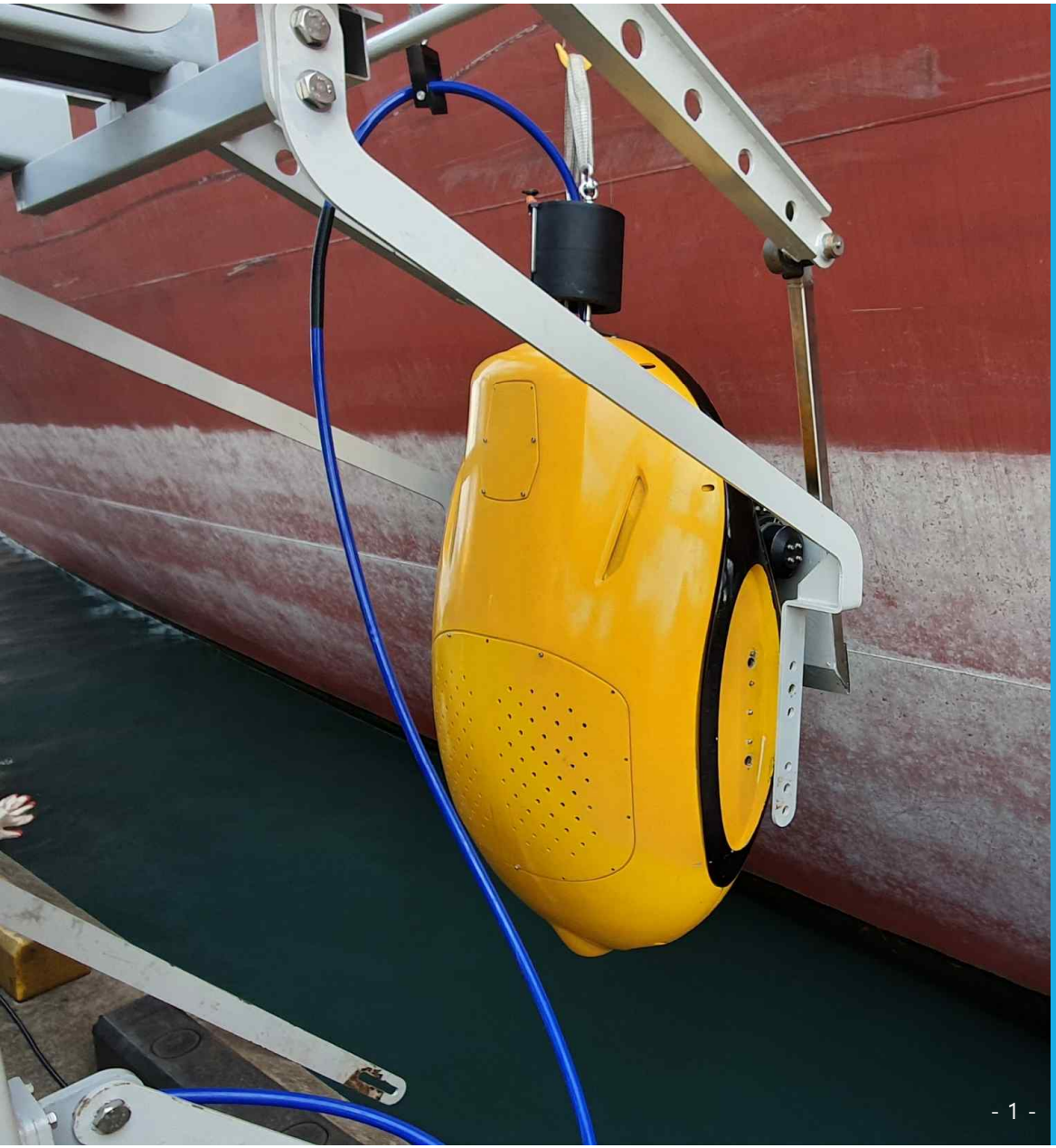

Underwater Hull Cleaning Robot

NEXT-GENERATION ECO-FRIENDLY SHIP CLEANING ROBOT

PACIFIC OCEAN

Pacific Ocean Marine Industries Co., Ltd.

PACIFIC OCEAN
Pacific Ocean Marine Industries Co., Ltd.

Robot System configuration

❖ Robot remote control and monitoring
❖ Real-time monitoring and storage of robot cleaning video
❖ Sharing cleaning progress using cloud platform

Under-Ship Cleaning Robot

❖ Curved part driving mechanism
❖ Equipped with fouling cleaning debris collection device
❖ Applying brush type according to fouling condition

Integration Robot Management System

❖ All-in-one robot operation system
(Robot attachment/recovery, power supply, control room)
❖ Cable Supply System (Winch System)
❖ External purification treatment system

