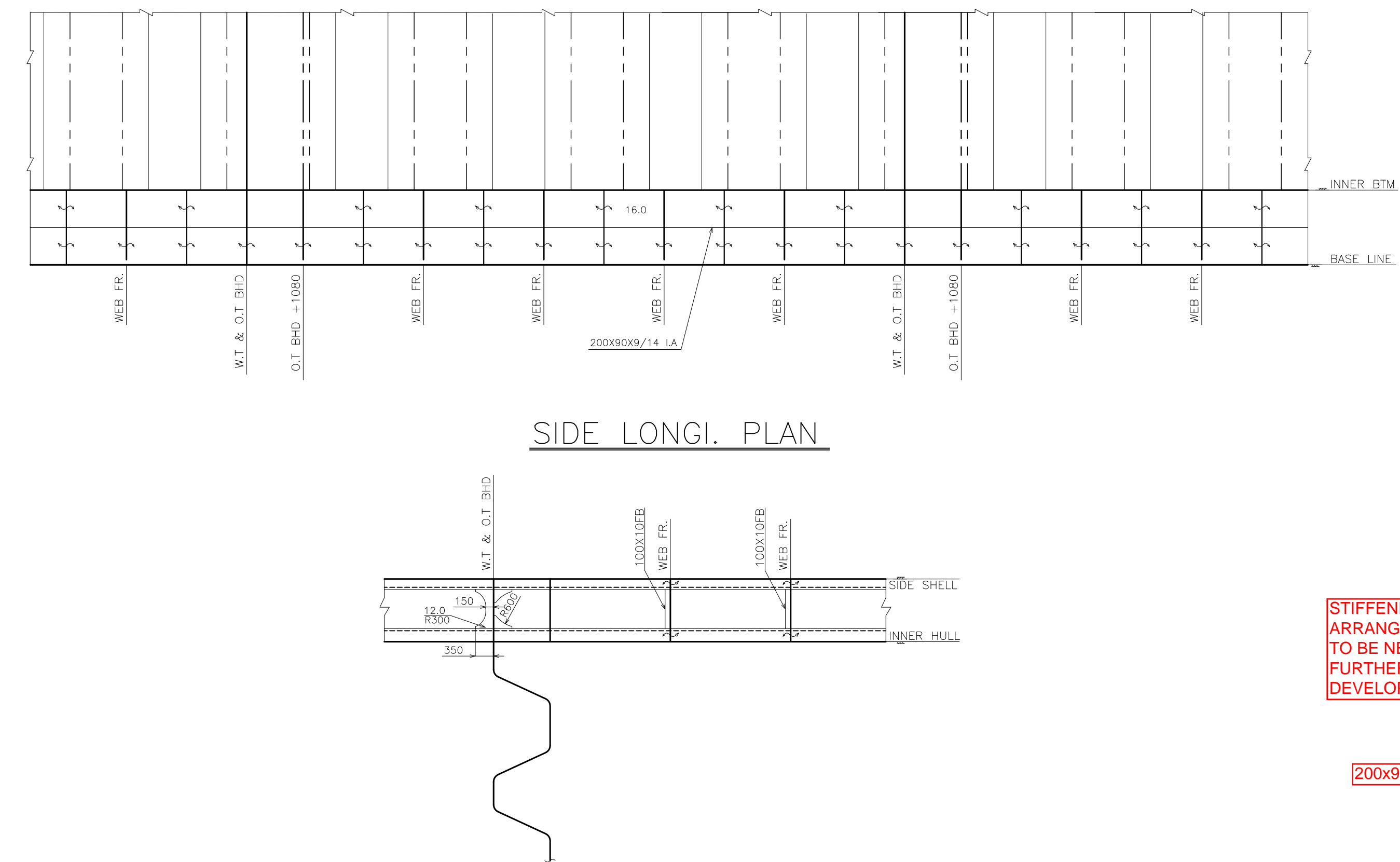
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## 540 OFF C.L ELEV. (P)

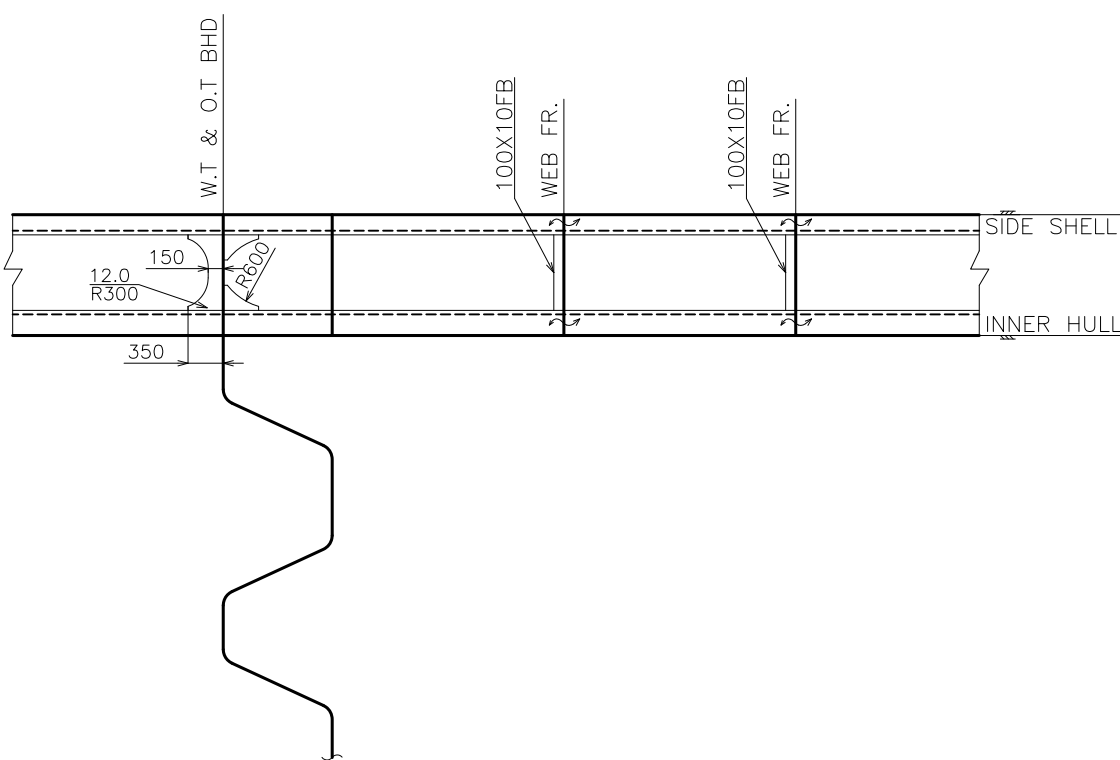
CORRUGATED BULKHEAD THICKNESS : 21.0 (EX. AS SHOWN)  
STIFFENER: 125X12.0 F.B(EX. AS SHOWN)

## 540 OFF C.L ELEV. (S)

CORRUGATED BULKHEAD THICKNESS : 21.0 (EX. AS SHOWN)

