FIG. 1

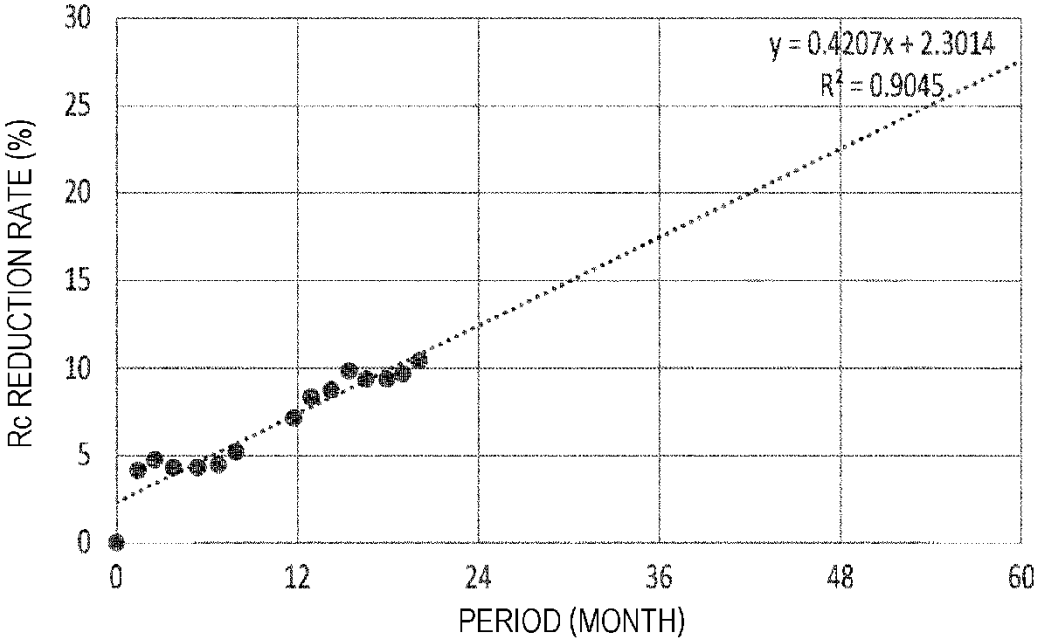

y = 0.4207x + 2.3014
R² = 0.9045
Rc REDUCTION RATE (%)
PERIOD (MONTH)
30
25
20
15
10
5
0
0
12
24
36
48
60

FIG. 2

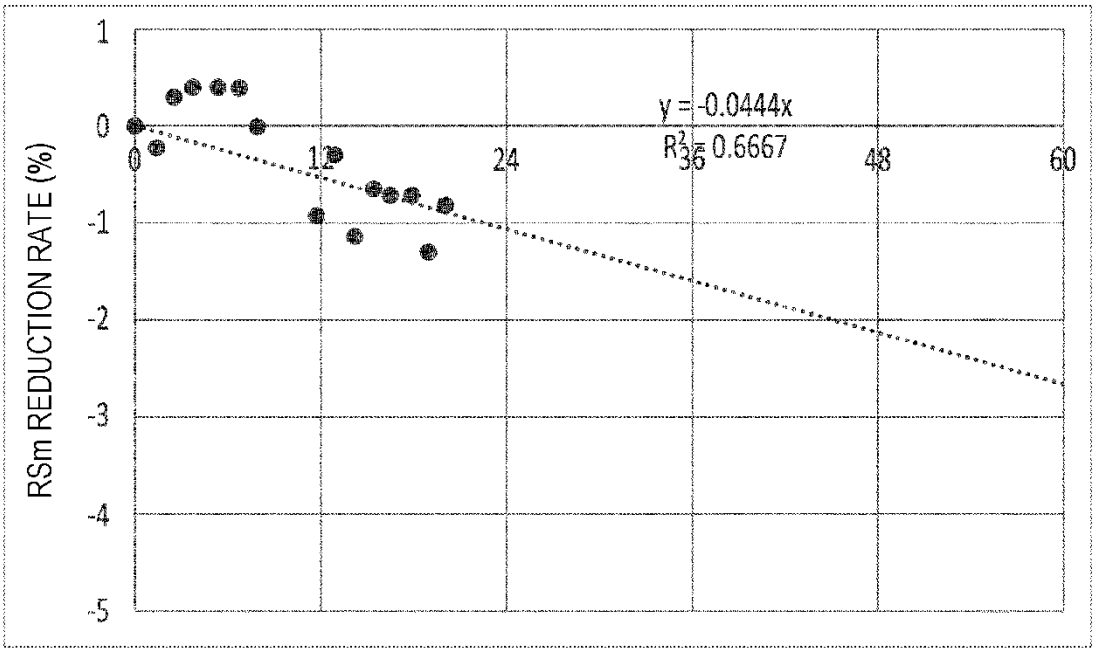

y = -0.0444x
R² = 0.6667
RSm REDUCTION RATE (%)
1
0
-1
-2
-3
-4
-5
0
12
24
36
48
60

FIG. 3

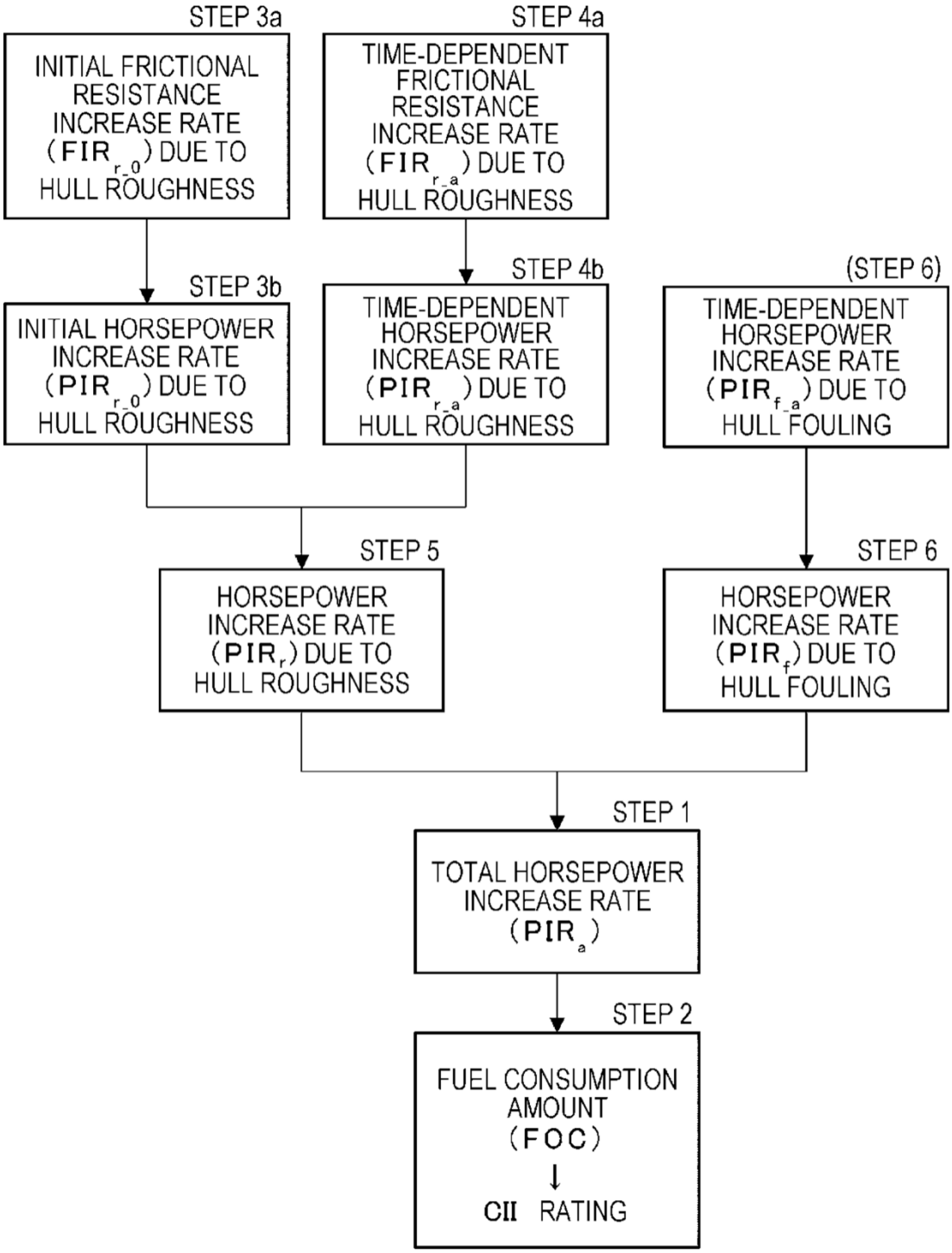

STEP 3a
INITIAL FRICTIONAL RESISTANCE INCREASE RATE (FIR_{r_0}) DUE TO HULL ROUGHNESS
STEP 4a
TIME-DEPENDENT FRICTIONAL RESISTANCE INCREASE RATE (FIR_{r_a}) DUE TO HULL ROUGHNESS
STEP 3b
INITIAL HORSEPOWER INCREASE RATE (PIR_{r_0}) DUE TO HULL ROUGHNESS
STEP 4b
TIME-DEPENDENT HORSEPOWER INCREASE RATE (PIR_{r_a}) DUE TO HULL ROUGHNESS
(STEP 6)
TIME-DEPENDENT HORSEPOWER INCREASE RATE (PIR_{f_a}) DUE TO HULL FOULING
STEP 5
HORSEPOWER INCREASE RATE (PIR_r) DUE TO HULL ROUGHNESS
STEP 6
HORSEPOWER INCREASE RATE (PIR_f) DUE TO HULL FOULING
STEP 1
TOTAL HORSEPOWER INCREASE RATE (PIR_a)
STEP 2
FUEL CONSUMPTION AMOUNT (FOC)
↓
CII RATING