Robot Control System

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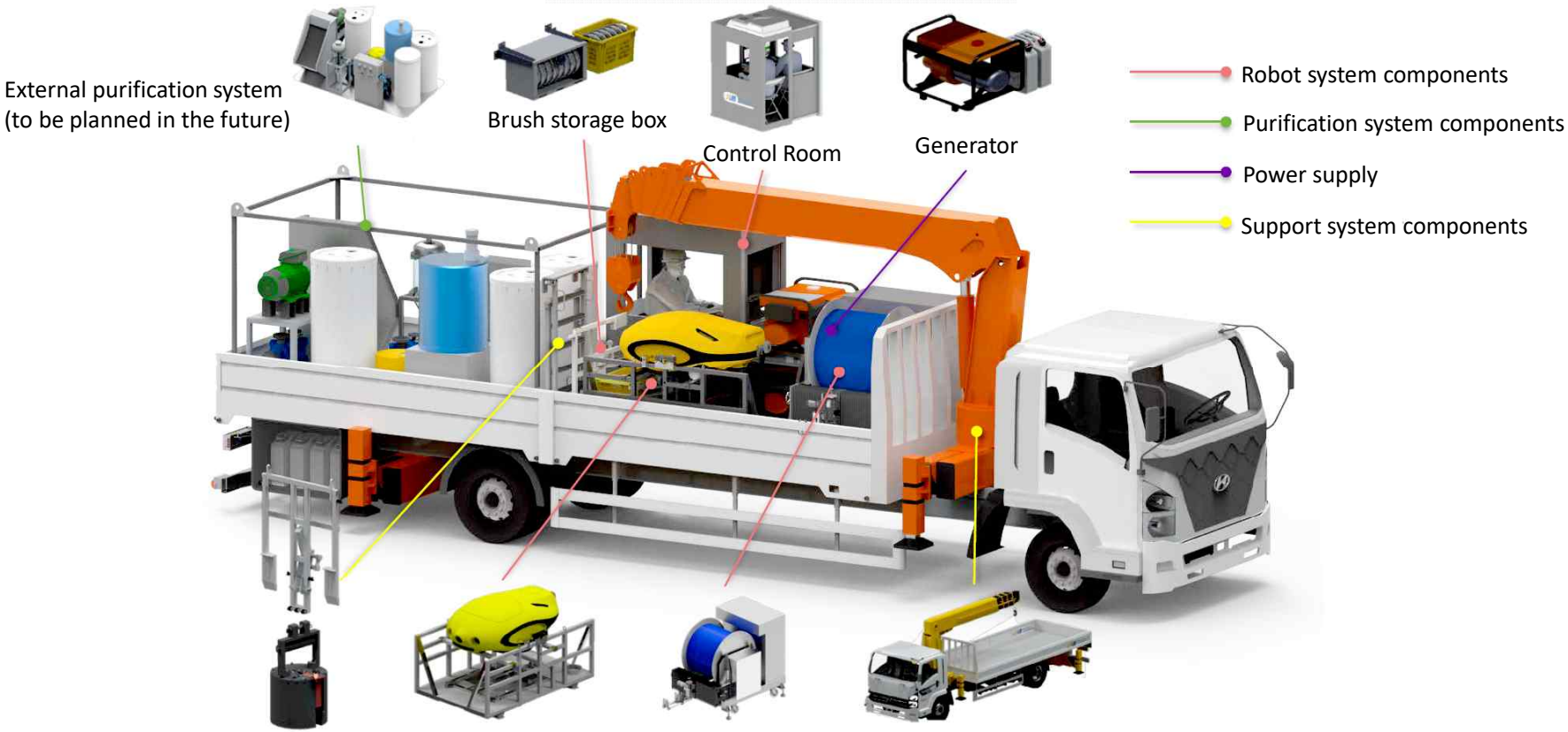
Robot system configuration



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Features of Ship Sweeping Robot

Next-generation eco-friendly ship cleaning system

- Collection of debris generated during hull cleaning
- Filtration through fine filter system
- Land collection and disposal of debris

Reduce working time and improve work convenience

- Robot, power, cable supply, robot-attached equipment all-in-one configuration
- All tasks such as attaching, retrieving and controlling robots can be performed on the truck.
- Reduction of work preparation time and cleanup work time (within 1 hour)

Minimize the Manpower

- Robot movement distance of 200m or more
- Port, starboard, and hull bottoms can be cleaned without moving from the quay wall
- No need for support ships for cleaning work
- Number of workers: 2~3 people

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Robot system features

Enhancement of convenience by controlling the robot in t he way of driving a car

- Robot control using handles, gears, and pedals similar to the driving method of a car
- Independent cockpit equipped with air conditioning and heating facilities

Operator-friendly robot remote control and status monito ring

- Real-time robot cleaning video transmission
- Real-time monitoring of robot movement path and work path
- Real-time work position display possible through the modularization of the hull shape

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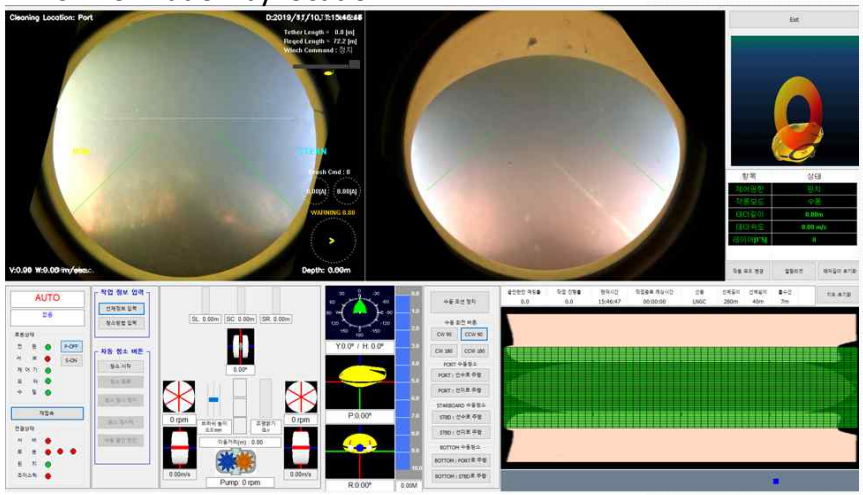
Robot program features

