版本 REV.	描　　述 Description	修改 Drawn	校对 Checked	日期 Date

FINAL DRAWING　完工图

63600MT DWT PANAMAX BULKER WITH TRAINING PURPOSE

SC4622(WH)-396-01

CURRENT REVISION 当前版本	A	CURRENT STATUS 当前状态	O

SACRIFICIAL ANODE ARRANGEMENT
牺牲阳极布置图

HULL NO.: AVIC399

DESIGNED 设 绘		DATE 日 期	
CHECKED 校 对		DATE 日 期	
VERIFIED 审 核		DATE 日 期	
APPROVED 批 准		DATE 日 期	

WEIGHT 重 量	kg	SCALE 比 例	1:100
PAGE 页 数	1/19	TOT. AREA 总面积	0.06 m²

SHANGHAI MERCHANT SHIP DESIGN & RESEARCH INSTITUTE
上海船舶研究设计院

旧 底 图 总 号

底 图 总 号

面积 AREA: 0.06 m^2

1.Application Documents

参考文献

1.1 Sacrificial anode design and installation(GB8841-88)

牺牲阳极的设计与安装 GB8841-88

2.Technical Requirements

技术要求

2.1 The vessel registered in DNV class

本船入DNV船级社

2.2 The zinc anodes in water ballast tanks for 5 years life span.

压载水舱的牺牲阳极设计寿命为5年

2.3 The zinc anodes outside rudder for 5 years life span.

外部舵叶的牺牲阳极设计寿命为5年

3.Calculation For The Sacrificial Anode

牺牲阳极计算

3.1 The zinc anodes chosen as followings:

选用的牺牲阳极为

3.1.1 THE anodes in W.B.tank is Al-Zn-In,with weight 7.4Kg,and dimension is (90+110)x300x100mm.

压载水舱中的阳极为铝-锌-铟合金,重量为7.4Kg,尺寸(90+110)x300x100mm.

3.1.2 THE anodes for outside rudder is Al-Zn-In,with weight 11.25Kg, and dimension is 600x150x50mm.

舵叶外的阳极为铝-锌-铟合金,重量为11.25Kg,尺寸600x150x50mm.

3.2 The Calculation For The Out Put Current Of Above Two Type Of Anodes

选用的两种阳极的发生电流计算

3.2.1 Calculation Fomular

计算公式

$$I_f = \frac{\Delta E \times 1000}{R}$$

I_f-the out put current of the sacrificial anodes(mA)

牺牲阳极的发生电流量(mA)

ΔE-the driving voltage of sacrificial anode.For zinc anode is 0.25V.

牺牲阳极的驱动电位,锌阳极时取0.25V

R-The resistance(water touching) of the anode

牺牲阳极的接水电阻

When the anode is fixed on the protected object,the R is:

牺牲阳极安装在被保护体上时

$R=\frac{\rho}{2\pi L}(\ln\frac{4L}{r}1)$ or $R=\frac{\rho}{2S}$

ρ-the resistance ratio of the sea water,normally it is 25 Ω.cm

海水电阻率,通常取 25Ω.cm

$r=\frac{C}{2\pi}$ (cm) $S=\frac{L+B}{2}$ (cm)

C-the cross section perimeter of the anode (cm) 牺牲阳极横截面周长 (cm)

L-the length of the anode (cm) 牺牲阳极的长度 (cm)

B-the width of the anode (cm) 牺牲阳极的宽度 (cm)

3.2.1 Then,after calculation 经计算得出

I_f=974.6416mA. For anode in B.W.tank.. 压载水舱牺牲阳极

I_f=750mA. For anode outside rudder 舵叶外牺牲阳极

3.3 Life calculation for sacrifical anode

牺牲阳极寿命计算

3.3.1 Calculation Fomular 计算公式

$t=\frac{mQx1000}{Imx8760xkxr}$

t-service life of zinc anode(year) 牺牲阳极的寿命(年)

m-net weight of sacrificial anode(Kg) 每块牺牲阳极的质量(kg)

Q-effective capacity(A.h/Kg),for zinc anode it is 2400A.h/Kg

牺牲阳极的实际电容量(A.h/Kg),对于锌阳极取 2400(A.h/Kg)

I_m-even out put current of anode(mA) 牺牲阳极的平均发生电流量(mA)

$I_m=0.65I_f$

1/k-utilization coefficient for anode ,take it as 0.85

牺牲阳极的利用系数,通常取0.85

r-ballast ratio 压载舱利用率

r=0.5 in W.B.tank 压载水舱为0.5

3.3.2 Then,after calculation 经计算得出

for anode in W.B.tank 压载水舱阳极寿命

$t=\frac{7.4X2400X1000X0.85}{0.65X974.6416X8760X0.5}\approx 5.4$ years(年)

for anode in outside rudder 舵外部阳极寿命

$t=\frac{11.25X2400X1000X0.85}{0.65X750X8760}\approx 5.37$ years(年)

3.4 The quantity of zinc anodes N_i 所需的阳极数量N_i

3.4.1 Calculation Fomular 计算公式

$$N_i = \frac{iS_i}{I_f}$$

S_i -the immersed area of structural component(m^2)

被保护部位的面积(m^2)

I_f-the out put current of the sacrificial anodes(mA)

牺牲阳极的发生电流量(mA)

i-protect current density(mA/m^2):

保护电流密度

in W.B.tank it is 6 mA/m^2

压载水舱内取 $i=6mA/m^2$

outside rudder it is 100 mA/m^2

舵外取 $i=100mA/m^2$

3.4.2 The quantity of zinc anode in W.B.tank:

压载水舱内牺牲阳极的数量

Tank 位置	S_i (m^2)	Quantity 数量	Tank 位置	S_i (m^2)	Quantity 数量
NO.5 B.S.W.B.TK.(P) NO.5底边压载水舱(左)	2338	16	NO.5 B.S.W.B.TK.(S) NO.5底边压载水舱(右)	2338	16
NO.4 B.S.W.B.TK.(P) NO.4底边压载水舱(左)	3442	23	NO.4 B.S.W.B.TK.(S) NO.4底边压载水舱(右)	3442	23
NO.3 B.S.W.B.TK.(P) NO.3 底边压载水舱(左)	4102	27	NO.3 B.S.W.B.TK.(S) NO.3 底边压载水舱(右)	4102	27
NO.2 B.S.W.B.TK.(P) NO.2底边压载水舱(左)	3634	24	NO.2 B.S.W.B.TK.(S) NO.2 底边压载水舱(右)	3634	24
NO.1 B.S.W.B.TK.(P) NO.1底边压载水舱(左)	2789	18	NO.1 B.S.W.B.TK.(S) NO.1底边压载水舱(右)	2789	18
NO.3 T.S.W.B.TK.(P) NO.3 顶边压载水舱(左)	1662	11	NO.3 T.S.W.B.TK.(S) NO.3 顶边压载水舱(右)	1662	11
NO.2 T.S.W.B.TK.(P) NO.2顶边压载水舱(左)	1338	9	NO.2 T.S.W.B.TK.(S) NO.2顶边压载水舱(右)	1338	9
NO.1 T.S.W.B.TK.(P) NO.1顶边压载水舱(左)	1290	9	NO.1 T.S.W.B.TK.(S) NO.1顶边压载水舱(右)	1290	9
A.P.TK. 尾尖舱	3168	20	F.P.TK. 首尖舱	2933	20

3.4.3 The quantity of zinc anode outside rudder:

舵叶外牺牲阳极的数量

Tank 位 置	S_i (m^2)	Quantity 数 量
Outside rudder body 舵叶外	100	14

TECHNICAL REQUIREMENT:

1.ITEM 2 TO BE DERUSTED AND HOT GALVANIZED

2.THE SURFACE OF ANODE HAVE NO DROSS,NO BURR,NO FLASH,NO CRACK AND DEPTH OF SHRINK HOLE TO BE LESS THAN 10% OF THE THICKNESS OF ANODE.

3.THE CONTACT RESISTANCE BETWEEN ANODE AND ITEM 2 TO BE LESS THAN 0.001Ω.

4.COMPLETE UNDERWATER HULL, INCLUDING STERN FRAME, RUDDER AND RUDDER TRUNK, PROPELLER ARE TO BE PROTECTED BY I.C.C.P. SYSTEM.

5.EVERY SEA CHEST TO BE PROTECTED BY TWO SACRIFICIAL ANODE, SEE PERTINENT DRAWING OF ENGINE PART.

技 术 要 求

1.平钢除锈并进行热镀锌。

2牺牲阳极的工作表面应无氧化渣、无毛刺、无飞边、无裂纹，缩孔深度小于牺牲阳极厚度的百分之十，并不得沾有油漆、油污。

3. 牺牲阳极基体与铁芯之间的接触电阻小于 。 0.001Ω

4. 船体水下部分（包括尾框、舵和舵围阱、螺旋桨等）由I.C.C.P.系统提供保护。

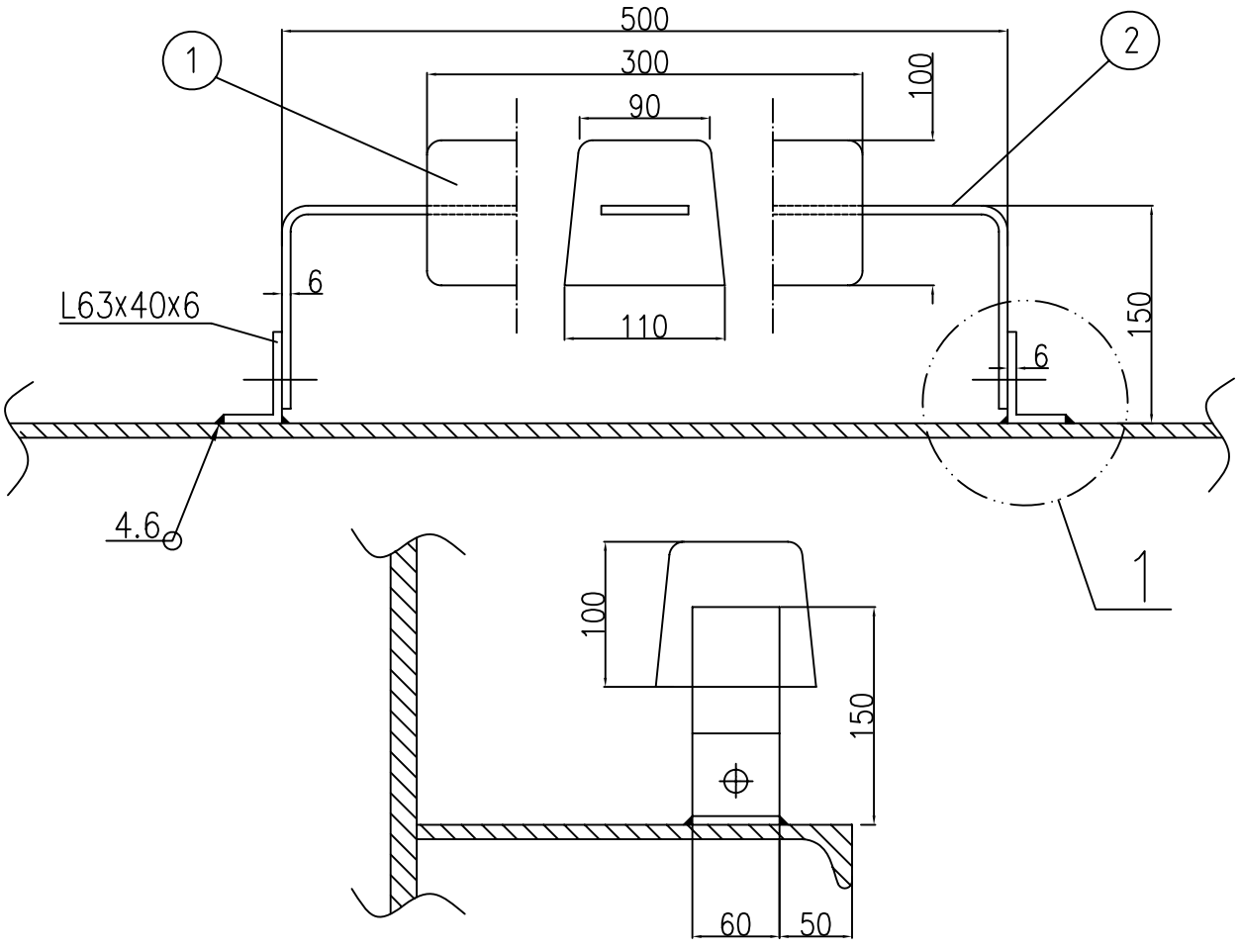
5.高位、低位海水阀箱各布置两块,具体位置见轮机专业图纸.