FIG. 4

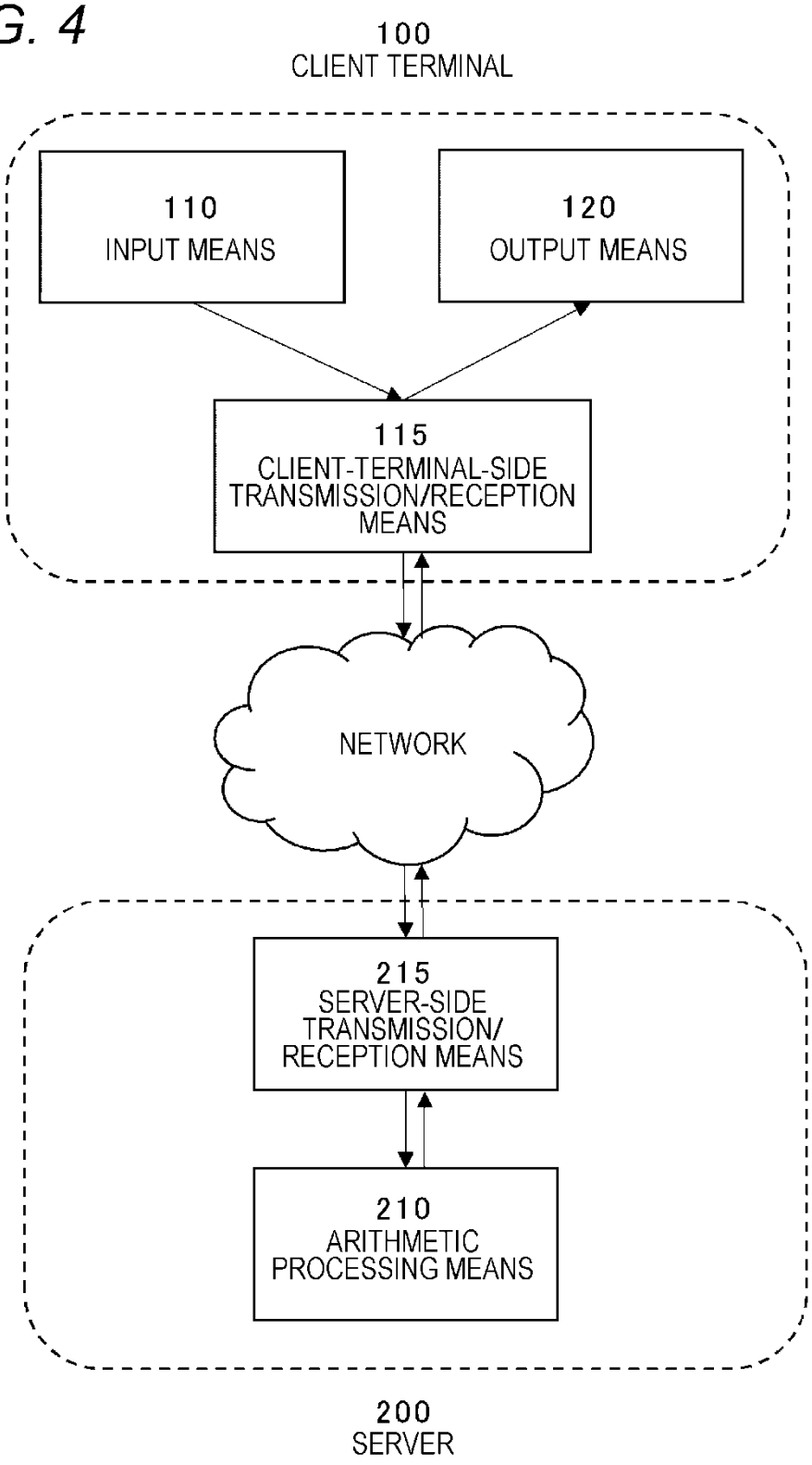

100
CLIENT TERMINAL
110
INPUT MEANS
120
OUTPUT MEANS
115
CLIENT-TERMINAL-SIDE TRANSMISSION/RECEPTION MEANS
NETWORK
215
SERVER-SIDE TRANSMISSION/ RECEPTION MEANS
210
ARITHMETIC PROCESSING MEANS
200
SERVER