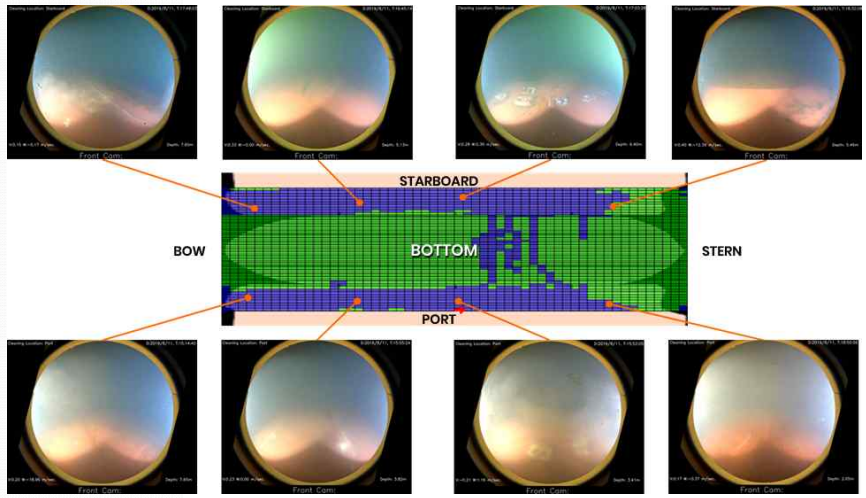
Real-time robot movement path and work position identification

- Real-time identification of robot's movement path and work position
- Storage and management of cleaning images and hull status information by location



Provides cleaning video for each hull location

- Acquisition and storage of cleaning images by hull position
- Provides a report of cleaning results by hull location



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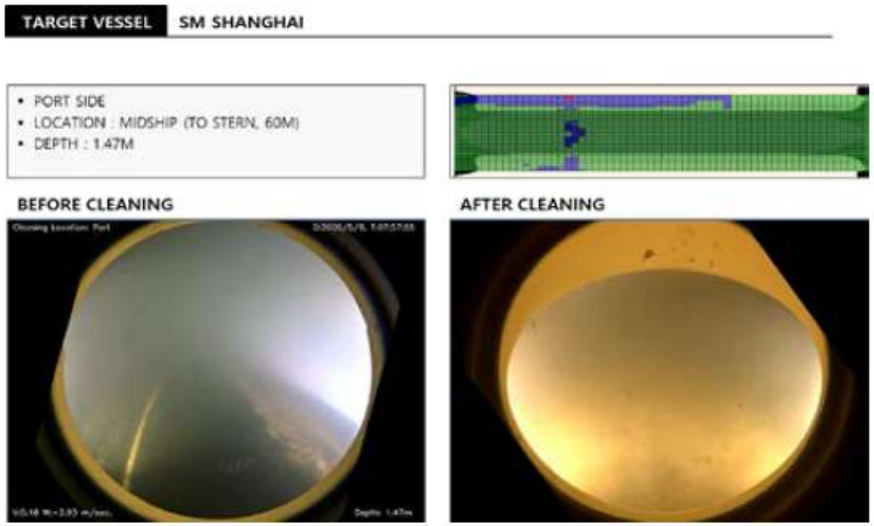
Robot program features

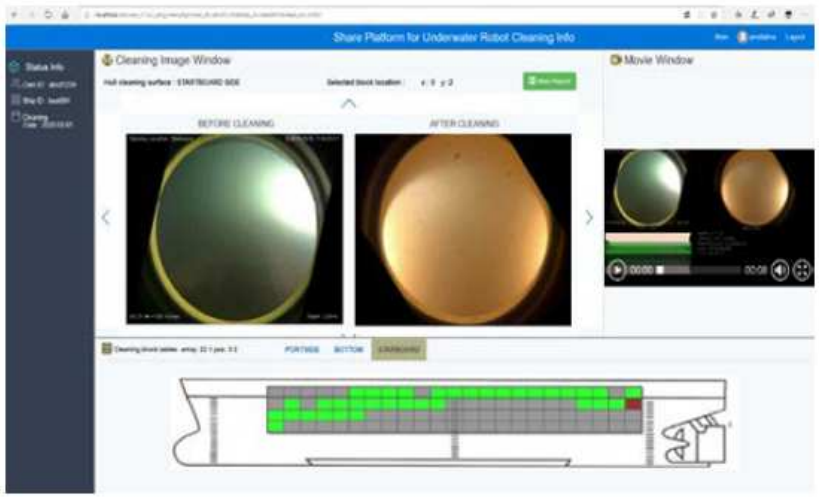
Automatic generation of cleaning result report

- Automatic generation of cleaning result report after work
- Applying hull location and cleaning image processing techn ology



Cloud-based cleaning management platform

- Cleaning video and cleaning progress report management
- Storage and management of cleaning photos and cleaning i mages by ship location
- Cleaning history and hull condition history management