SACRIFICIAL ANODE ARRANGEMENT 牺牲阳极布置图				AVIC409-396-01			PAGE 6/19
ITEM	MARK	NAME & SPEC	Q'TY	MATERIAL	WEIGHT(Kg)		REMARK
					SET	TOTAL	
1		Zn-ANODE 锌块本体	314	Al-Zn-In ALLOY 铝-锌-铟合金	7.4		
2		FLAT BAR t=4 扁 钢	314	A GRADE	0.4		
3	GB5782-86	BOLT 螺栓 M8X25	628				STAINLESS STEEL 不锈钢
4	GB6170-86	NUT 螺母 M10	628				STAINLESS STEEL 不锈钢
5	GB97.1-85	NUT 垫片 M10	628				STAINLESS STEEL 不锈钢
6		Zn-ANODE (WELDING TYPE) 锌块本体 (焊接式)	14	Al-Zn-In ALLOY 铝-锌-铟合金	11.25	157.5	Yard
7	L 60x40x6	ANGLE IRON 角钢	628	A GRADE			

锌块典型安装图

Zn-ANODE TYPICAL INSTALLATION

M 1 : 5



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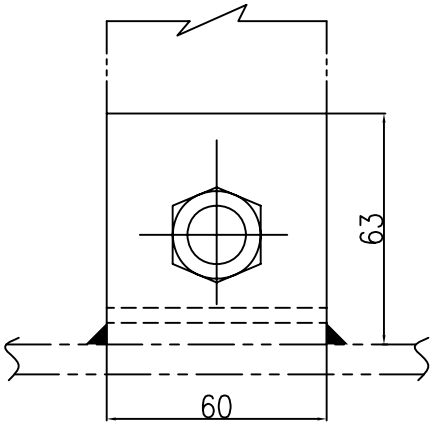

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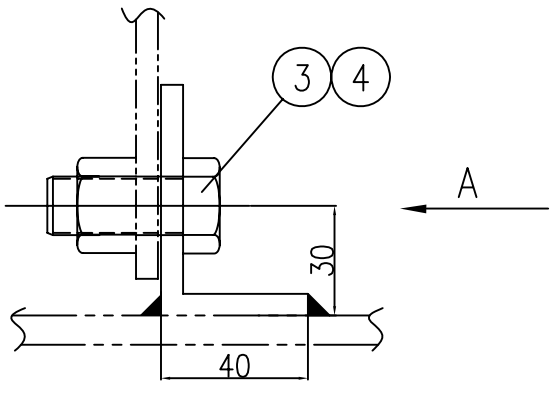
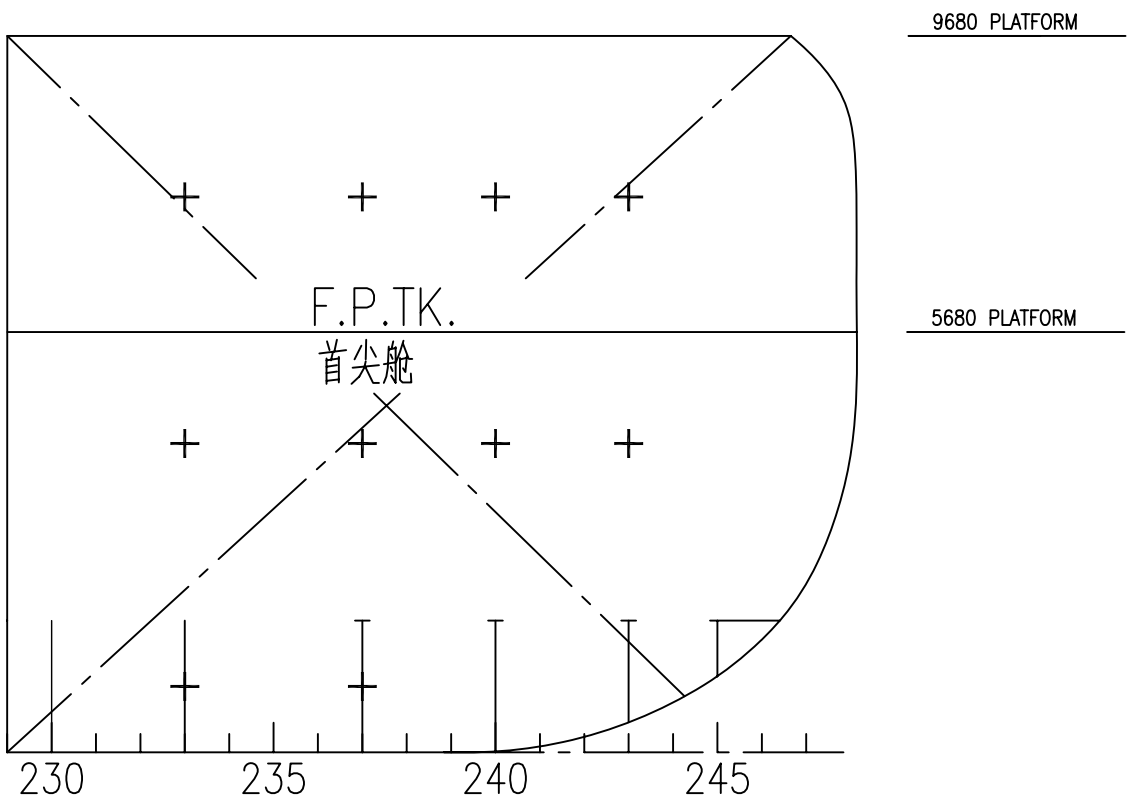


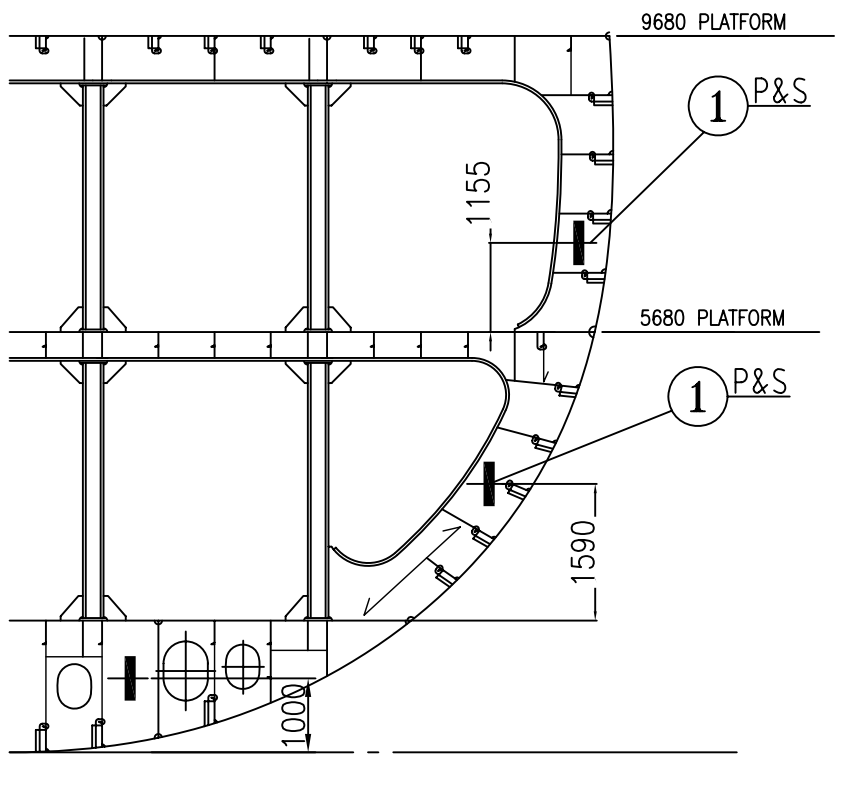
说明:

1、牺牲阳极不能布在外板及水密壁上,其安装位置可现场调整使其均匀分布。

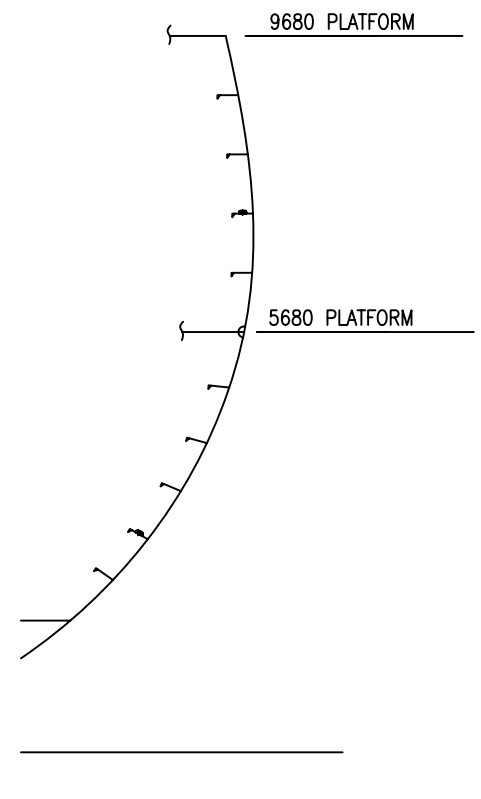
F.P.TK.
首尖舱



FR218
FR233,237 SIMILAR

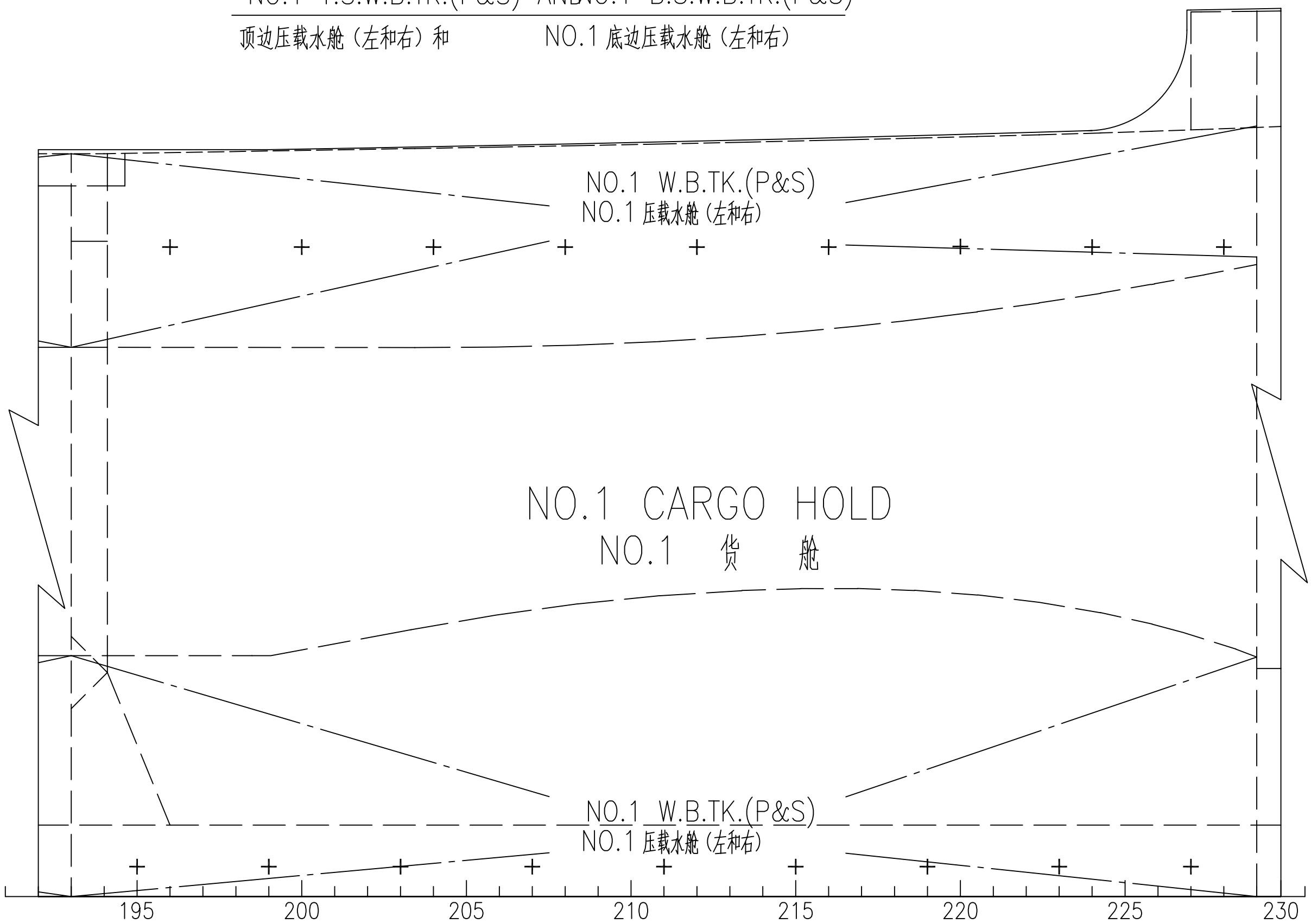


FR218
FR240,243 SIMILAR

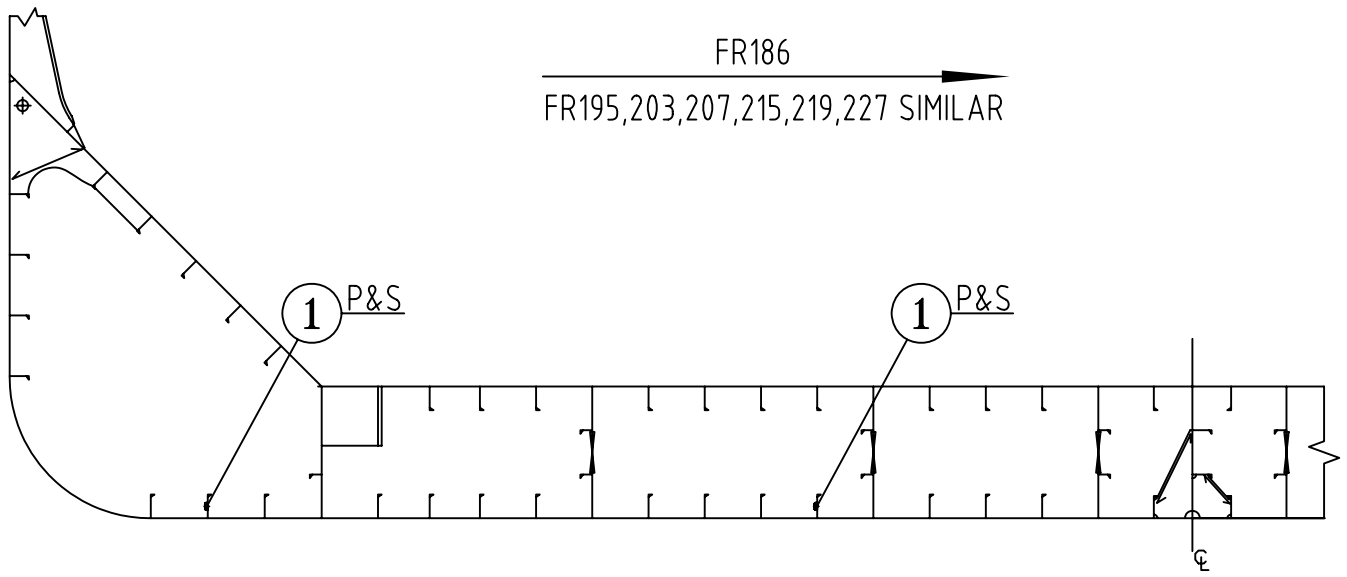


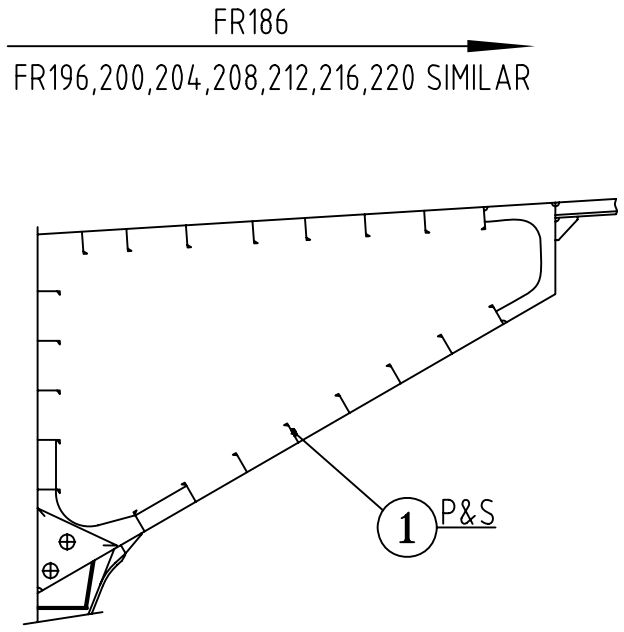
NO.1 T.S.W.B.TK.(P&S) AND NO.1 B.S.W.B.TK.(P&S)

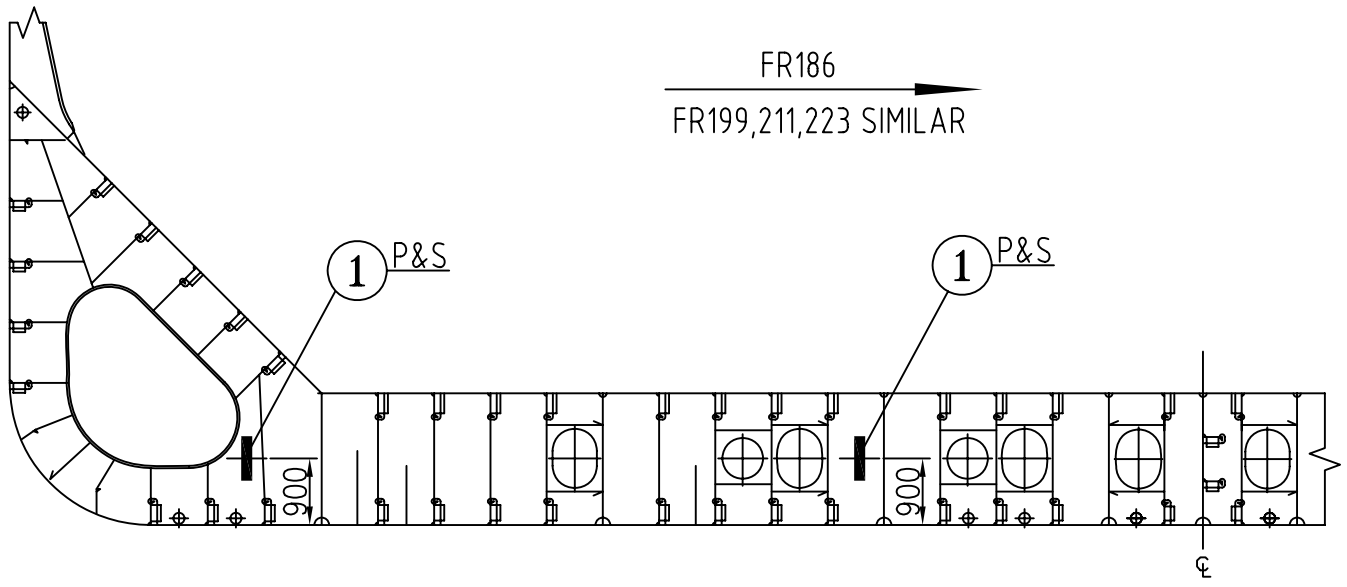
顶边压载水舱（左和右）和 NO.1 底边压载水舱（左和右）

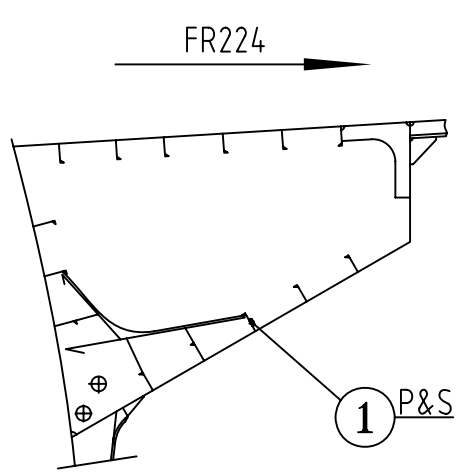


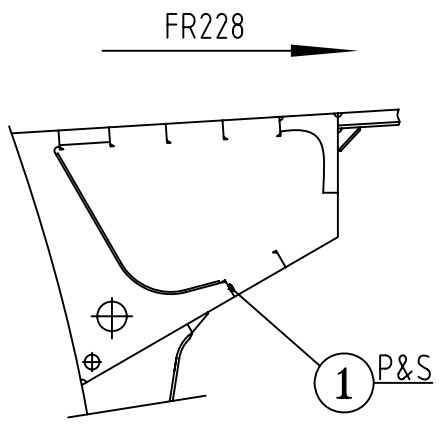
SACRIFICIAL ANODE ARRANGEMENT 牺牲阳极布置图	AVIC409-396-01	PAGE 10 / 19











NO.2 T.S.W.B.TK.(P&S) ANDNO.2 B.S.W.B.TK.(P&S)