FIG. 5

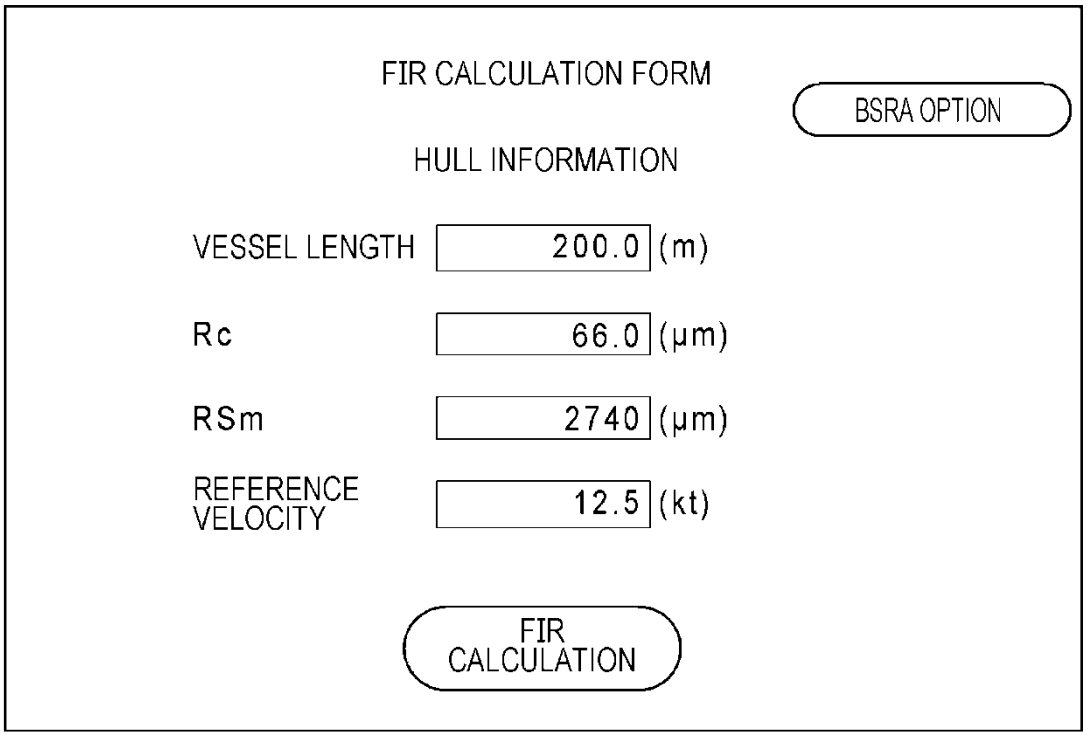

FIR CALCULATION FORM
BSRA OPTION
HULL INFORMATION
VESSEL LENGTH
200.0
(m)
Rc
66.0
(μm)
RSm
2740