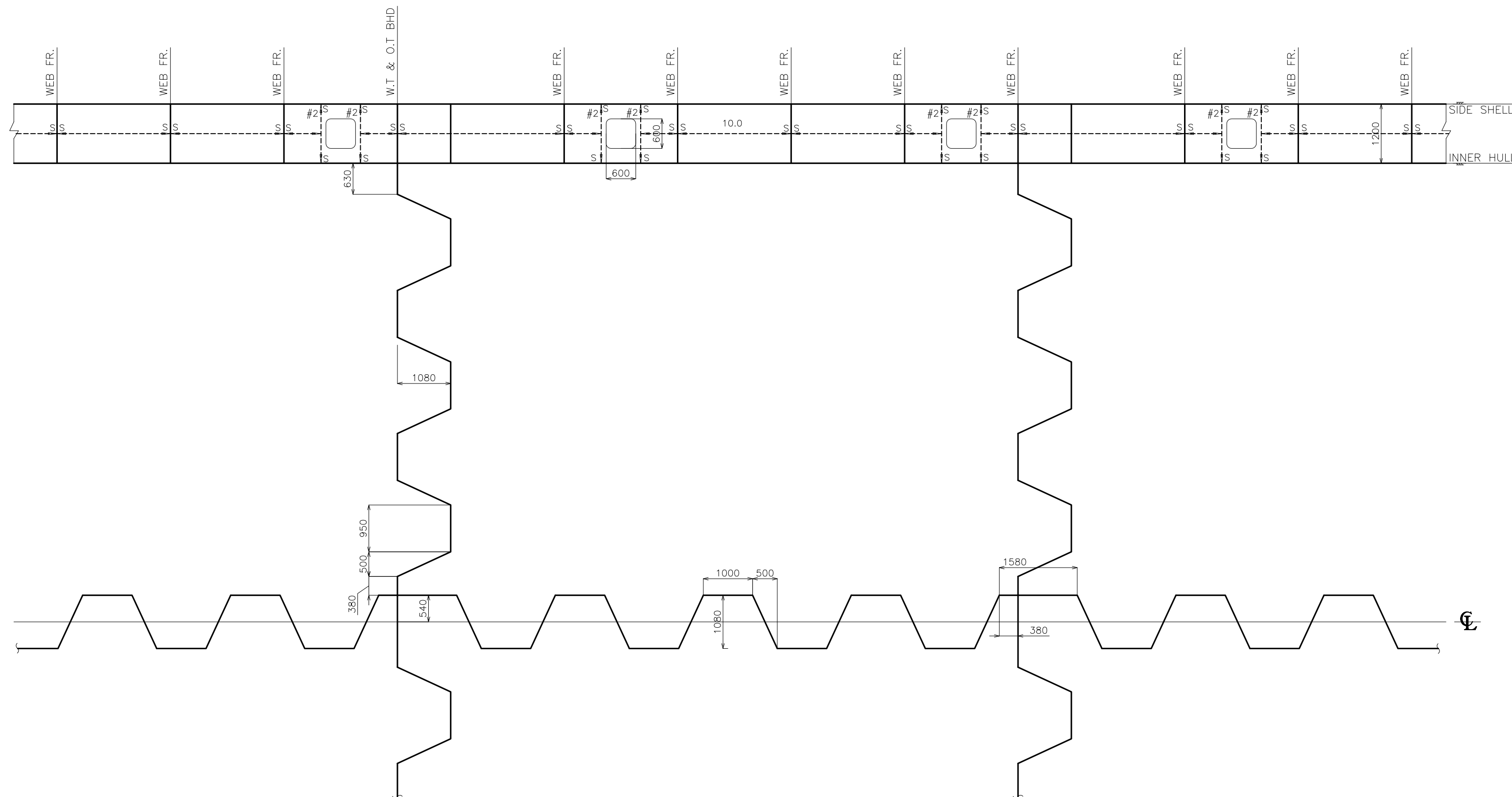


## SIDE LONGI. PLAN

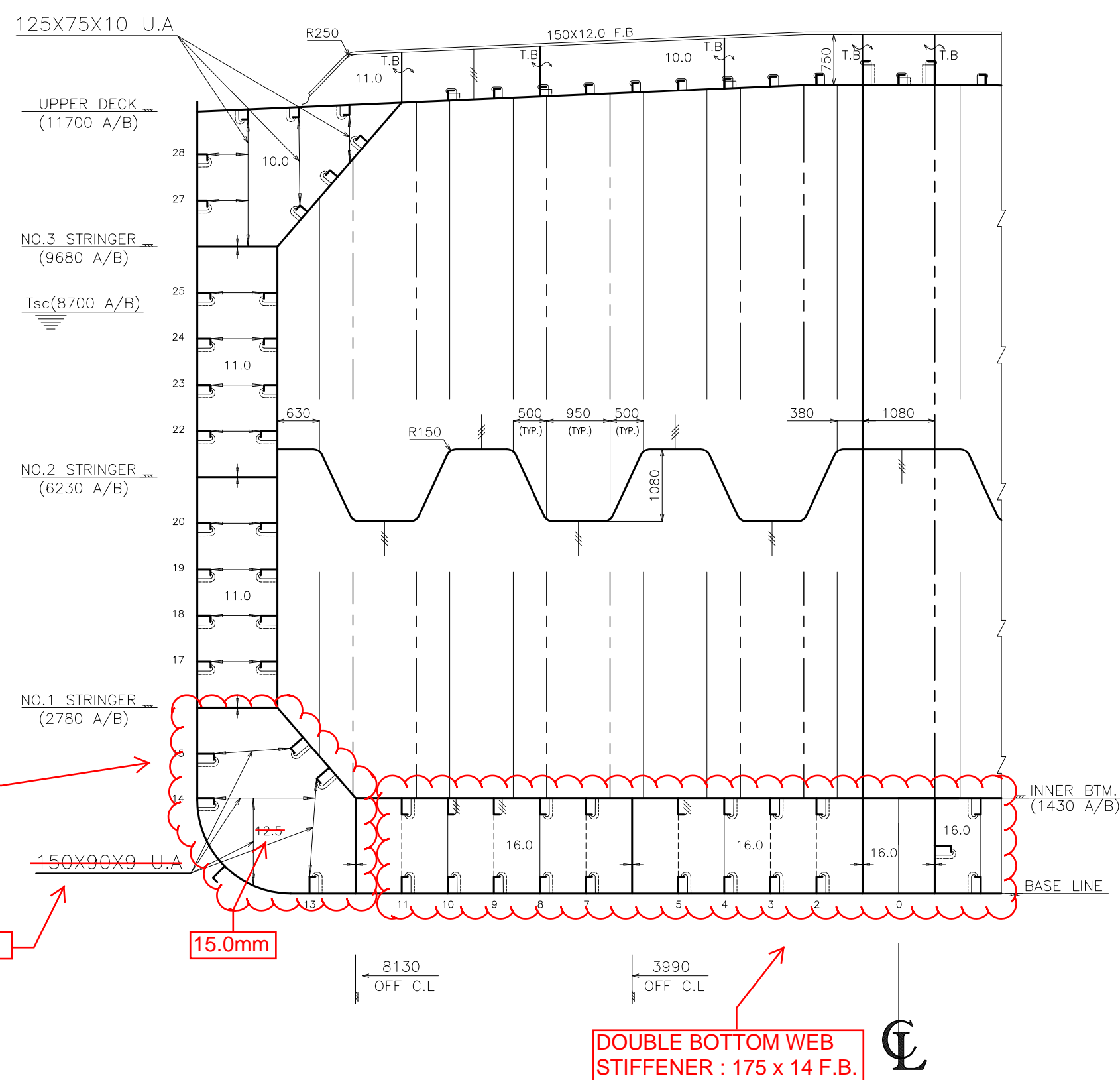


## NO.2 STRINGER PLAN

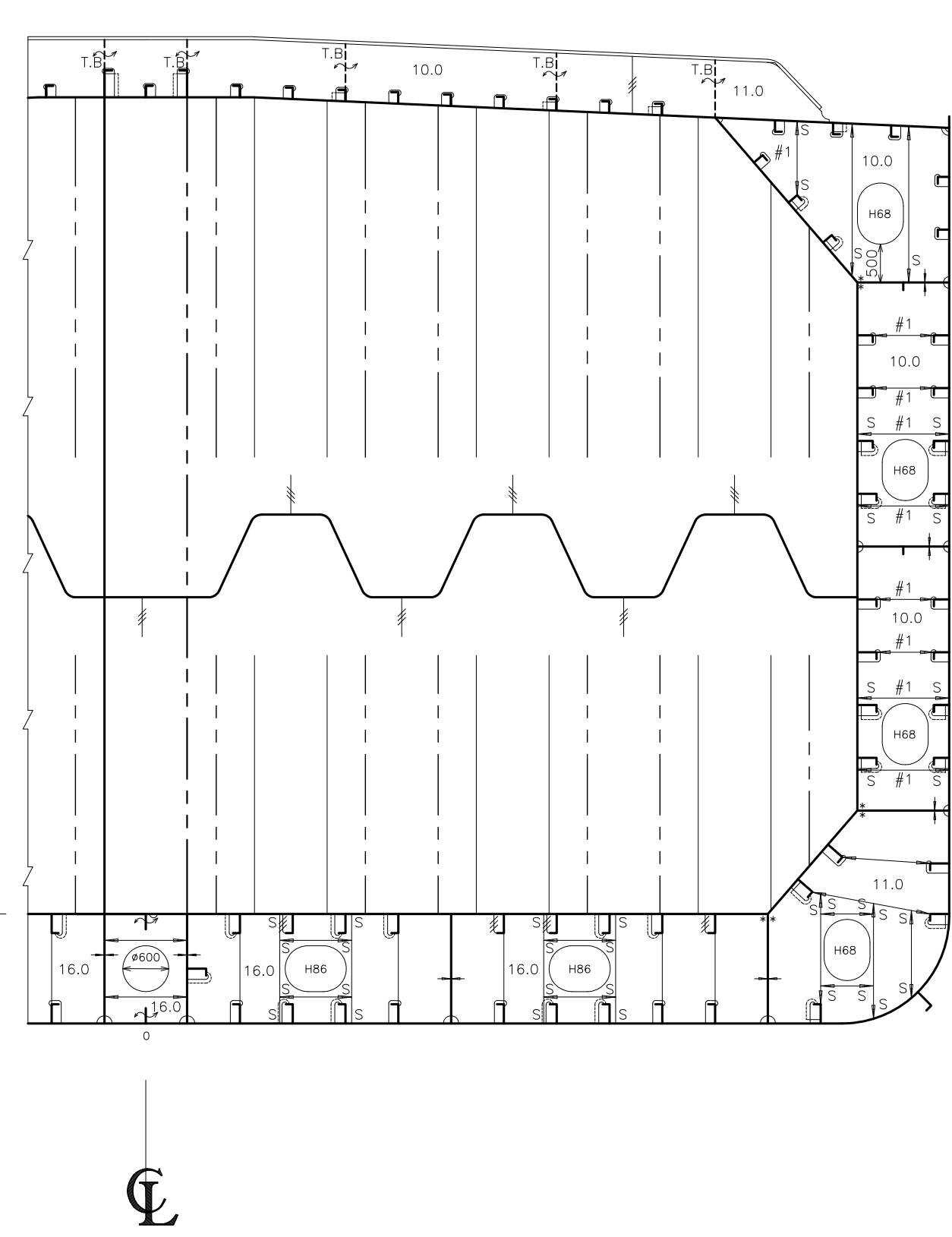
STIFFENER: 100X10.0 F.B(EX. AS SHOWN)



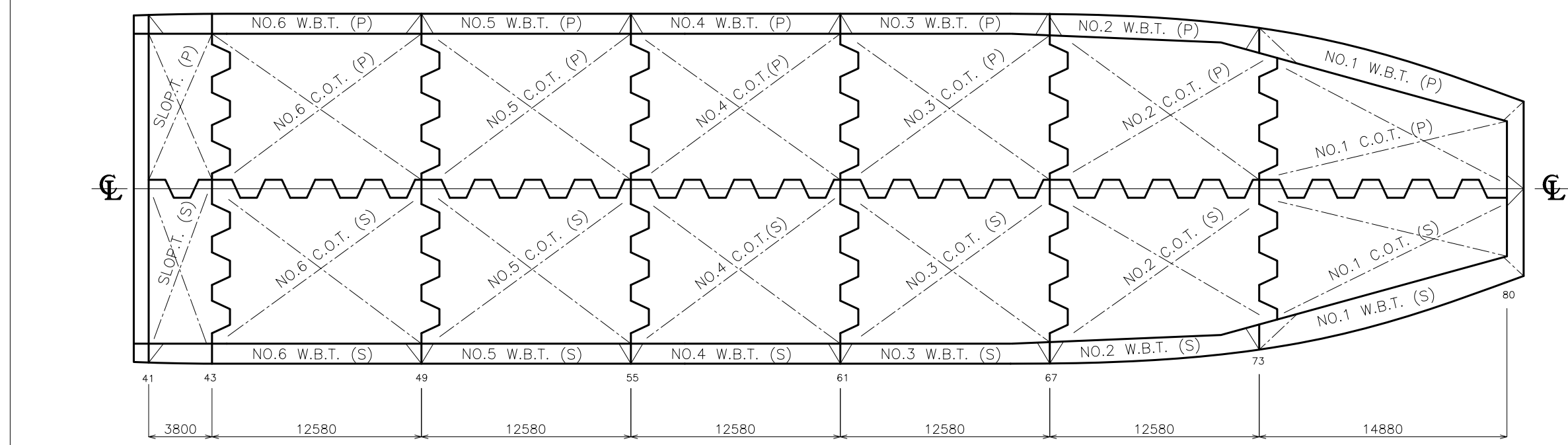