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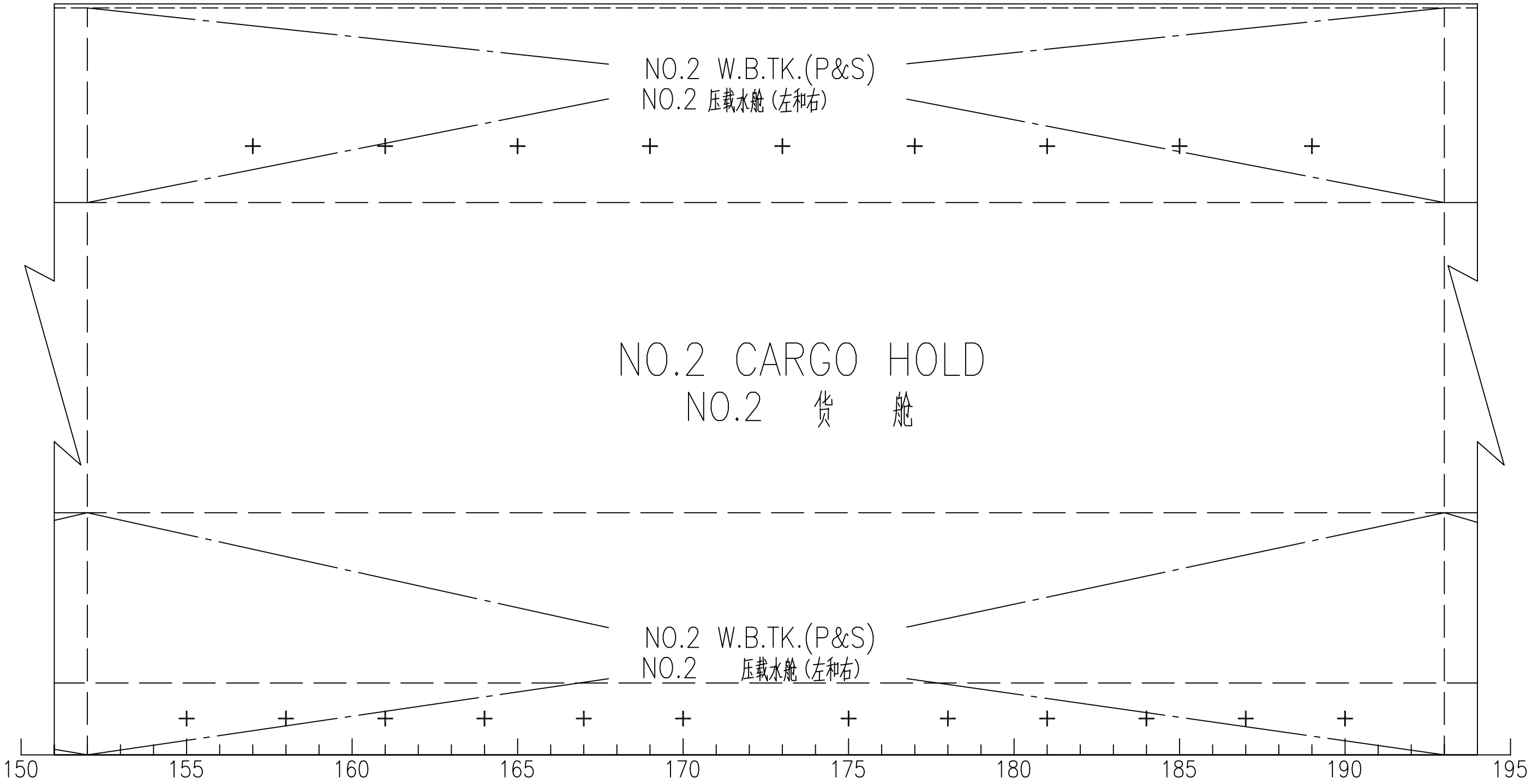

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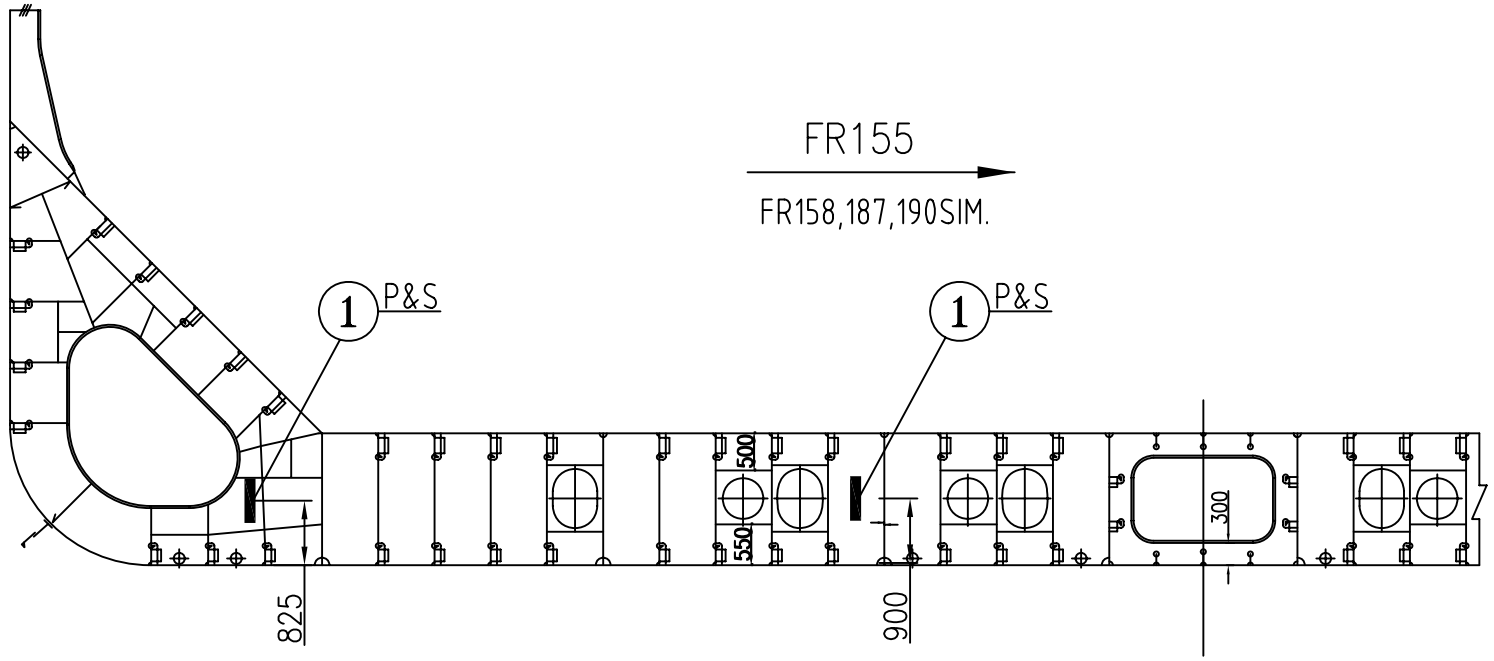
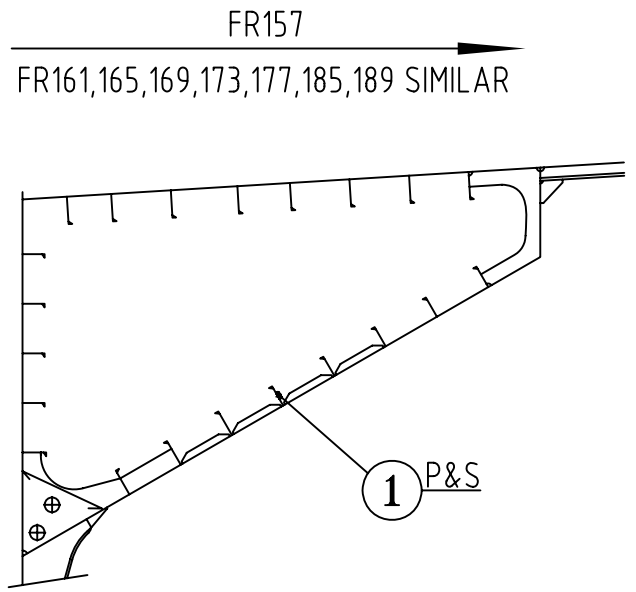
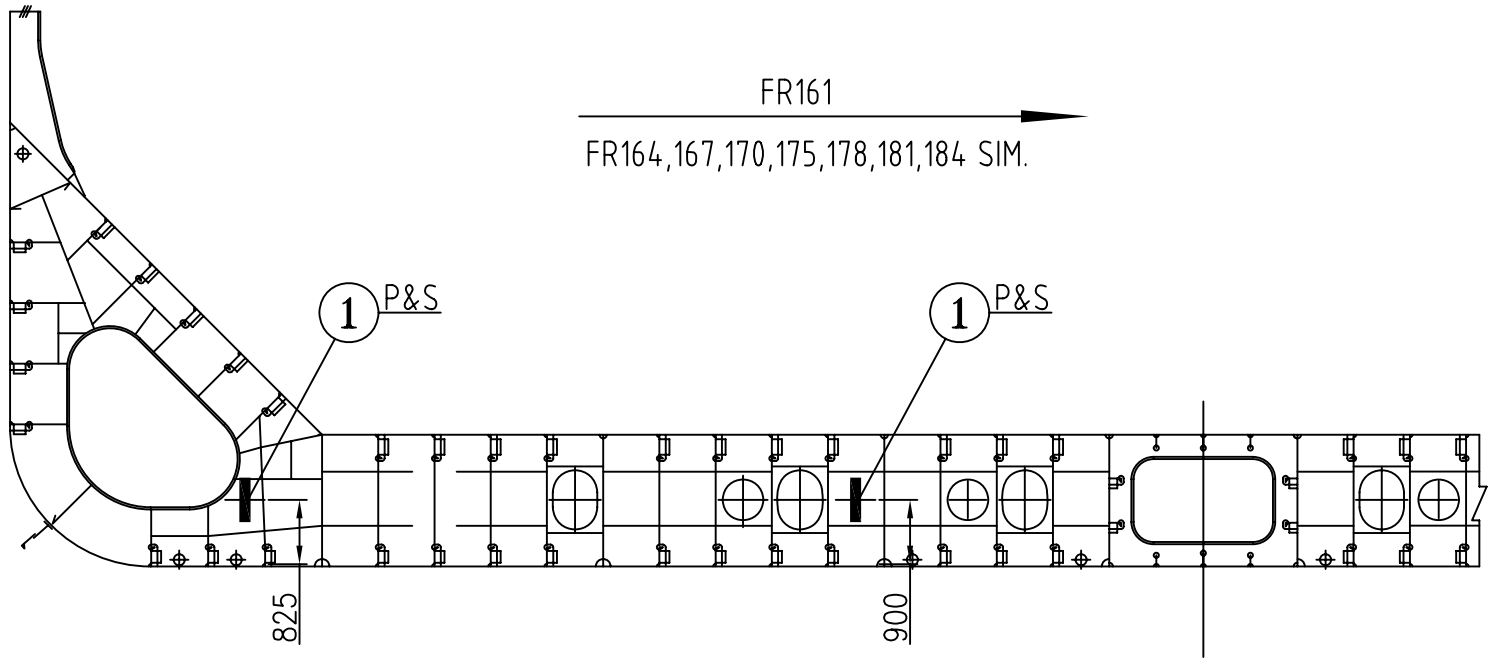
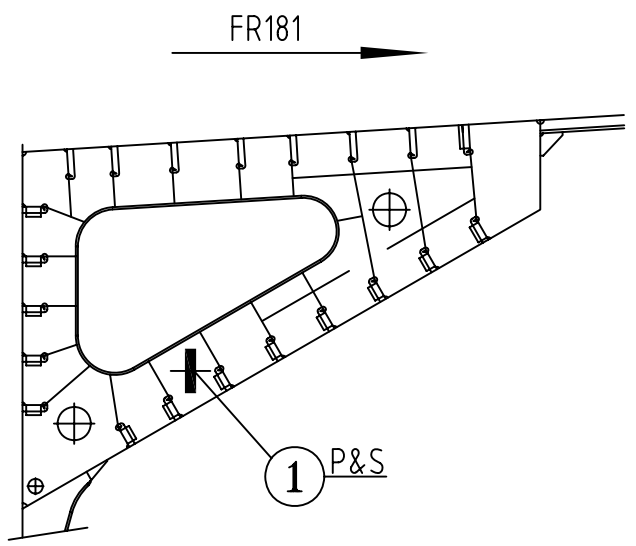