(μm)
REFERENCE VELOCITY
12.5
(kt)
FIR CALCULATION

FIG. 6

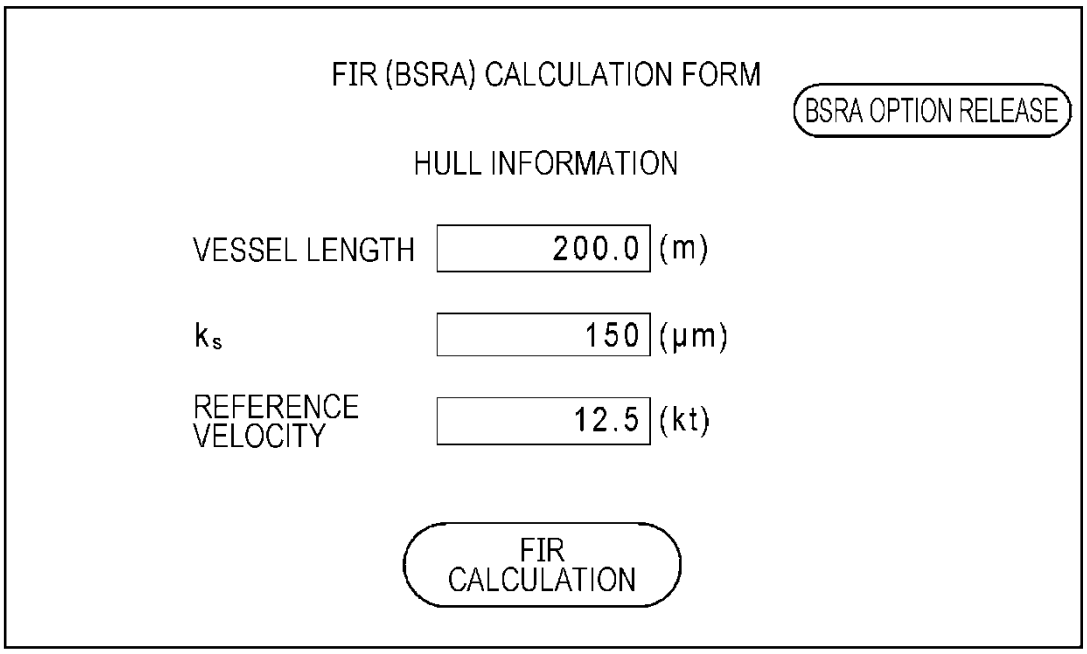
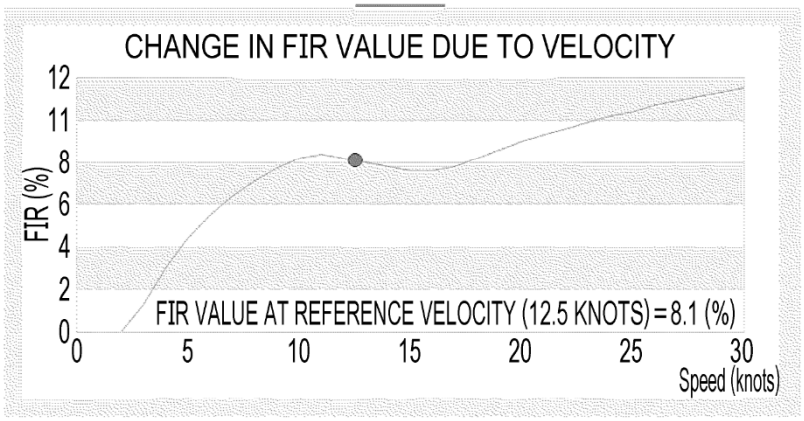