## W.T &amp; O.T BHD. SECTION

CORRUGATED BULKHEAD THICKNESS: 21.0 (EXCEPT AS SHOWN)  
WEB STIFFENER: 125X11.0 F.B(EXCEPT AS SHOWN)

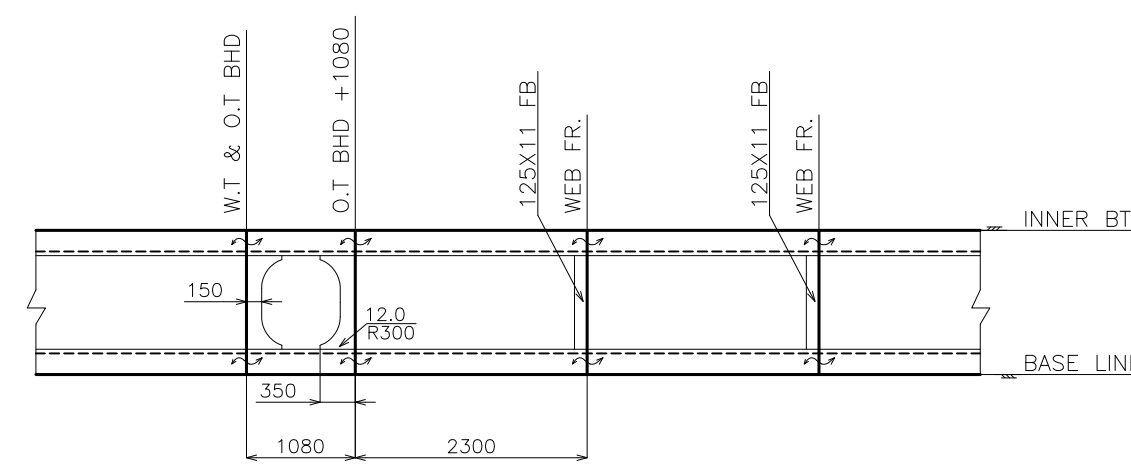
## O.T BHD. +1080 SECTION

SIM. TO "W.T & O.T BHD. SECTION" (EXCEPT AS SHOWN)  
WEB STIFFENER: 125X11.0 F.B(EXCEPT AS SHOWN)