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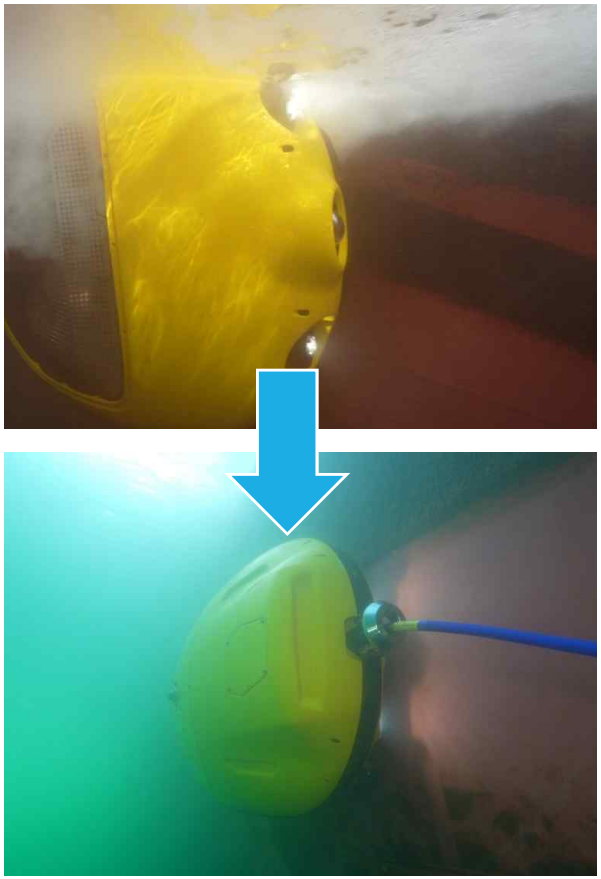
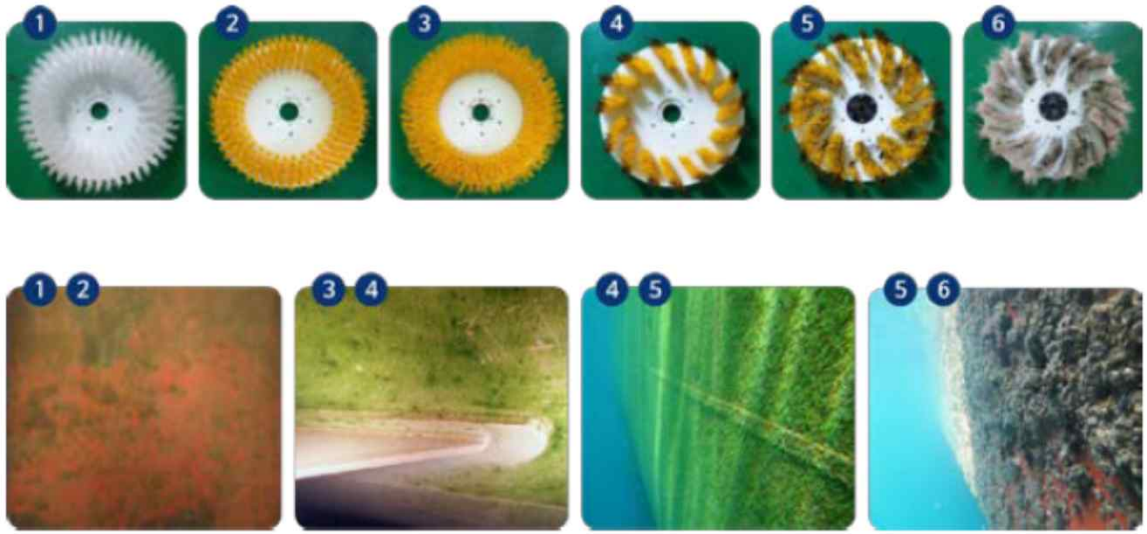
Optimal brush application according to hull fouling condition





- Soft fouling removal brush (4 types)
- Brush for removing hard fouling (2 types)

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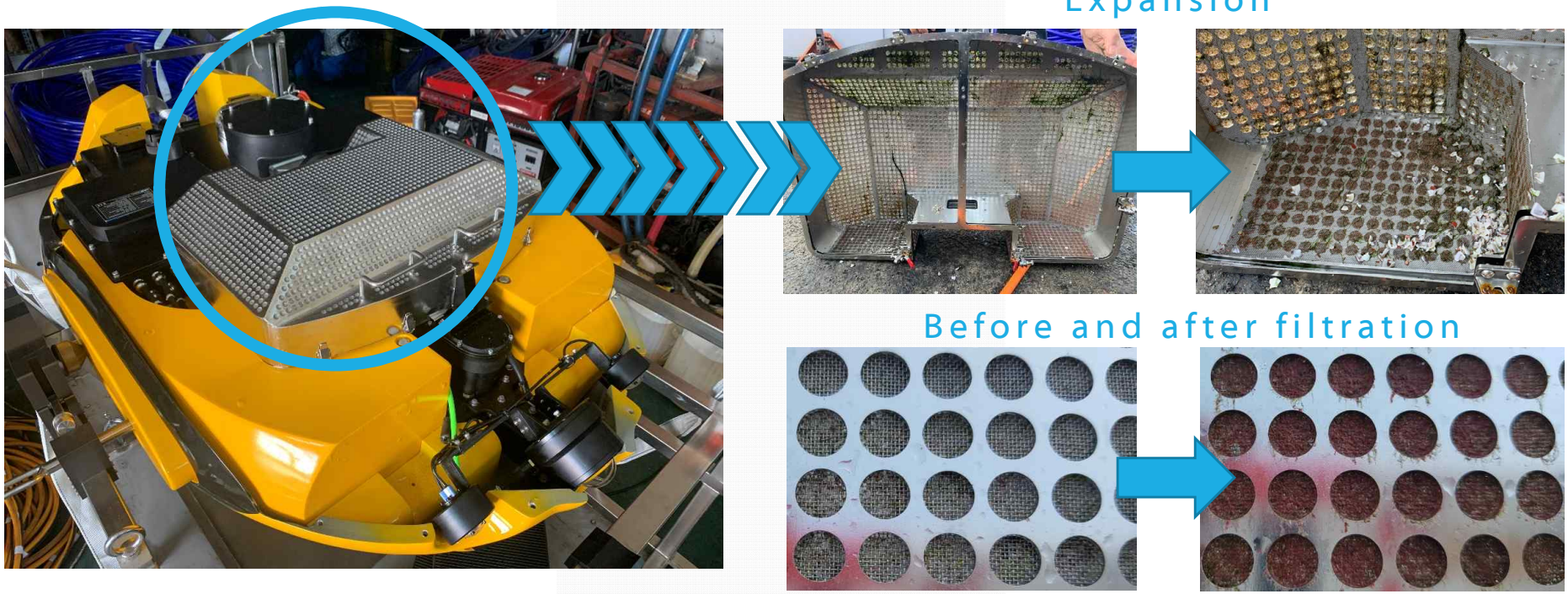
Filter System