FIR (BSRA) CALCULATION FORM
BSRA OPTION RELEASE
HULL INFORMATION
VESSEL LENGTH
200.0
(m)
ks
150
(μm)
REFERENCE VELOCITY
12.5
(kt)
FIR CALCULATION

FIG. 7

FIR CALCULATION RESULT



FIR VALUE AT EACH VELOCITY

VELOCITY (kt)	1	2	3	4	5	6	···	···	24	25	26	27	28	29	30
FIR (%)	0.0	0.0	1.3	3.0	4.4	5.5	···	···	10.2	10.4	10.7	10.9	11.1	11.3	11.5

PLEASE UNCHECK BOX BELOW WHEN PIR SIMULATION IS NOT NECESSARY.

☑ THIS CALCULATION RESULT IS USED AS "CONVENTIONAL ANTI-FOULING PAINT" OF PIR SIMULATION.

FIG. 8

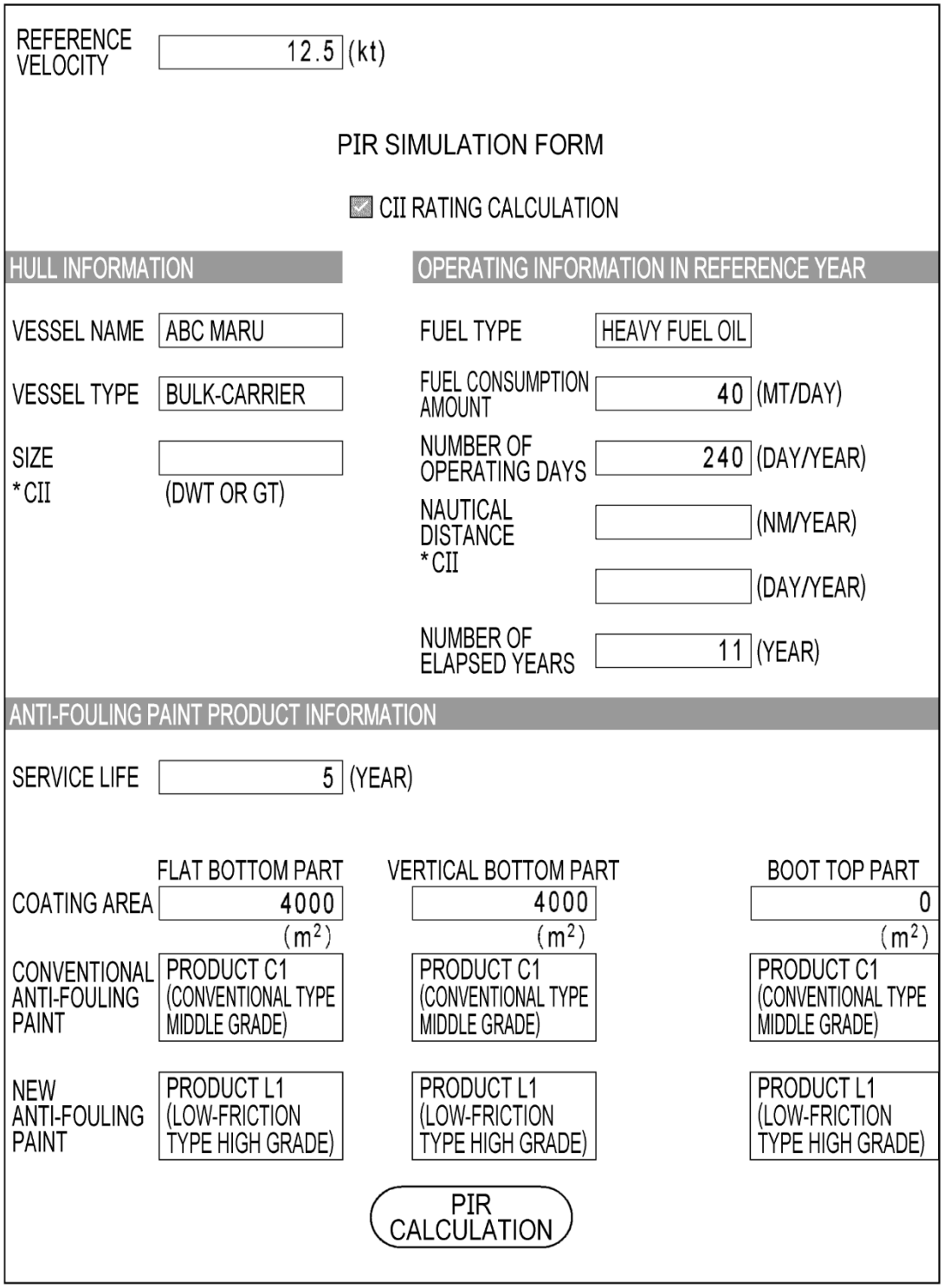

REFERENCE VELOCITY
12.5
(kt)
PIR SIMULATION FORM
CII RATING CALCULATION
HULL INFORMATION
VESSEL NAME
ABC MARU
VESSEL TYPE
BULK-CARRIER
SIZE
*CII
(DWT OR GT)
OPERATING INFORMATION IN REFERENCE YEAR
FUEL TYPE
HEAVY FUEL OIL
FUEL CONSUMPTION AMOUNT