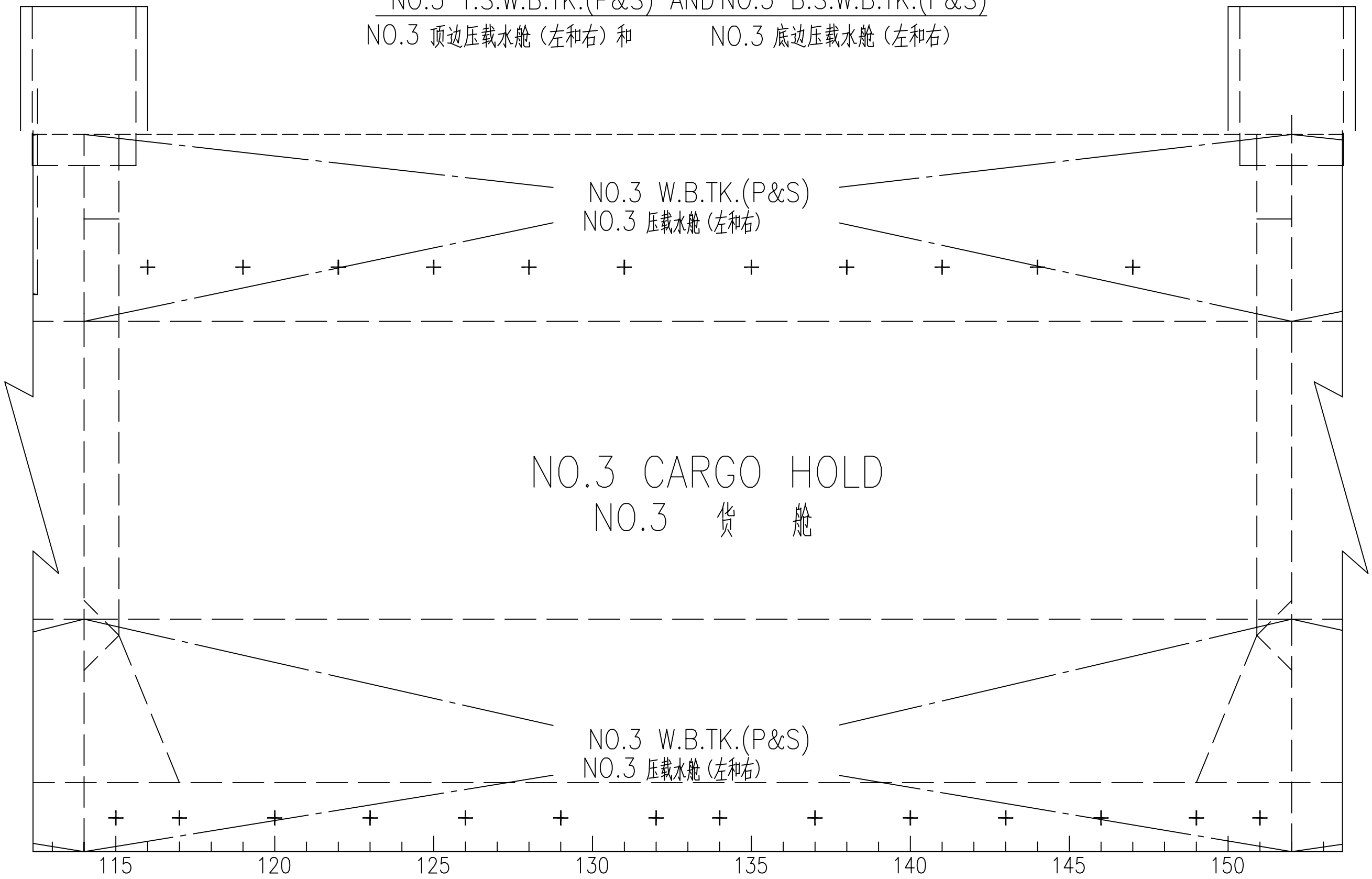






NO.3 T.S.W.B.TK.(P&S) AND NO.3 B.S.W.B.TK.(P&S)

NO.3 顶边压载水舱（左和右）和 NO.3 底边压载水舱（左和右）



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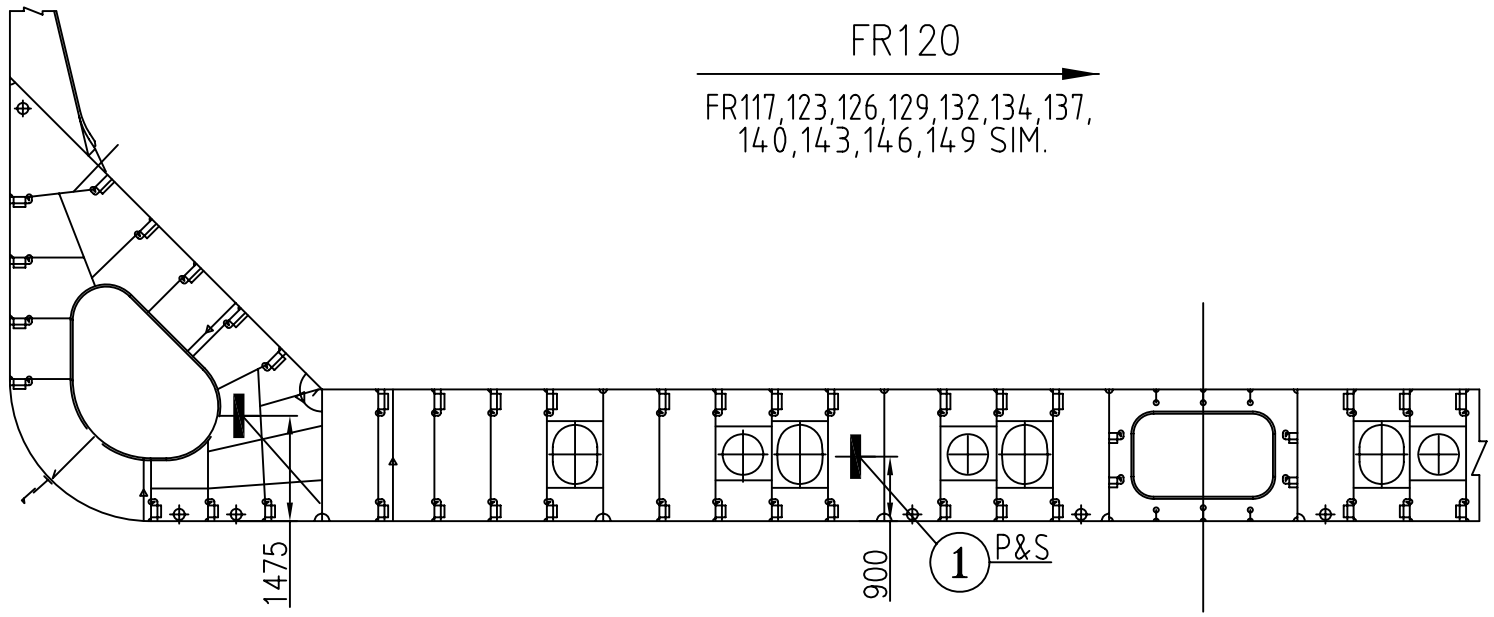
FR120

FR117,123,126,129,132,134,137,
140,143,146,149 SIM.



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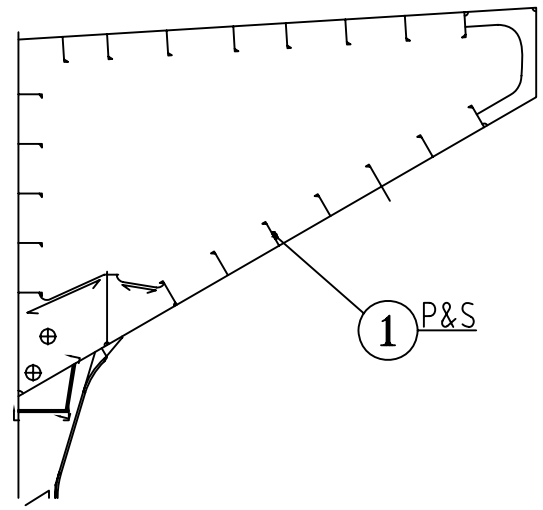

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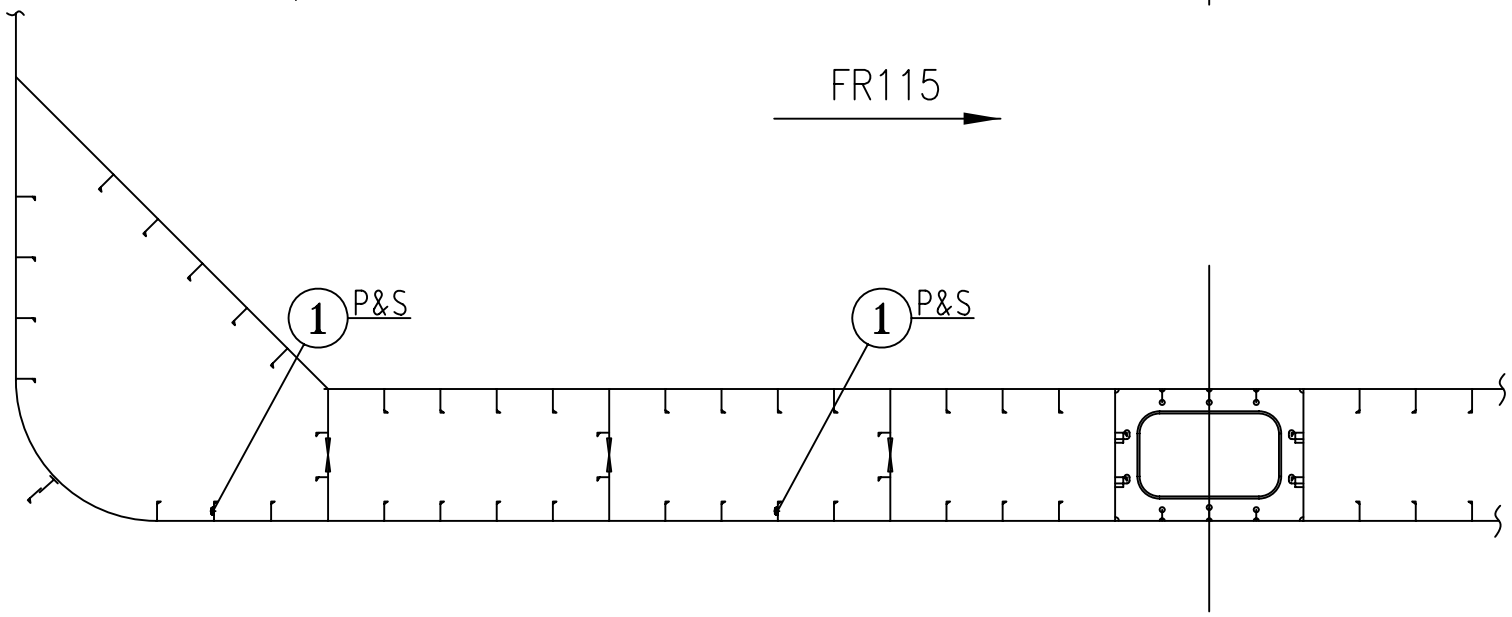