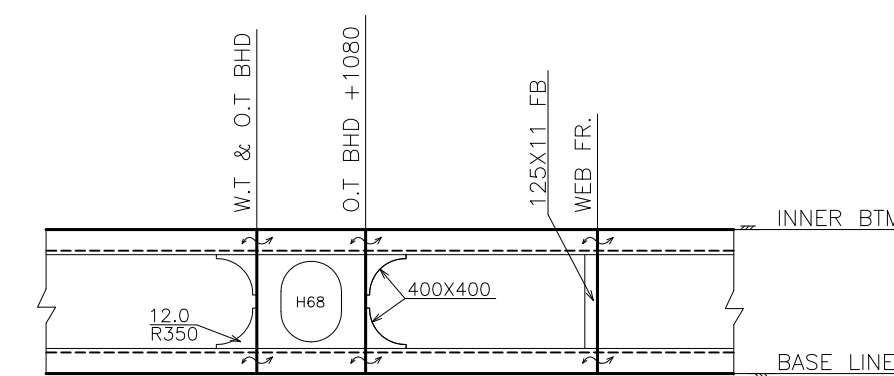
## TANK ARRANGEMENT OF CARGO AREA



## TYP. LONGI. ELEVATION

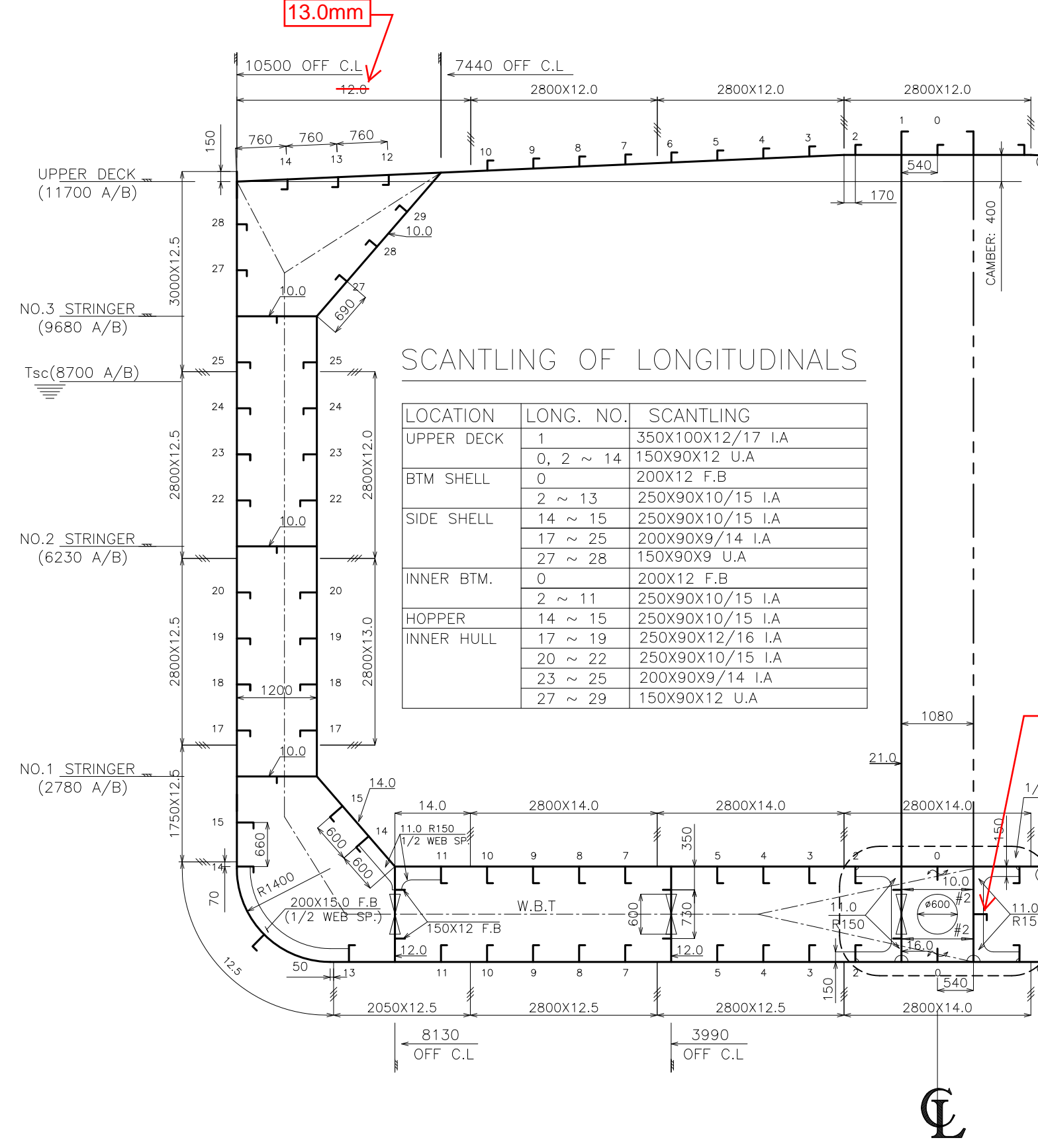


## LONG. NO. 4, 8, 10 ELEVATION



## ORDINARY SECTION

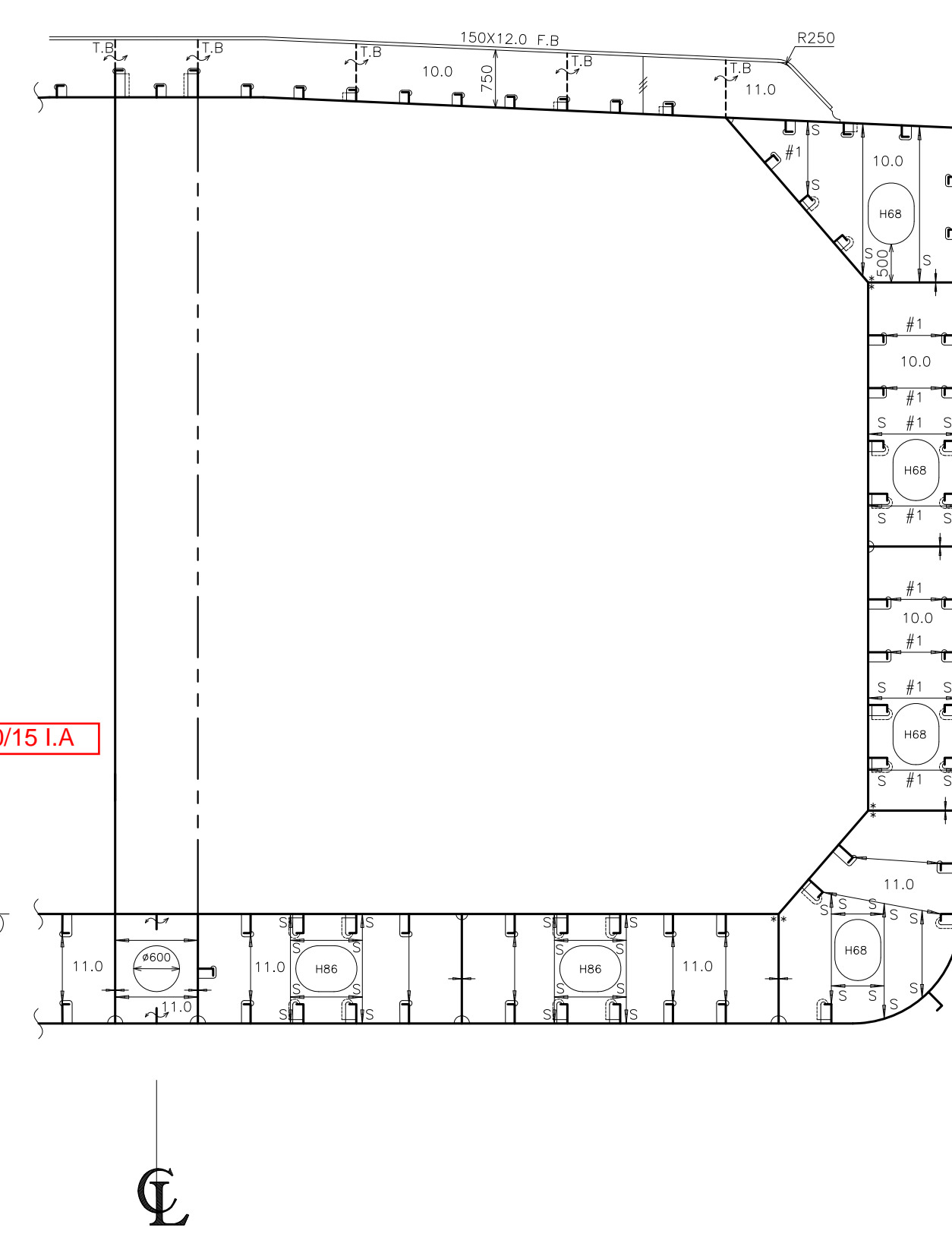
LONGITUDINAL SPACE: 690 MM (EXCEPT AS SHOWN)



## SCANTLING OF LONGITUDINALS

LOCATION	LONG. NO.	SCANTLING
UPPER DECK	1	300X100X12/17 I.A
	2 ~ 14	150X90X12 I.A
BTM SHELL	0	200X12 F.B
	2 ~ 13	250X90X10/15 I.A
SIDE SHELL	14 ~ 15	250X90X10/15 I.A
	17 ~ 25	200X90X9/14 I.A
INNER BTM	27 ~ 28	150X90X9 U.A
	0	200X12 F.B
HOPPER	2 ~ 11	250X90X10/15 I.A
	14 ~ 15	250X90X10/15 I.A
INNER HULL	17 ~ 19	250X90X12/16 I.A
	20 ~ 22	250X90X10/15 I.A
	23 ~ 25	200X90X9/14 I.A
	27 ~ 29	150X90X12 I.A

## TYP. WEB FRAME SECTION

MAX. WEB FRAME SPACE: 2300 MM  
WEB STIFFENER: 125X11.0 F.B(EXCEPT AS SHOWN)  
\* MARKED LOCATION: NO SCALLOP

## PLAN HISTORY

REV. NO	DATE	DESCRIPTION	REMARK
0	2021.09.01	ISSUED FOR APPROVAL IN PRINCIPLE.	

## PRINCIPAL DIMENSIONS

LENGTH O.A.	Appx. 128.00 M
LENGTH B.P.	120.00 M
LENGTH SCANT.(Ls)	119.80 M
BREADTH(MOULDED)	21.00 M
DEPTH(MOULDED)	11.70 M
SCANT. DRAFT(MOULDED)	8.70 M

## CLASSIFICATION

LR

## MAX. ALLOWABLE STILLWATER BENDING MOMENT

HOGGING : 408,000 KN-M  
SAGGING : 408,000 KN-M

## NOTES

- BOTH SIDES ARE SYMMETRICAL UNLESS OTHERWISE SHOWN.
- THE PLANS, SECTIONS AND ELEVATIONS ARE SHOWN IN LOOKING DOWNWARD, FORWARD AND PORT RESPECTIVELY.
- LOCATIONS OF SEAMS AND BLOCK BUTT LINES MAY BE MODIFIED AND/OR ADDED WHERE NECESSARY FOR CONSTRUCTION.
- SCANTLING MAY BE ALTERED ACCORDING TO FURTHER DESIGN DEVELOPMENT SUBJECT TO THE CLASS APPROVAL.
- MATERIAL
  - NO MARKED : MILD STEEL GRADE "A" OF MIN. YIELD STRESS 235 N/MM<sup>2</sup>
- WELDING
  - MIN. LEG LENGTH OF FILLET WELDING TO BE 4.5 (EXAS SHOWN)
- STIFFENER END CONNECTION
  - NO MARKED : WELDING CONNECTION
  - MARKED B : BRACKET CONNECTION
  - MARKED S : END SNIP
- STIFFENER SIZE
  - MARKED #1 : 100X10.0 F.B