- Soft fouling: Apply inner robot filter (reduce installation and preparation time)
- Hard fouling: Waste recovery and purification treatment using external filters (two-stage filter application)

PACIFIC OCEAN
Pacific Ocean Marine Industries Co., Ltd.

ROBOT

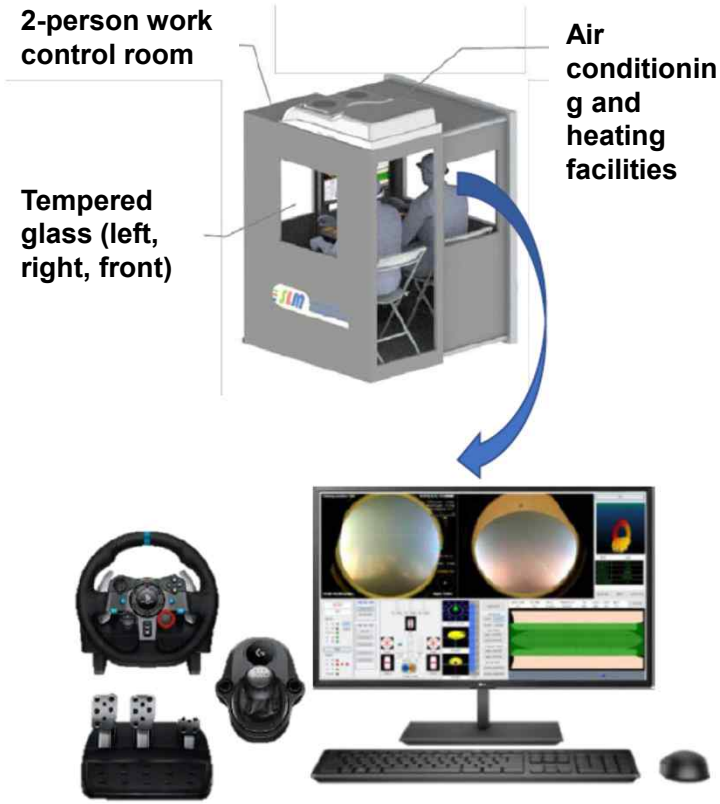
Next-generation eco-friendly ship cleaning robot

SPECIFICATION

ITEMS	SPEC
Size and weight	Size: 1,620 x 950 x 570 [mm]
	Weight: 250 kg (permissible error ±5%)
Waterproof rating	IP68 or higher
Cleaning ability	1,440 m2/hr or more (excluding structures)
Turnabout	180° rotatable in place (360° possible)
Depth of operation	Depth of 20m or more (maximum 35m)
Adjustment mode	Autonomous or manual control possible
Power	3-phase 220V (60Hz)
Sustainable operation time	Can be used for more than 8 hours continuously
Front and rear camera resolution	1080p FHD or higher camera
Recording information storage function	Monitor output video can be saved for more than 24 hours
Front and rear camera lighting	Front lighting: 2 / 2,500 lumen or more
	Rear lighting: 2 / 2,500 lumen or more
Robot position recognition	Real-time robot position grasp when working underwater

PACIFIC OCEAN
Pacific Ocean Marine Industries Co., Ltd.

Operation control unit (control room)



SPECIFICATION

항목	제원
Size and weight	Size: 1,700 x 1,700 x 2,100 [mm]
	27-inch, 1080p FHD
Controller	Steering wheel, gear, pedal
Performance	1,440 m2/hr or more (excluding structures)
Inside the control room	Control Room Provide (2 or more people can work)
	Complete air conditioner installation
	Left/right/front tempered glass installation
	Equipped with transport vehicle
	Cleaning history management, monitoring exclusive S/W included

PACIFIC OCEAN
Pacific Ocean Marine Industries Co., Ltd.

Quality management and new marine technology certification

Certificate of Registration

The Governing Board of
Q.A. International Certification Limited
hereby grants to:

[redacted]
Registration No.: QAIC / KR / 18354 - A

(hereinafter called the Registered Company) the right to be listed in the Directory of Registered Companies in respect of the services listed below. These services shall be offered by the Registered Company at or from only the address given below in accordance with the quality management system in compliance with ***ISO 9001:2015.***

Address to which this Certificate refers:

[redacted]

Approved Scope to which this Certificate refers:

The Manufacture of Ship Cleaning Robot.
(Please note that the above scope represents the certified activity of the named organisation and as such, the organisation may undertake additional activities that are not covered under this certification).