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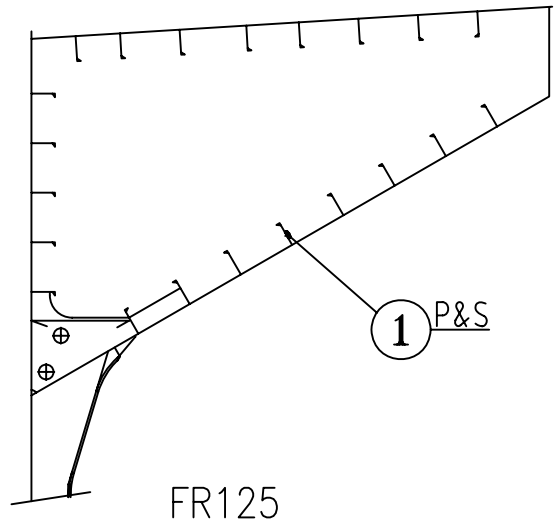
FR128,138,144 SIM



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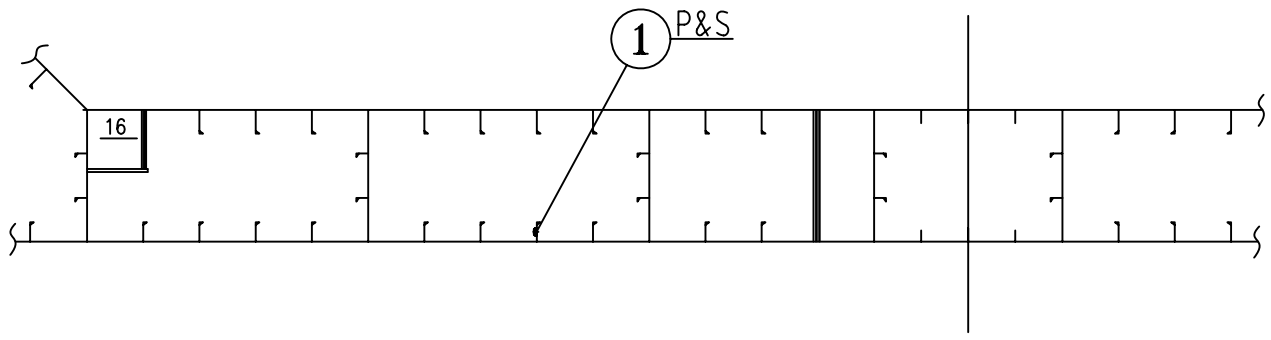
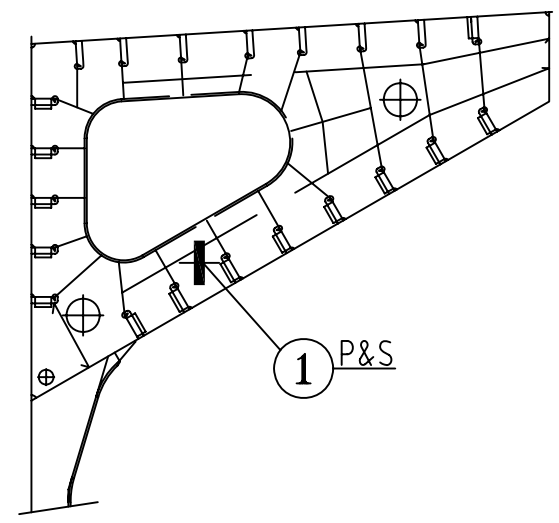