  - MARKED #2 : 125X11.0 F.B
- HOLE SIZE
  - H68 : 600X800
- THE DRAIN HOLE IS NOT REPRESENTED IN THIS DRAWING

## APPROVAL IN PRINCIPLE

This plan has been appraised for compliance with the Rules and Regulations stated in the letter referenced below.

Letter reference: **BTS/ST/H212474**

Date: 18 October 2021 Initials: YBU

Marine and Offshore  
Busan Technical Support Office  
Structures Group  
Lloyd's Register Asia

본 도면은 대한민국 정부의 "중형선박 설계경쟁력 강화사업"의 일환으로 작성된 문서입니다.

MANAGER	G.D.OK	DATE : 2021.09.01	SCALE
APPROVED	U.N.KIM	LNG FUELED 13K CLASS CHEMICAL TANKER	1/75
CHECKED	S.M.JEON		TEAM
DRAWN	S.J.BAEK	MIDSHIP SECTION	HULL BASIC
TEL.	051-260-7811		REV. 0

중형선박설계사업단





# Design Appraisal Document

**Lloyd's Register Asia**  
**Busan Technical Support Office**  
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**119, Daegyo-ro, Jung-gu (2, 6-ga, Jungang-dong)**  
**Busan 48943, Republic of Korea**  
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Date  
**19 October 2021**

Please quote the document number on all future communications

**APPROVAL IN PRINCIPLE**  
**MSDE of KRISO**  
**LNG FUELED 13K CLASS CHEMICAL TANKER**  
**MACHINERY ARRANGEMENT, FGSS PIPE & INSTRUMENT DIAGRAM**

The Document(s) listed in paragraph 1 of the appendix have been examined for compliance with the piping design and system arrangement requirements of Lloyd's Register's Rules and Regulations for the Classification of Ships (Rules for Ships), July 2021, Part 5, Lloyd's Register's Rules and Regulations for the Classification of Ships using Gases or other Low-Flashpoint Fuels (Rules for Gas Fuelled Ships), July 2021, and the International Code of Safety for Ships using Gases or Other Low-Flashpoint Fuels (IGF Code) adopted on 11 June 2015, Resolution MSC. 391(95) with a view to granting 'Approval in Principle' for the LNG Fuel systems therein described. The proposal is considered acceptable subject to satisfactory resolution of the following matters:-