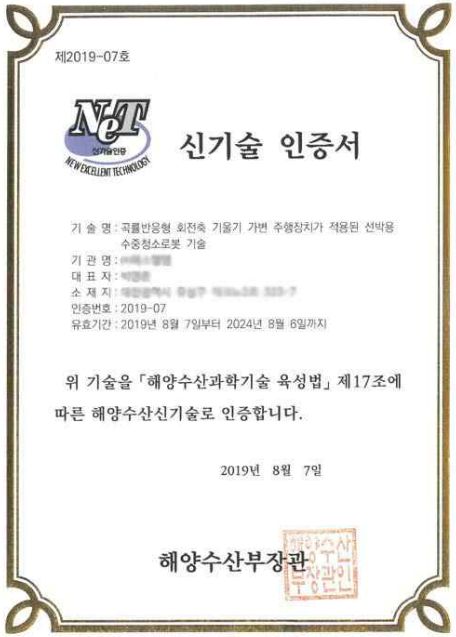
Signed for and on behalf of the Board

CHIEF EXECUTIVE SCHEME MANAGER

Certificate Issue Date: *26th March 2019* - **Certificate Renewal Before**: *25th March 2020*
Date of Initial Registration: *26th March 2019* - **Re-Certification Before**: *25th March 2022*

This Certificate of Registration is granted subject to the Regulations approved by the Board.

QA INTERNATIONAL
Q.A. International Certification Ltd.
Dudley Court
Dudley Road
Darlington
United Kingdom
DL1 4GG



제2019-07호

NET 신기술 인증서

기 술 명 : 곡률반응형 회전축 기술기 가변 주행장치가 적용된 선박용 수중청소로봇 기술
기 관 명 : [redacted]
대 표 자 : [redacted]
소 재 지 : [redacted]
인증번호 : 2019-07
유효기간 : 2019년 8월 7일부터 2024년 8월 6일까지

위 기술을「해양수산과학기술 육성법」제17조에 따른 해양수산신기술로 인증합니다.

2019년 8월 7일

해양수산부장관

PACIFIC OCEAN MARINE INDUSTRIES CO., LTD

PACIFIC OCEAN
Pacific Ocean Marine Industries Co., Ltd.

CE & KC certification

SZUTEST CE

CERTIFICATE OF COMPLIANCE
UYGUNLUK SERTİFİKASI

The technical file and test reports of the following product have been checked and found in compliance with the Parliament and Council Directive 2006/42/EC of 17 May 2006 on the approximation of the laws of the Member States relating to machinery.

Teknik dosya ve test raporları incelenerek, belirtilen ürünün Avrupa Birliği Teknik Komisyonu tarafından 17 Mayıs 2006 tarihinde yayınlanan 2006/42/AT Makina Emniyeti Yönetmeliğine uygunluğu saptanmıştır.

Certificate Number: *Sertifika Numarası*	OSE-20-1214/01
Applicant: *Başvuru Sahibi:*	[illegible]
Manufacturer: *Üretici*	[illegible]
Product: *Ürün:*	UNDER WATER HULL CLEANING ROBOT SYSTEM (CHIRO)
Type: *Model:*	[illegible]
Base of attestation: *Onay Dayanağı:*	File of technical documentation, test report Ref. No. **SK 81 205082** *Teknik Dokümantasyon SK SK 81 205082 numaralı Test Raporu*
Validity: *Geçerlilik*	11.12.2020-10.12.2023

* This Certificate of compliance is issued on a voluntary basis according to Council Directive Parliament and Council Directive 2006/42/EC of 17 May 2006 on the approximation of the laws of the Member States relating to machinery.It comforms that listed equipment/machinery (Not AnnexIV equipment/machinery) complies essential health and safety requirements of the directive.The referred technical file(s) is reviewed and attested with presumption of compliance with the essential requirements listed EU Directive(s) above. This attestation does not abrogate the compulsory obligation of the manufacturer to issue the declaration of conformity

**Bu uygunluk sertifikası 17 Mayıs 2006 tarihinde yayınlanan 2006/42/AT Makina Emniyeti Yönetmeliğine göre isteğe bağlı düzenlenmiştir. Yukarıda listelenmiş ekipman/makinaların ilgili yönetmeliğin temel gerekliliklerine uygun olduğunun onaylar.Diğer ilgili direktiflere uyulmalıdır. Bu onay üreticinin uygunluk beyanı düzenleme zorunluluğunu ortadan kaldırmaz. Referans teknik dosya ile ürünün(EKIV Kapsamında olmayan) yukarıda belirtilen AT Direktiflerinin temel gereklerine uygunluğu kabul edilir.*

Dept. Manager
Şeyda IŞLI
SZUTEST

SZUTEST UYGUNLUK DEĞERLENDİRME A.Ş.
Tatlısu Mahallesi, Akif İnan Sk. No:1 Ümraniye 34774 İSTANBUL / TÜRKİYE
Szutest.com.tr

D184-33DC-1872-A215

방송통신기자재등의 적합등록 필증
Registration of Broadcasting and Communication Equipments

상호 또는 성명 Trade Name or Registrant	[illegible]
기자재명칭(제품명칭) Equipment Name	UNDER WATER HULL CLEANING ROBOT SYSTEM (CHIRO)
기기부호/추가 기기부호 Equipment code /Additional Equipment code	IND
기본모델명 Basic Model Number	[illegible]
파생모델명 Series Model Number	
등록번호 Registration No.	R-R-UHR-SLM-HCR-M1
제조자/제조국가 Manufacturer/Country of Origin	[illegible]
등록연월일 Date of Registration	2021-01-05
기타 Others	