40
(MT/DAY)
NUMBER OF OPERATING DAYS
240
(DAY/YEAR)
NAUTICAL DISTANCE
*CII
(NM/YEAR)
(DAY/YEAR)
NUMBER OF ELAPSED YEARS
11
(YEAR)
ANTI-FOULING PAINT PRODUCT INFORMATION
SERVICE LIFE
5
(YEAR)
FLAT BOTTOM PART
VERTICAL BOTTOM PART
BOOT TOP PART
COATING AREA
4000
(m2)
4000
(m2)
0
(m2)
CONVENTIONAL ANTI-FOULING PAINT
PRODUCT C1 (CONVENTIONAL TYPE MIDDLE GRADE)
PRODUCT C1 (CONVENTIONAL TYPE MIDDLE GRADE)
PRODUCT C1 (CONVENTIONAL TYPE MIDDLE GRADE)
NEW ANTI-FOULING PAINT
PRODUCT L1 (LOW-FRICTION TYPE HIGH GRADE)
PRODUCT L1 (LOW-FRICTION TYPE HIGH GRADE)
PRODUCT L1 (LOW-FRICTION TYPE HIGH GRADE)
PIR CALCULATION

FIG. 9–1

PIR SIMULATION RESULT OF ABC MARU

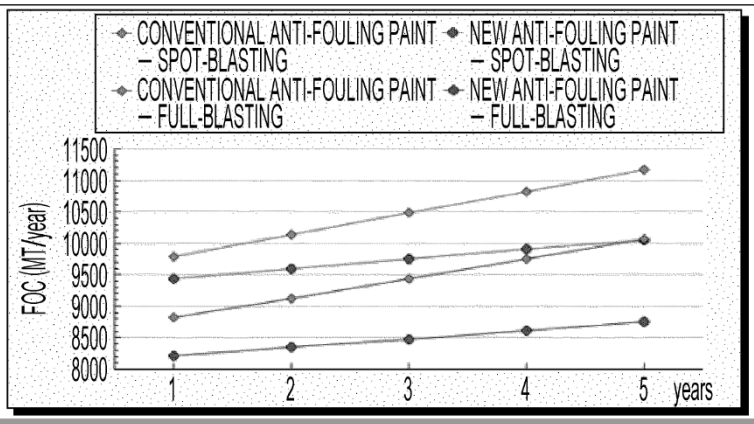
HULL PERFORMANCE INFORMATION	
(a) FOC	40
(b) NUMBER OF OPERATING DAYS	240