1. The risk based techniques may be for designs which deviate from existing specific Rules and Regulation requirements, or for novel or complex designs where prescriptive Rules and Regulations do not currently apply. A risk-based study for newly developed LNG fuelled system and associated ancillaries is to be undertaken to a recognised Standard to ensure that risks arising from the use of low-flashpoint fuels affecting persons on board, the environment, the structural strength or the integrity of the ship are addressed on the PSApp (Approval for Particular Ship Application) stage in accordance with LR's ShipRight procedure Risk Based Designs (RBD). Section 4.2 of the Rules for Gas Fuelled Ships and Part 7, Chapter 14 of the Rules for Ships refer.
2. The primary issue is considered to be separation of the hazards introduced by the LNG/Fuel gas system. The system must be designed such that any failure in the LNG/Fuel gas system which results in a hazardous situation cannot escalate into a situation that will hazard the environment, the ship or ships personnel. In this respect it will be necessary to carry out a detailed Failure Modes and Effect Analysis and/or HAZID/HAZOP study on the LNG/Fuel Gas system in due course.
3. The air space between the gas fuel piping and inner wall of this pipe or duct should be equipped with mechanical under pressure ventilation having a capacity of at least 30 air changes per hour. Paragraph 9.6.1.2 of the Rules for Gas Fuelled Ships refers. Detail arrangements of double-walled piping system, and ventilation systems with air change capacity are to be submitted on PSApp stage.
4. For the operation of the automatic master gas fuel valve, the valve shall be operable from safe locations on escape routes, inside a machinery space containing gas consumer, the engine control room, outside the machinery space and from the navigation bridge. Paragraph 9.4.3 of the Rules for Gas Fuelled Ships refers.
5. Pipe wall thickness is to be in accordance with the requirements in Paragraph 7.3.4 of the Rules for Gas Fuelled Ships. In this regard, supporting calculation is to be submitted for fuel gas service lines (inner / outer pipe) on PSApp stage. For outer pipes system, paragraphs 9.8.1 to 9.8.4 of the Rules for Gas Fuelled Ships refer.

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Date  
**19 October 2021**

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6. G/E GVUs are to be suitable for the design pressure and the material is to be adequate for the possible leakage. Details are to be submitted on PSApp stage.
7. The ventilation inlet for the double wall piping (including G/E GVUs) or duct shall always be located in a non-hazardous area away from ignition sources. The inlet opening shall be fitted with a suitable wire mesh guard and protected from ingress of water. And, the ventilation outlet shall be placed in a position where no flammable gas-air mixture may be ignited. Paragraph 13.8.3 and 9.6.1.2 of the Rules for Gas Fuelled Ships refer.
8. Permanently installed gas detectors shall be fitted in accordance with paragraph 15.8.1 and LR 15.8-01 of the Rules for Gas Fuelled Ships. Gas detection system shall be continuous type without delay.
9. Evidence of piping stress analysis for high pressure fuel piping systems shall be submitted for approval as required by the paragraph 7.3.4.4, 7.3.4.5 and LR 7.3-03 of the Rules for Gas Fuelled Ships on PSApp stage.
10. Evidence of fatigue analysis for all pressurised low-flashpoint fuel piping arrangements shall be submitted for approval as required by paragraph LR 7.3-04 of the Rules for Gas Fuelled Ships on PSApp stage.
11. It is noted that 'GVT Room' is located outside of the cargo area. In this regard, please note that direct access shall not be permitted from a non-hazardous area to hazardous area. An airlock which complies with the paragraph 5.12 of the IGF code shall be provided. Paragraph 5.11.1 of the Rules for Gas Fuelled Ships refers.
12. Arrangements shall be made for safe management of any spilled fuel. Physical arrangements are to be provided for safe management of any spilled fuel during bunkering. This is to include spray shields as appropriate and drip tray fitted below bunkering connections and where leakage may occur. Paragraph 8.3.1.3 and LR 8.3-02 of the Rules for Gas Fuelled Ships refer.
13. Suitable arrangements are to be provided to protect the hull structure from potential spillages during the bunkering operation (e.g., water curtain or stainless steel sheath / plating to protect from low temperature).
14. PRVs shall be connected to the highest part of the fuel tank. PRVs shall be positioned on the fuel tank so that they will remain in the vapour phase at the filling limit (FL) as given in 6.8, under conditions of 15° list and 0.015L trim, where L is defined in 2.2.25. Part A-1, 6.7.2.13 of the IGF Code refers.
15. The overall capacity of the fuel gas handling system and the utilisation plant shall be such that it can control the fuel tank pressure within the design conditions without venting to atmosphere except emergency situation.
16. The availability of the fuel gas handling system and the utilisation plant and its supporting auxiliary services shall be such that in case of a single failure the fuel tank pressure and temperature can be maintained by another service/system. Consideration needs to be given for the redundancy operation of vaporizer, if necessary, to keep propulsion reliability in the event of gas supply failure.
17. Where the fuel gas piping is installed within a gas tight double walled pipe or ventilated ducting, the air space between the gas piping and the duct inner wall is to be provided with mechanical ventilation having a capacity that takes into account the construction and arrangement of protective pipes or duct and is to ensure at least 30 air changes per hour. Part A-1, 9.6.1.2 of the IGF Code refers.
18. Where the fuel gas piping is installed within a gastight double walled pipe or ventilated ducting, ventilation outlets are to be located in an open area where no flammable gas-air mixture may be ignited and shall be covered by a protected screen.
19. All vent and purging lines which will pass through the mechanically ventilated spaces (including the engine room) shall be fully butt. welded in accordance with 9.5.2 of the Rules for Gas Fuelled Ships.
20. Outlet from pressure relief valves are to be located at least 10 m away from air inlets and air outlet or openings of accommodation, service, control spaces or other non-hazardous area. Paragraph 6.7.2.8 of the IGF Code refers. The location of vent mast is to be decided subject to the result of the risk assessment.

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21. Tank master isolation valve (TMIV) is a remotely operated valve on a liquefied gas pipe from a liquefied gas storage tank. The valve is located as closed as possible to the tank outlet. LR 2.2-23, LR 5.3-01 of the Rules for Gas Fuelled Ships refers.
22. Means shall be provided to prevent liquid overflow from gas vent outlets, due to hydrostatic pressure from space to which they are connected. Paragraph 6.7.2.9 of the Rule for Gas Fuelled Ships refers.
23. Suitable protection screens of not more than 13 mm square mesh shall be fitted on vent outlets to prevent the ingress of foreign objects without adversely affecting the flow. Paragraph 6.7.2.11 of the Rules for Gas Fuelled Ships refers.
24. The FGSS Room should be arranged to safely contain cryogenic leakages. The material of the boundaries of the FGSS Room have a design temperature corresponding with the lowest temperature it can be subjected to in a probable maximum leakage scenario unless the boundaries of the space, i.e. bulkheads and decks, are provided with suitable thermal protection. The calculations to determine the possible leakage rate and the suitability of boundary materials are to be submitted on PSApp stage.
25. The FGSS Room shall be fitted with mechanical ventilation system in accordance with the requirements in paragraphs 13.6 of the Rules for Gas Fuelled Ships.
26. Maintenance of the fuel gas tank pressure and temperature controls has to be done by methods stated in paragraph 6.9.1.1 of the IGF Code. The methods chosen shall be capable of maintaining tank pressure below the set pressure of the tank pressure relief valves for a period of 15 days assuming full tank at normal service pressure and the ship in idle condition, i.e. only power for domestic load is generated. The availability of the system and its supporting auxiliary services shall be such that in case of a single failure the fuel tank pressure and temperature can be maintained by another service/system. Paragraph 6.9.1.1 and 6.9.6 of the Rules for Gas Fuelled Ships refer. The design philosophy for the operational concept of proposed boil-off gas handling / utilisation systems including redundancy operation concepts are to be submitted for consideration on PSApp stage.
27. Venting of fuel vapour for control of the tank pressure is not acceptable except in emergency situation. Please note that the activation of the safety system alone required in 15.2.2 is not deemed as an emergency situation. Paragraph 6.9.1.2 of the Rules for Gas Fuelled Ships and MSC.1 / Circ. 1558 refer. Details of how to handle boil-off gas in the event of the safety system activation (Tank valves closed) to be provided on PSApp stage.
28. Capacity calculation for pressure relief valves for fuel tank is to be submitted for approval. 6.7.3 of the Rules for Gas Fuelled Ships refer. Calculations to be submitted on PSApp stage.
29. LNG Fuel tank shall be fitted with a minimum of 2 pressure relief valves (PRVs) allowing for disconnection of one PRV in case of malfunction or leakage, in accordance with Paragraph 6.7.2.2 of the Rules for Gas Fuelled Ships.
30. In the event of a failure of a fuel tank PRV a safe means of emergency isolation shall be available in accordance with Paragraph 6.7.2.6 of the Rules for Gas Fuelled Ships. In this regard, detailed procedure including interlock arrangement is to be provided on PSApp stage.
31. All pipelines or components which may be isolated in a liquid full condition shall be provided with relief valves. Additionally, the section which may be isolated automatically due to a fire with a liquid volume of more than 0.05 m<sup>3</sup> entrapped shall be provided with pressure relief valves sized for a fire condition. Paragraph 7.3.1.3 and LR 7.3-01 of the Rules for Gas Fuelled Ships refer. Capacity calculation for pressure relief valves size for a fire condition is to be submitted for approval on PSApp stage.
32. Please note that liquefied fuel pipe shall be protected by a secondary enclosure able to contain leakages outside of machinery space. This requirement shall apply to ships constructed on or after 1 January 2024, which is adopted on 14 June 2019 by MSC 458(101).