FR125

FR119,131,135,141,147 SIM



NO.4 B.S.W.B.TK.(P&S)
NO.4 底边压载水舱（左和右）

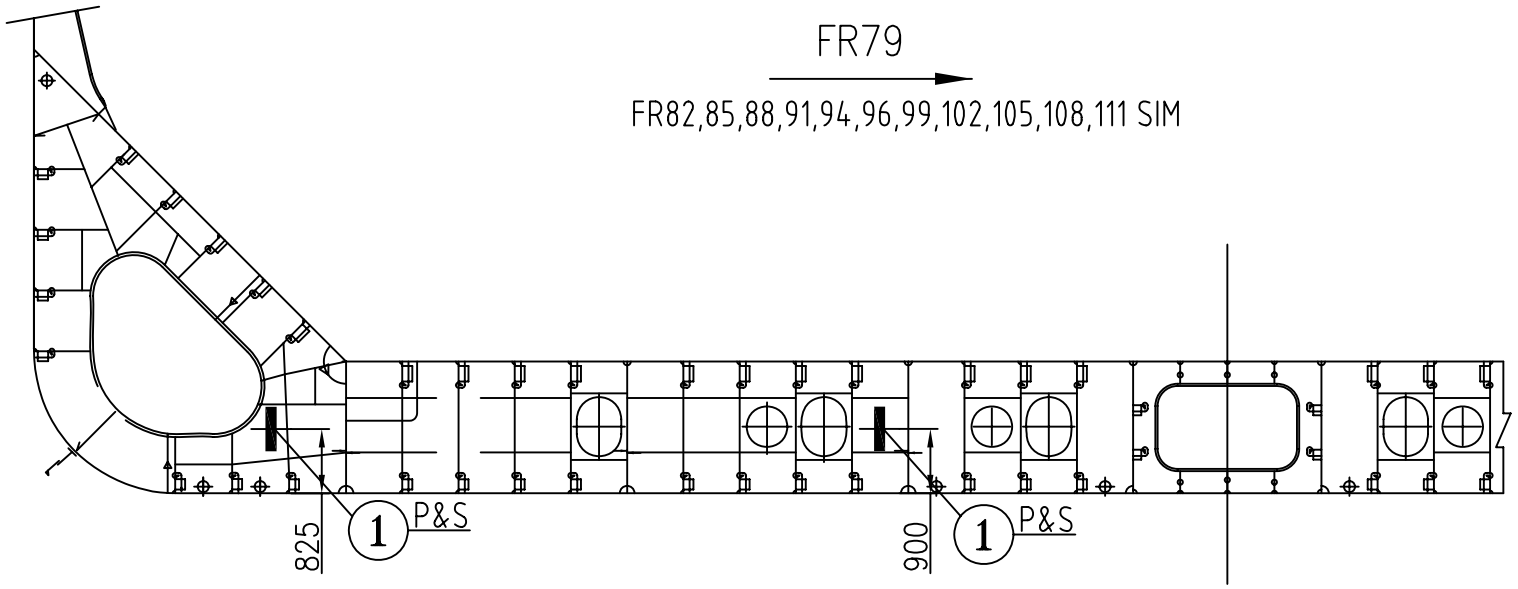
NO.1 H.F.O.TK.(P&S)
NO.1 燃料油舱（左和右）

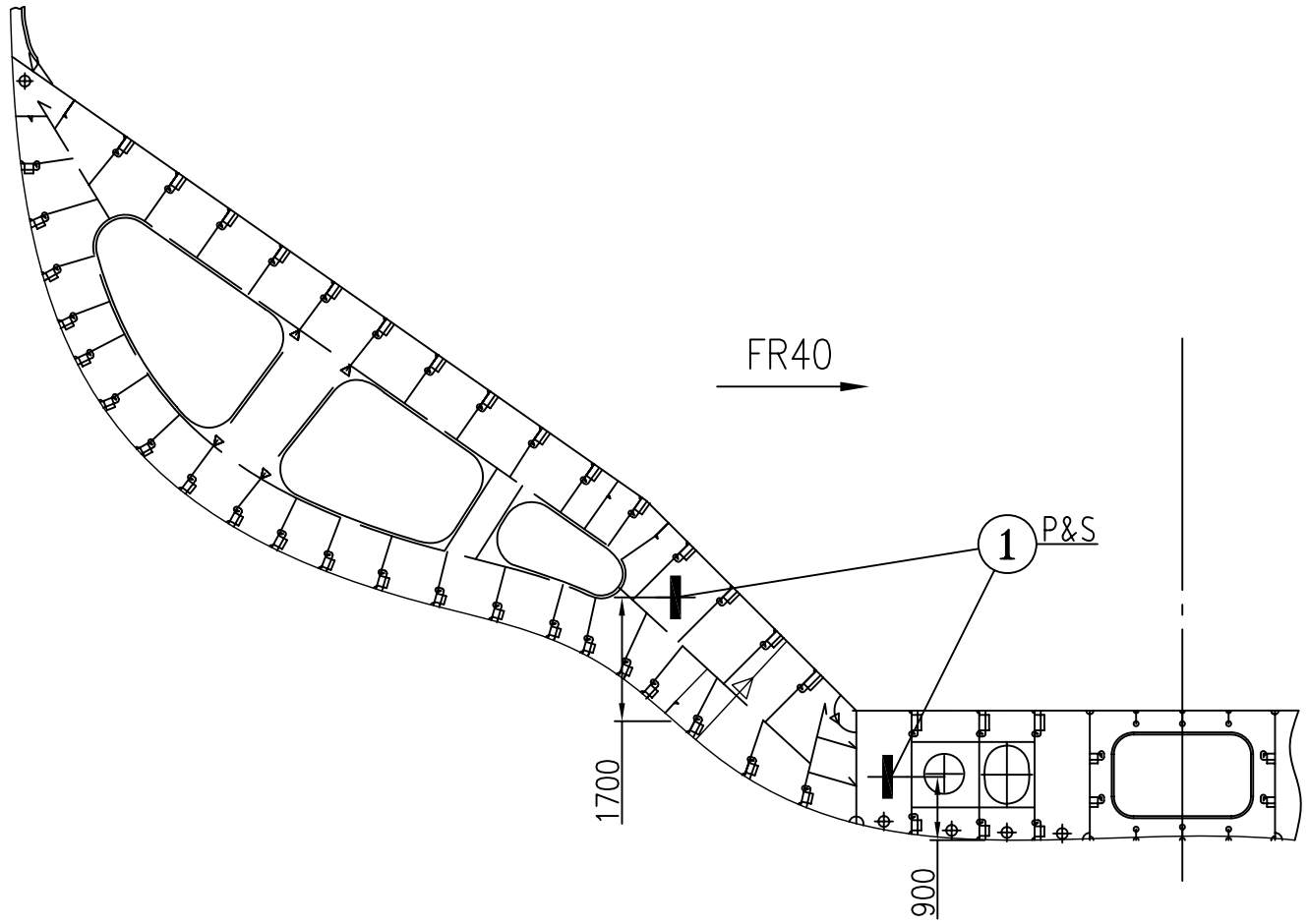
NO.4 CARGO HOLD
NO.4 货 舱

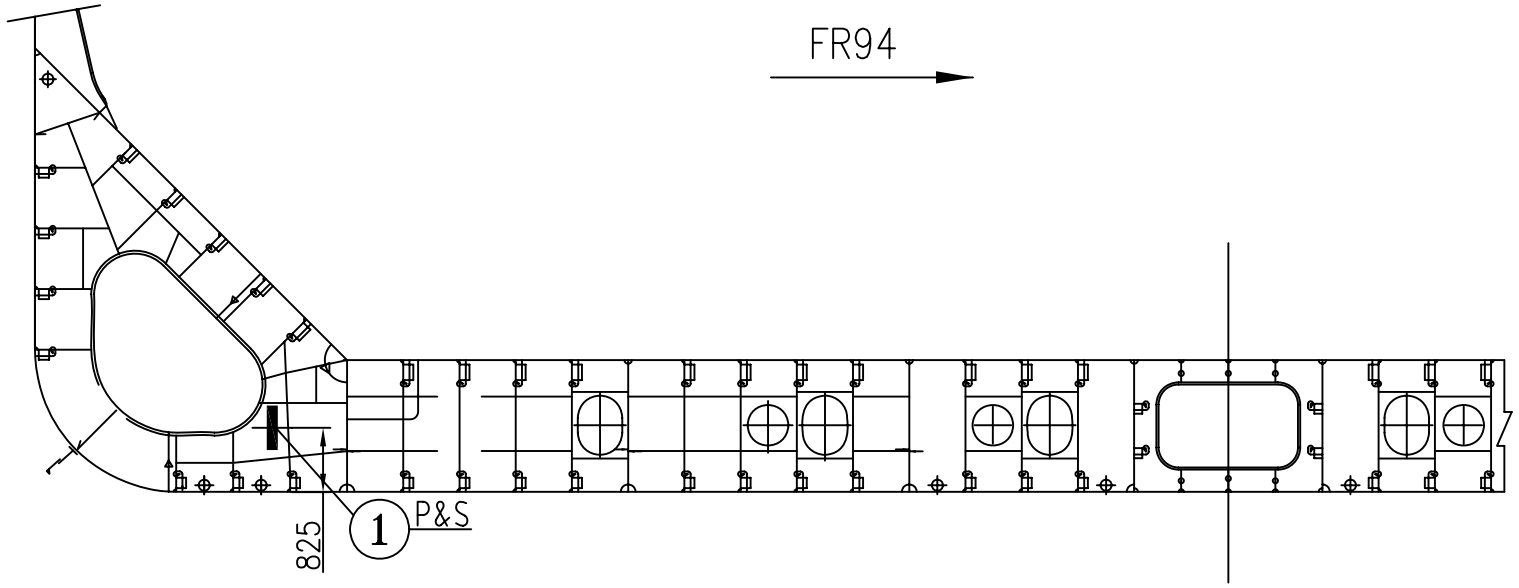
NO.4 W.B.TK.(P&S)
NO.4 压载水舱（左和右）

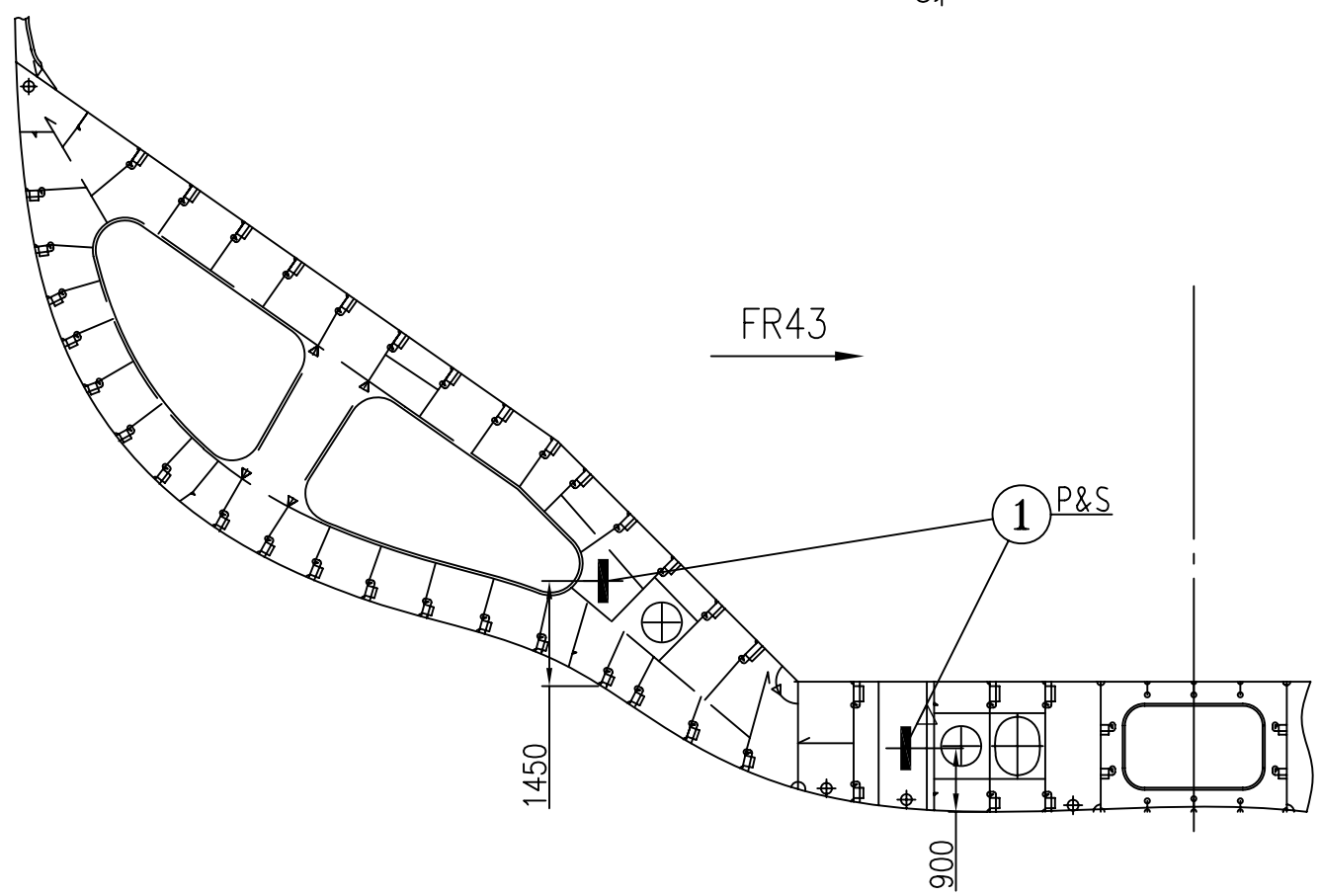
75 80 85 90 95 100 105 110 115

SACRIFICIAL ANODE ARRANGEMENT 牺牲阳极布置图	AVIC409-396-01	PAGE 16 / 19









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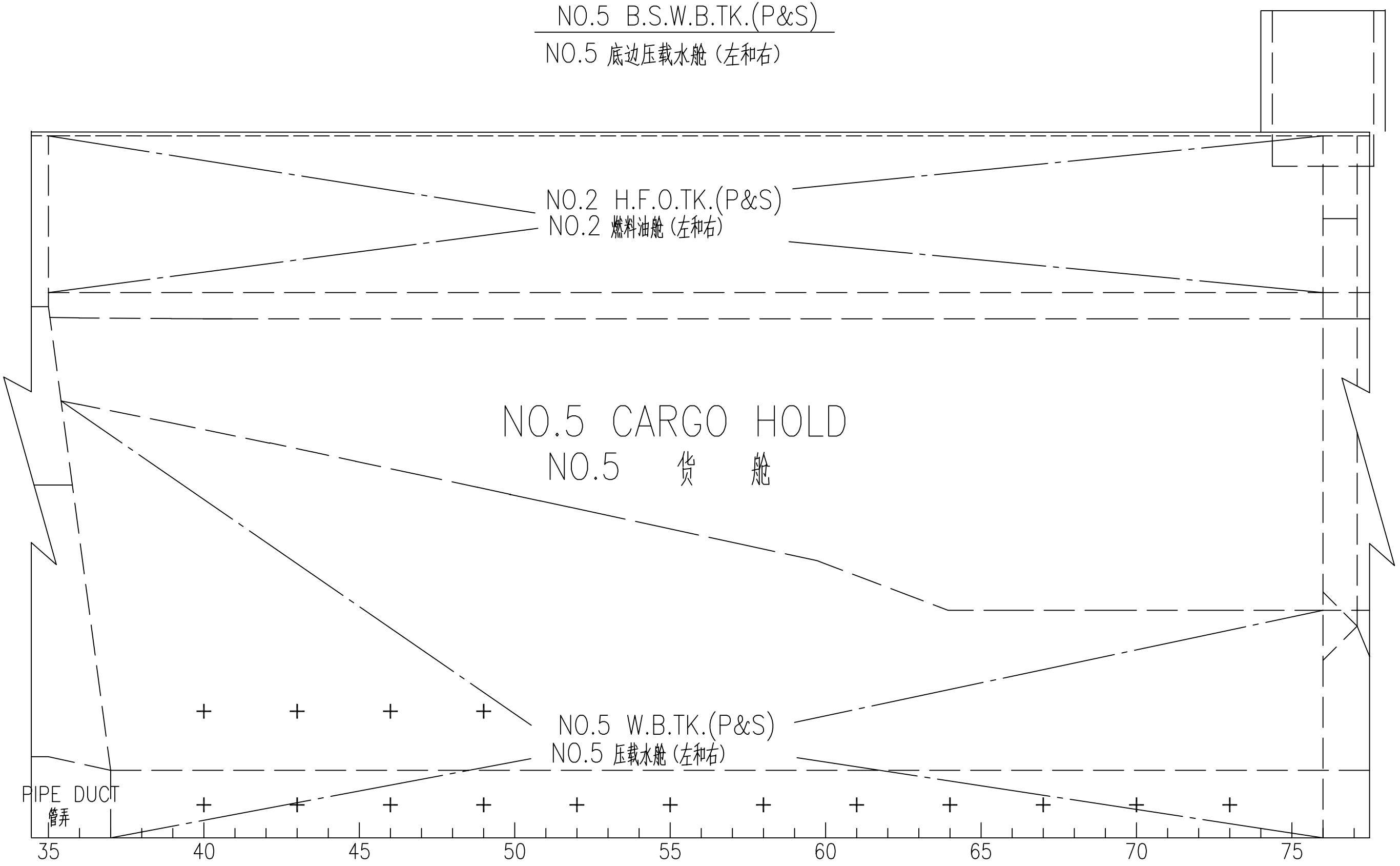

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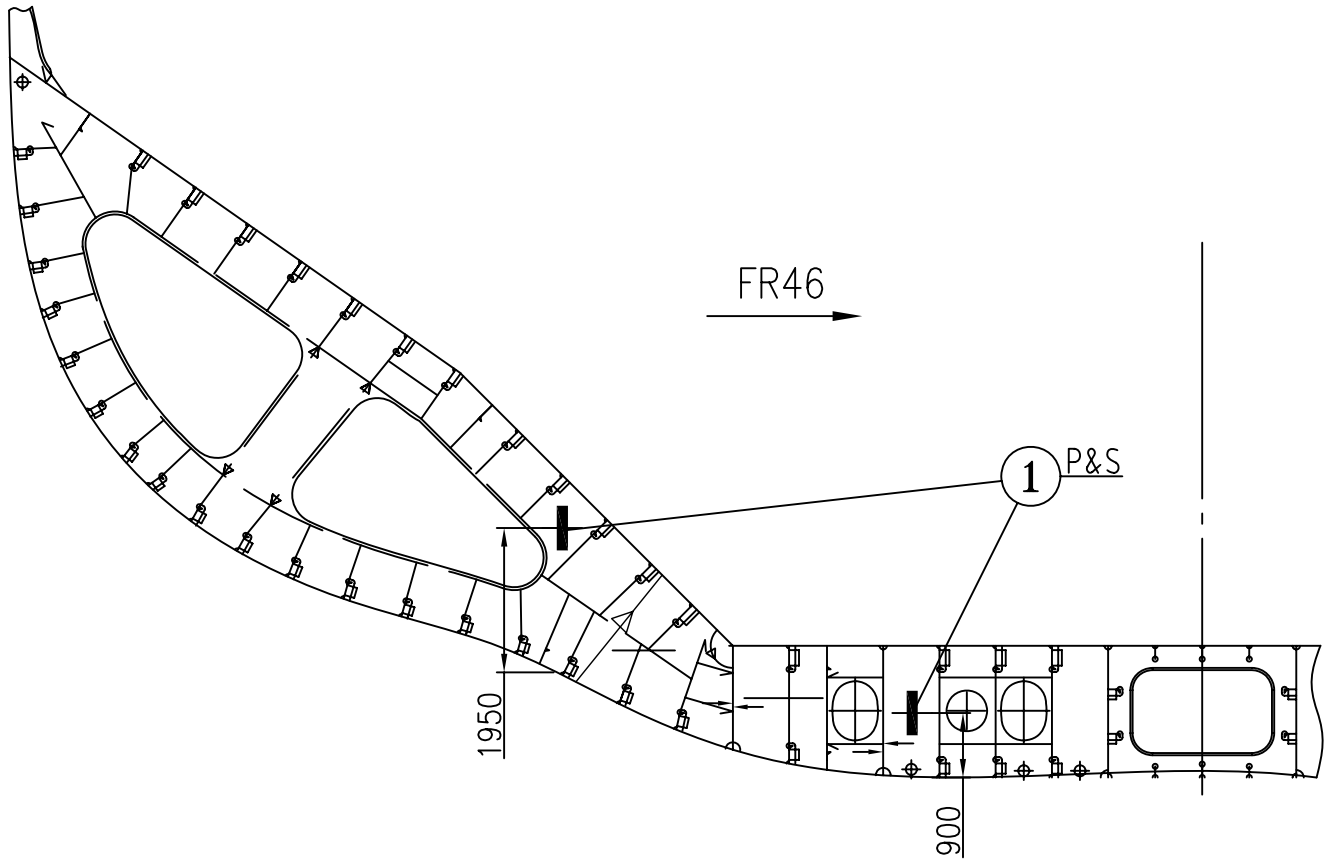