SIMULATION FACTOR	ROUGHNESS FACTOR			FOULING FACTOR	
	FIR(%)	Form factor	PIR(%)	AVERAGE SPEED LOSS (%)	AVERAGE PIR (%)
(c) CONVENTIONAL ANTI-FOULING PAINT – SPOT-BLASTING	20.3	0.8	16.24	3	9
(d) NEW ANTI-FOULING PAINT – SPOT-BLASTING	17.0	0.8	13.56	1.4	4.2
(e) CONVENTIONAL ANTI-FOULING PAINT – FULL-BLASTING	7.9	0.8	6.32	3	9
(f) NEW ANTI-FOULING PAINT – SPOT-BLASTING	1.2	0.8	0.96	1.4	4.2
(g) HORSEPOWER REDUCTION RATE (PRR) : (c) – (d)			2.68		
(h) HORSEPOWER REDUCTION RATE (PRR) : (c) – (e)			9.92		
(i) HORSEPOWER REDUCTION RATE (PRR) : (c) — (f)			15.28		

INITIAL PERFORMANCE SIMULATION	INITIAL FOC (MT/YEAR)
(j) CONVENTIONAL ANTI-FOULING PAINT – SPOT-BLASTING : (a) × (b)	9,600
(k) NEW ANTI-FOULING PAINT – SPOT-BLASTING : (j) × (100-(g)/100)	9,343
(l) CONVENTIONAL ANTI-FOULING PAINT – FULL-BLASTING : (j) × (100-(h)/100)	8,648
(m) NEW ANTI-FOULING PAINT – FULL-BLASTING : (j) × (100-(i)/100)	8,113

FIG. 9–2

LONG-TERM PERFORMANCE SIMULATION	FIRST YEAR (MT/YEAR)	SECOND YEAR (MT/YEAR)	THIRD YEAR (MT/YEAR)	FOURTH YEAR (MT/YEAR)	FIFTH YEAR (MT/YEAR)
CONVENTIONAL ANTI-FOULING PAINT – SPOT-BLASTING	9,787	10,133	10,478	10,842	11,170
NEW ANTI-FOULING PAINT – SPOT-BLASTING	9,428	9,585	9,742	9,899	10,056
CONVENTIONAL ANTI-FOULING PAINT – FULL-BLASTING	8,816	9,128	9, 439	9,750	10,062
NEW ANTI-FOULING PAINT – SPOT-BLASTING	8,207	8, 344	8,480	8,617	8,754



CII RATING	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	FIFTH YEAR
CONVENTIONAL ANTI-FOULING PAINT – SPOT-BLASTING	D	D	E	E	E
NEW ANTI-FOULING PAINT – SPOT-BLASTING	C	D	D	D	E
CONVENTIONAL ANTI-FOULING PAINT – FULL-BLASTING	C	C	D	D	E
NEW ANTI-FOULING PAINT – SPOT-BLASTING	B	B	C	C	C

COMPREHENSIVE PERFORMANCE	INITIAL FOC (MT/5 YEARS)	FOC REDUCTION (MT/5 YEARS)	CO_2 REDUCTION (MT/5 YEARS)
CONVENTIONAL ANTI-FOULING PAINT – SPOT-BLASTING	52,392	N/A	N/A
NEW ANTI-FOULING PAINT – SPOT-BLASTING	48,710	3,682	11,466
CONVENTIONAL ANTI-FOULING PAINT – FULL-BLASTING	47,195	5,197	16,183
NEW ANTI-FOULING PAINT – SPOT-BLASTING	42,402	9,990	31,109