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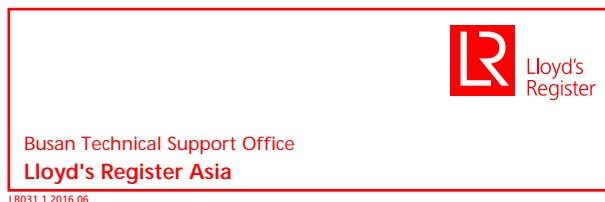
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33. Permanently installed gas detectors shall be fitted in accordance with paragraph 15.8.1 and LR 15.8-01 of the Rules for Gas Fuelled Ships. Gas detection system shall be continuous type without delay.
34. Relief valves fitted to the LNG vaporizers (HP & LP), and other pressure vessels including liquid cargo are to be sized for fire conditions. Calculations to be submitted on PSApp stage.
35. The bunker piping system for transfer of fuel to the storage tank shall be designed such that any leakage from the piping system cannot cause danger to personnel, the environment or the ship. Paragraph 8.2.1.1 of the Rules for Gas Fuelled Ships refers. Detail of safe measure is to be confirmed on PSApp stage.
36. A ship-shore link (SSL) or an equivalent means for automatic and manual ESD communication to the bunkering source shall be fitted. Paragraph 8.5.7 of the Rules for Gas Fuelled Ships refers.
37. If not demonstrated to be required at a higher value due to pressure surge considerations, a default time as calculated in accordance with 16.7.3.7 from the trigger of the alarm to full closure of the ESD remote operated valve shall be adjusted. Paragraph 8.5.8 of the Rules for Gas Fuelled Ships refers.



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Date  
**19 October 2021**

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## Appendix

1. The documents listed below have been examined



Document No.	Rev.	Title	Status	Date
-	0	<b>Machinery Arrangement (Preliminary)</b>	<b>SI</b>	<b>19-Oct-2021</b>
<b>B10310001</b>	<b>25-Aug-2021</b>	<b>FGSS Pipe &amp; Instrument Diagram</b>	<b>AQ</b>	<b>19-Oct-2021</b>

### Appraisal Status Key

AQ	Approved subject to the matters raised that require resolution - and provided the arrangements are to the surveyor's satisfaction
SI	Retained as supporting documentation for information only

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PLAN HISTORY				
REV. NO.	DATE	DESCRIPTION	REMARK	
0	2021.08.31	PREPARED BY OUTFITTING DESIGN TEAM.		
<div style="border: 1px solid red; padding: 10px; margin: 10px;"> <div style="display: flex; justify-content: space-between; align-items: center;"> <div> <p><b>APPROVAL IN PRINCIPLE</b></p> <p>This plan has been appraised for compliance with the Rules and Regulations stated in the letter referenced below.</p> <p>Letter reference: <b>BTS/ENG/M213348</b></p> <p>Date: 19 October 2021                      Initials: <b>SYC</b></p> <p><b>Marine and Offshore Busan Technical Support Office Engineering Systems Group Lloyd's Register Asia</b></p> </div> <div style="text-align: right;">  <p>Lloyd's Register</p> </div> </div> </div>				
( 10 ) SHEETS WITH A COVER				
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MANAGER	K.D.OK	DATE : 2021.08.05	SCALE	
APPROVED	S.T.CHEONG	LNG FUELED 13K CLASS CHEMICAL TANKER	NONE	
CHECKED	-	MACHINERY ARRANGEMENT (PRELIMINARY)	TEAM	
DRAWN	H.Y.LEE		OUTFITTING DESIGN	
TEL.	051-260-7832		REV.	0
		<b>중형선박설계사업단</b>		