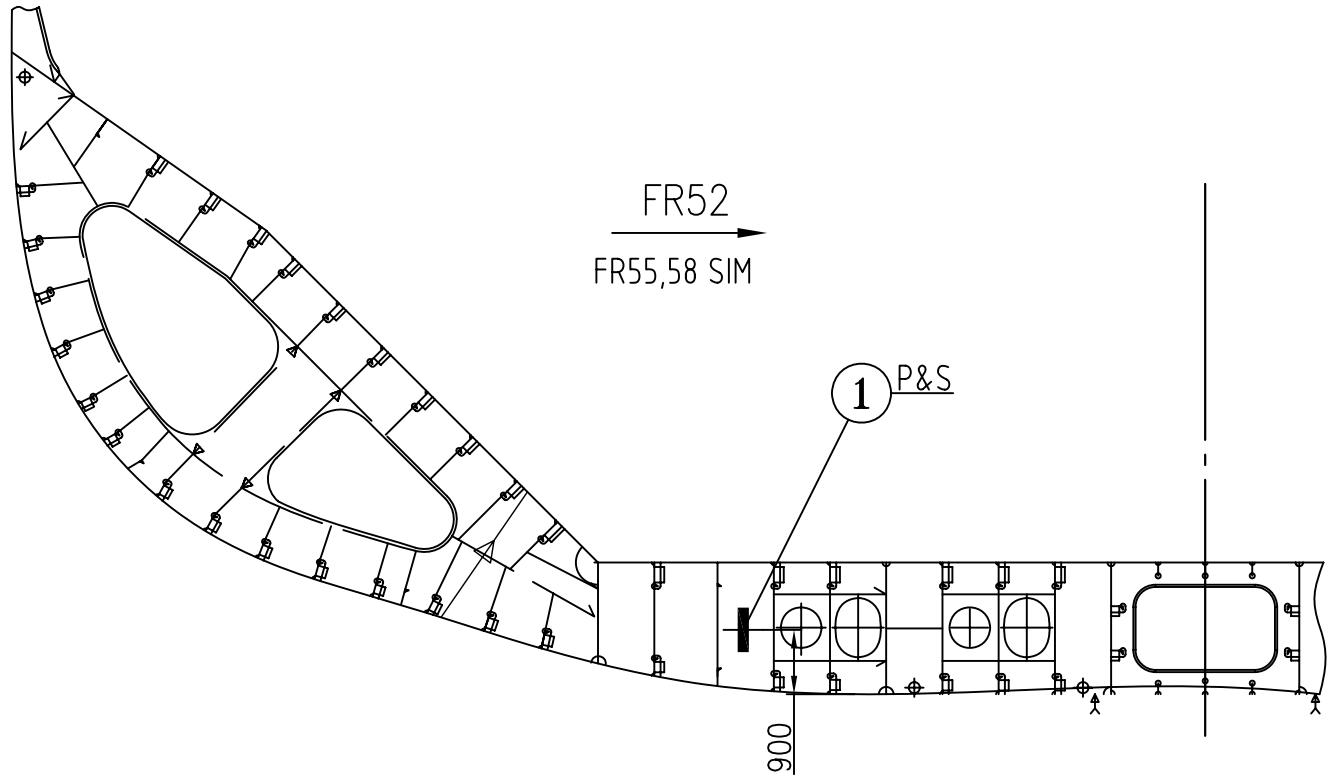

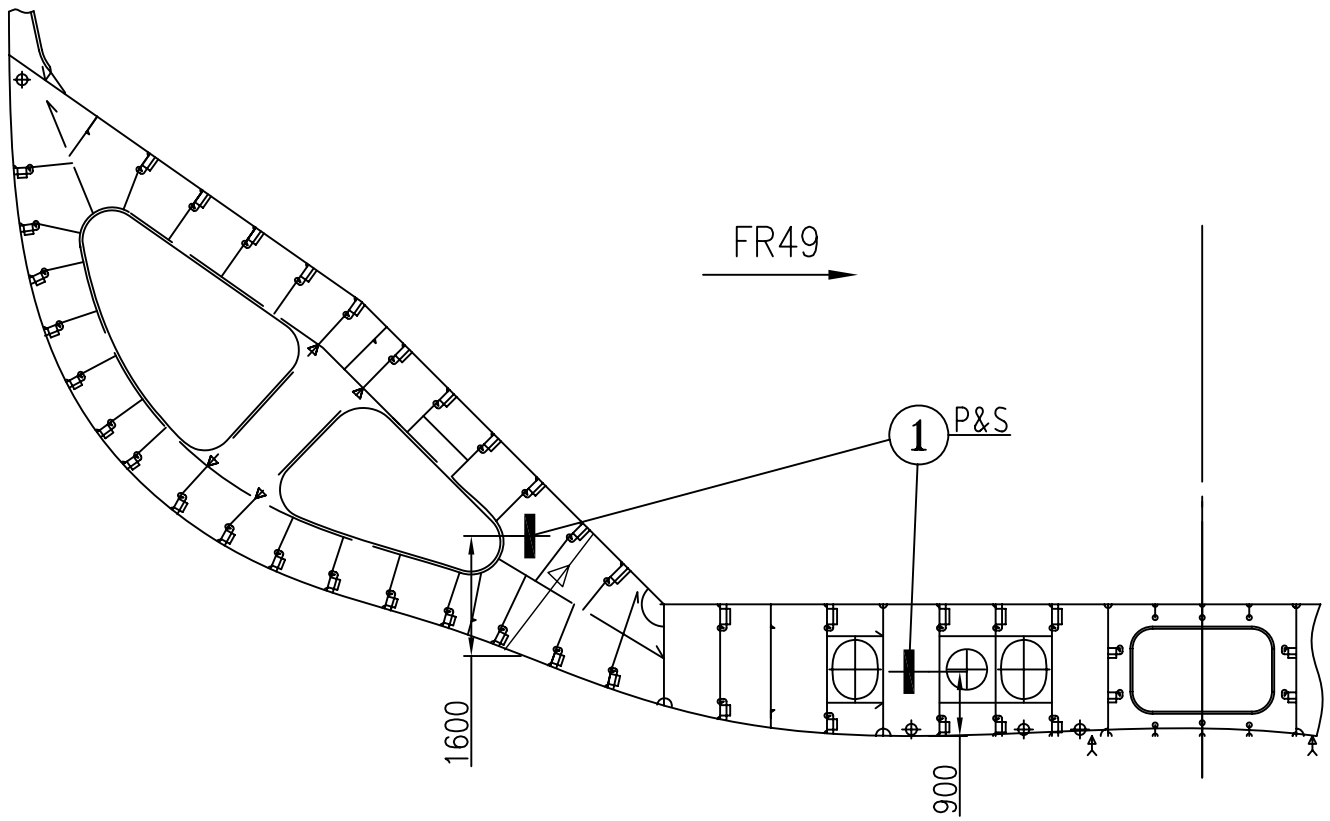

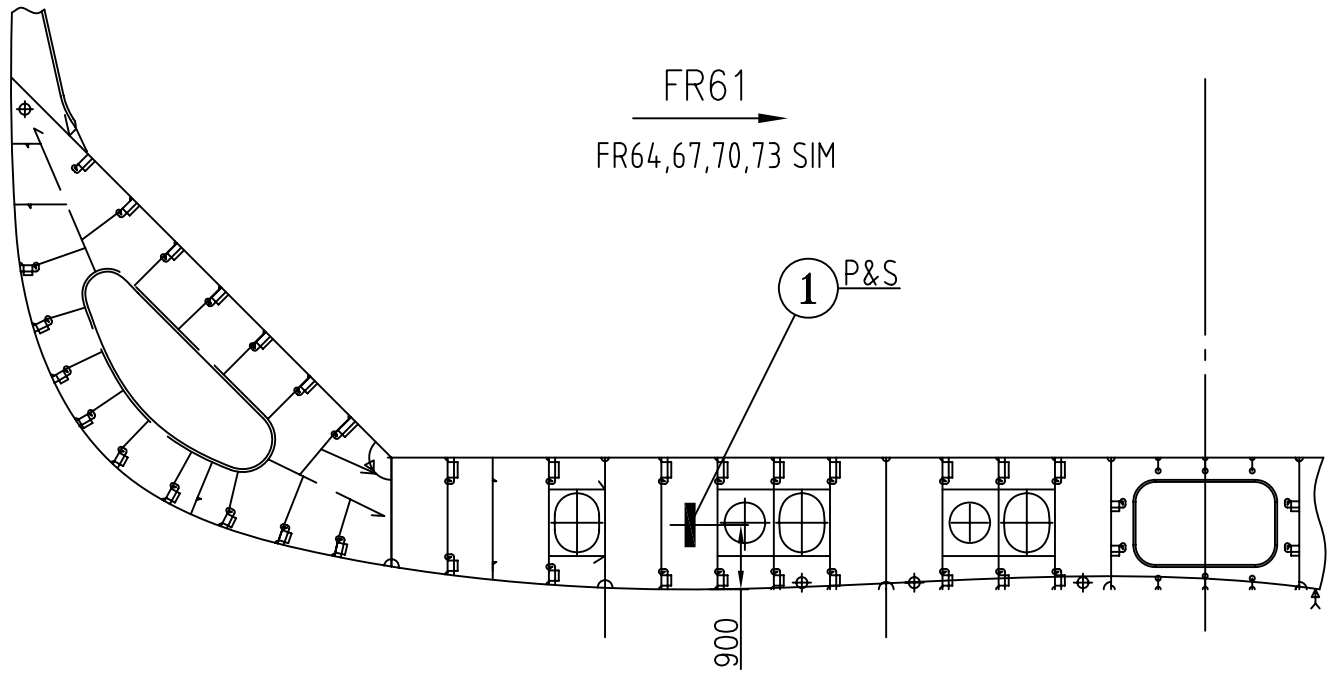

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