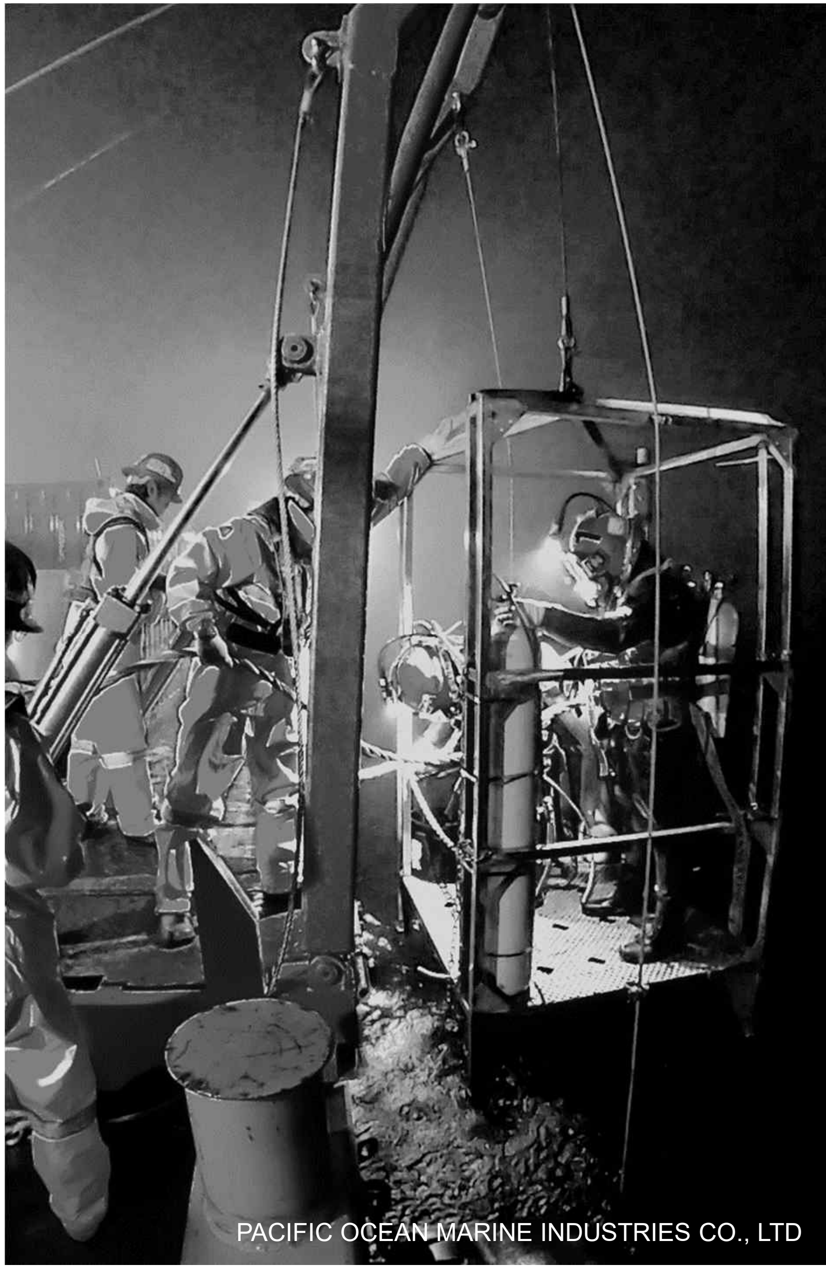
위 기자재는 「전파법」 제58조의2 제3항에 따라 등록되었음을 증명합니다.
It is verified that foregoing equipment has been registered under the Clause 3, Article 58-2 of Radio Waves Act.

2021년(Year) 01월(Month) 05일(Day)

국립전파연구원장 국립전파연구원장인

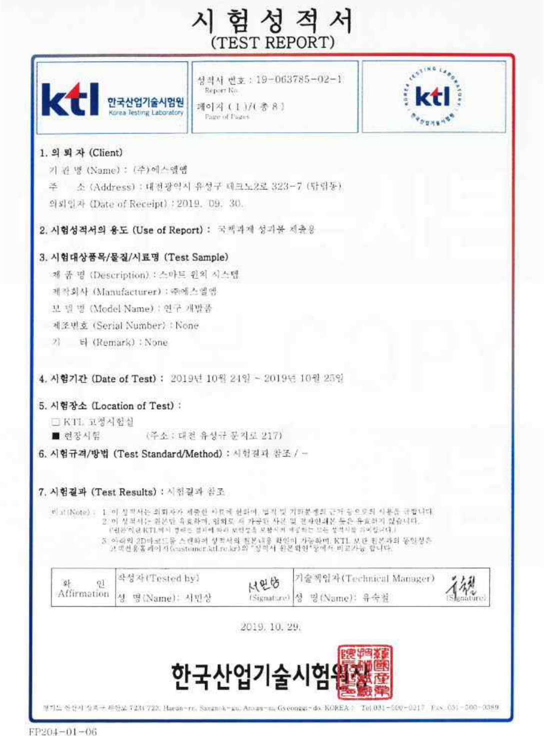
Director General of National Radio Research Agency

※ 적합등록 방송통신기자재는 반드시 "적합성평가표시" 를 부착하여 유통하여야 합니다.
위반시 과태료 처분 및 등록이 취소될 수 있습니다.



PACIFIC OCEAN
Pacific Ocean Marine Industries Co., Ltd.

Authorized agency test certification: KTL (Korea Testing and Technology Testing Institute)



시 험 성 적 서
(TEST REPORT)

ktl 한국산업기술시험원 Korea Testing Laboratory

성적서 번호 : 19-063785-02-1 (Report No.)
페이지 (1)/(총 8) (Page of Pages)

1. 의 뢰 자 (Client)
기 관 명 (Name) : (주)에스엠엠
주 소 (Address) : 대전광역시 유성구 테크노2로 323-7 (탑립동)
의뢰일자 (Date of Receipt) : 2019. 09. 30.