APPROVAL IN PRINCIPLE



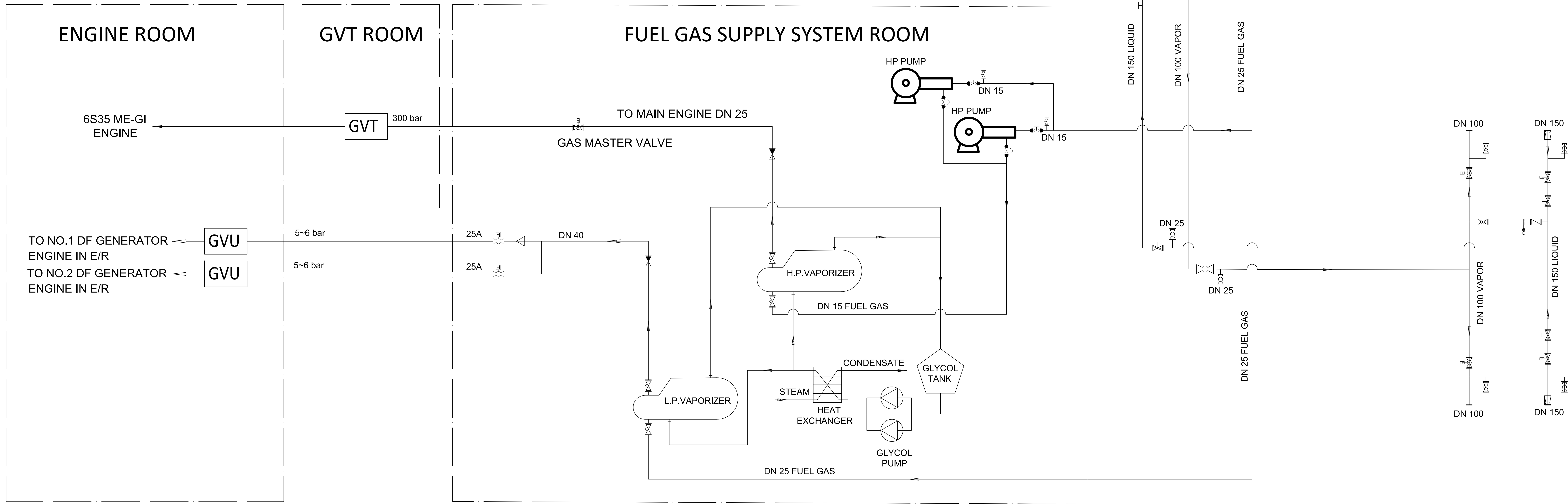
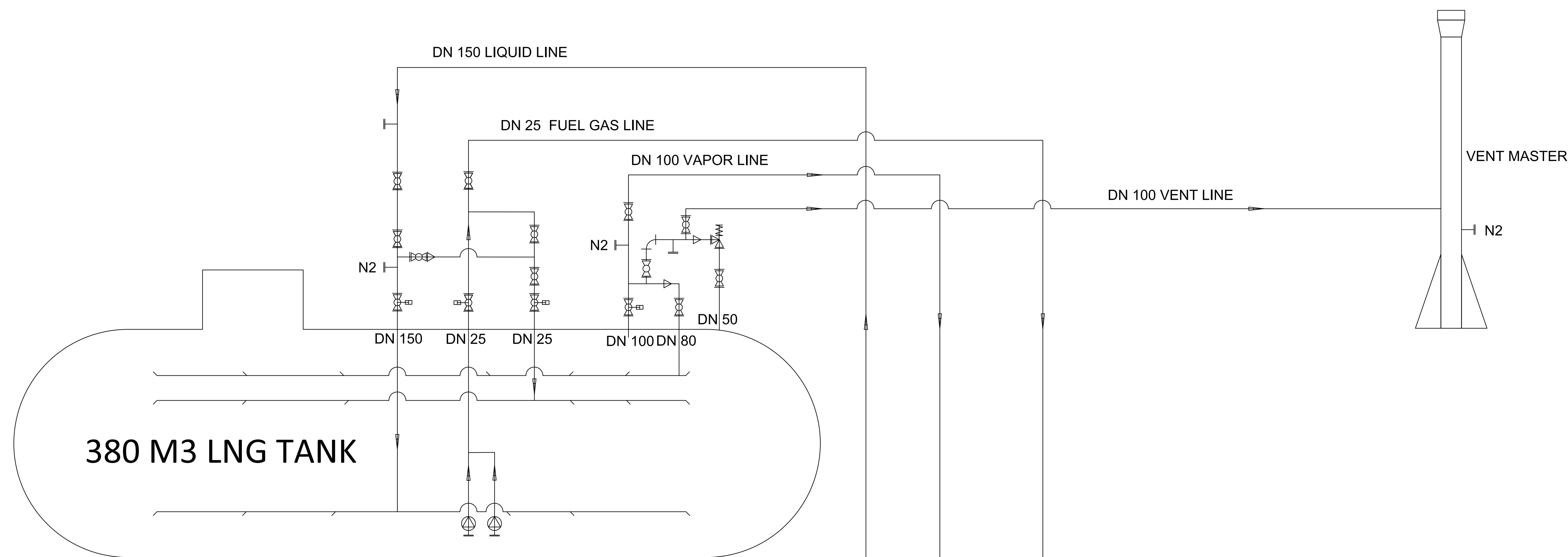
This plan has been appraised for compliance with the Rules and Regulations stated in the letter referenced below.

Letter reference:  
**BTS/ENG/M213348**

Date: 19 October 2021 Initials: SYC

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LR634.1.2016.07



PLAN HISTORY					
DATE	Rev.	DESCRIPTION	DWN.	CHK.	APP.
2021.08.25	0	Issued for Class and Owner Approval.			

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DWP: HULL OUTFITTING DESIGN		SHIP TYPE: LNG Fuelled 13K Class Chemical Tanker		Class: LR	
HULL NO.:		TITLE: FGSS PIPE & INSTRUMENT DIAGRAM			
APP. BY: G. D. OK					
CHK. BY: B. J. SANO					
DWN. BY: B. J. HA					
MSE IN KRISO		DWG NO.	B10310001	SCALE	1/100
		ISSUED DATE	AUG. 25, 2021	REV. NO	



# Design Appraisal Document

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Date  
**20 October 2021**

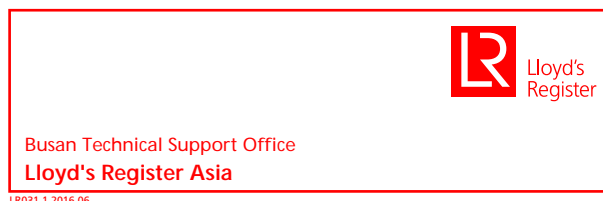
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## APPROVAL IN PRINCIPLE MSDE of KRISO LNG FUELED 13K CLASS CHEMICAL TANKER ELECTRIC LOAD ANALYSIS

The document listed in paragraph 1 of the appendix has been examined for compliance with Part 6, Chapter 1 & 2 of the Rules and Regulations for the Classification of Ships (Rules for Ships), July 2021; Part A-1, Chapter 12, 14 & 15 of the Rules and Regulations for the Classification of Ships using Gases or other Low-Flashpoint Fuels (Rules for Gas Fuelled Ships), July 2021; and the International Code of Safety for Ships using Gases or Other Low-Flashpoint Fuels (IGF Code) adopted on 11 June 2015, Resolution MSC. 391(95) with a view to granting 'Approval in Principle' for the LNG Fuel systems therein described. The proposal is considered acceptable subject to satisfactory resolution of the following matters: -

1. Summary table of total power after PT is empty. One set of generator is to be enough for the electrical load after PT.
2. On page 9; inert gas fans and scrubber and deck seal pumps are not to be disconnected by load management system(PT).
3. Failure modes and effects of single failure for electrical generation and distribution systems shall be analysed and documented. Part A-1, Chapter 14, 14.2 and 14.3.4 of Rules for Gas Fuelled Ships and IGF Code.
4. Hazardous area plans indicating the location of hazardous areas and their openings, access and ventilation arrangements and studies are to be developed for the specific constructions in accordance with Part A-1, Chapter 12 of Rules for Gas Fuelled Ships and IGF Code.
5. Electrical equipment and apparatus are to be suitably certified for the fore-mentioned hazardous area zones.
6. Alarms, safeguards and indications required by Part A-1, Chapter 15 of Rules for Gas Fuelled Ships and IGF Code are to be provided for the specific installation.

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Date  
**20 October 2021**

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## Appendix

1. The document listed below has been examined.

Document No.	Rev.	Title	Status	Date
-	1	ELECTRIC LOAD ANALYSIS	AQ	20-Oct-2021

### Appraisal Status Key

AQ Approved subject to the matters raised that require resolution - and provided the arrangements are to the surveyor's satisfaction

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# PLAN HISTORY

REV. NO.	DATE	DESCRIPTION	REMARK
O	2021. 09. 30	PRELIMINARY DESIGN	

## APPROVAL IN PRINCIPLE



This plan has been appraised for compliance with the Rules and Regulations stated in the letter referenced below.

Letter reference:  
**BTS/ETS/E212099**

Date: **20 October 2021**

Initials: **SRN**

**Marine and Offshore  
Busan Technical Support Office  
Electrotechnical Systems Group  
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LR034.1.2016.07

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MANAGER	K.D. Ok	DATE : 2021.08.31	SCALE
APPROVED	S.T. Cheong	LNG Fueled 13K Class Chemical Tanker	--
CHECKED		ELECTRIC LOAD ANALYSIS	TEAM
DRAWN	S.W. Park		OUTFIT DESIGN
TEL.	260-7823		REV. 1

	중형선박설계사업단