2. 시험성적서의 용도 (Use of Report) : 국책과제 성과물 제출용

3. 시험대상품목/물질/시료명 (Test Sample)
제 품 명 (Description) : 스마트 윈치 시스템
제작회사 (Manufacturer) : ㈜에스엠엠
모 델 명 (Model Name) : 연구 개발품
제조번호 (Serial Number) : None
기 타 (Remark) : None

4. 시험기간 (Date of Test) : 2019년 10월 21일 ~ 2019년 10월 25일

5. 시험장소 (Location of Test) :
☐ KTL 고정시험실
■ 현장시험 (주소 : 대전 유성구 문지로 217)

6. 시험규격/방법 (Test Standard/Method) : 시험결과 참조 / -

7. 시험결과 (Test Results) : 시험결과 참조

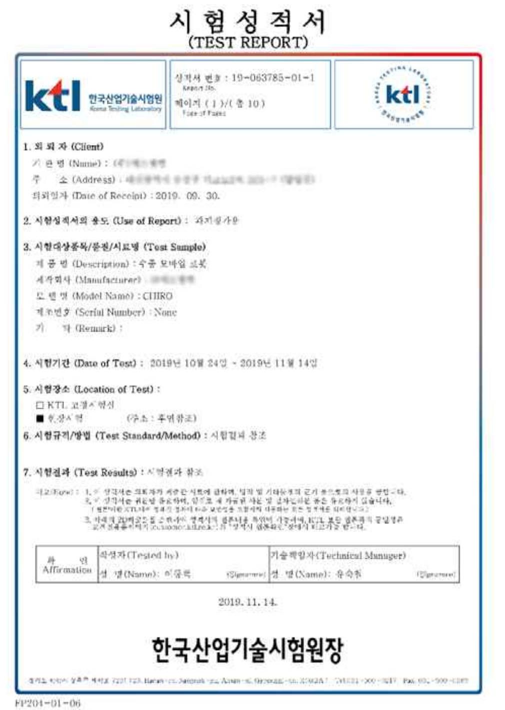
비고(Note) : [illegible]

확 인 Affirmation	작성자(Tested by) 성 명(Name): 서민상 (Signature)	기술책임자(Technical Manager) 성 명(Name): 유숙철 (Signature)

2019. 10. 29.

한국산업기술시험원장

FP204-01-06



시 험 성 적 서
(TEST REPORT)

ktl 한국산업기술시험원 Korea Testing Laboratory

성적서 번호 : 19-063785-01-1 (Report No.)
페이지 (1)/(총 10) (Page of Pages)

1. 의 뢰 자 (Client)
기 관 명 (Name) : [illegible]
주 소 (Address) : [illegible]
의뢰일자 (Date of Receipt) : 2019. 09. 30.

2. 시험성적서의 용도 (Use of Report) : 과제평가용

3. 시험대상품목/물질/시료명 (Test Sample)
제 품 명 (Description) : 수중 모바일 로봇
제작회사 (Manufacturer) : [illegible]
모 델 명 (Model Name) : CHIRO
제조번호 (Serial Number) : None
기 타 (Remark) :

4. 시험기간 (Date of Test) : 2019년 10월 24일 ~ 2019년 11월 14일

5. 시험장소 (Location of Test) :
☐ KTL 고정시험실
■ 현장시험 (주소 : 후면참조)

6. 시험규격/방법 (Test Standard/Method) : 시험결과 참조

7. 시험결과 (Test Results) : 시험결과 참조

비고(Note) : [illegible]

확 인 Affirmation	작성자(Tested by) 성 명(Name): 이중록 (Signature)	기술책임자(Technical Manager) 성 명(Name): 유숙철 (Signature)

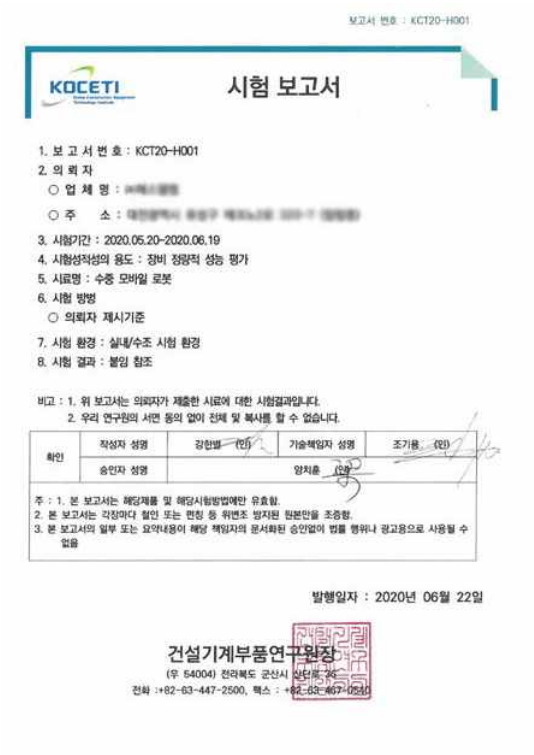
2019. 11. 14.

한국산업기술시험원장

FP204-01-06

PACIFIC OCEAN
Pacific Ocean Marine Industries Co., Ltd.

Authorized agency test certification: KOCETI (Construction Equipment Research Institute), KSEL (Korea IT Evaluation Institute)



보고서 번호 : KCT20-H001

KOCETI

시험 보고서

1. 보 고 서 번 호 : KCT20-H001
2. 의 뢰 자
   ○ 업 체 명 :
   ○ 주 소 :
3. 시험기간 : 2020.05.20-2020.06.19
4. 시험성적성의 용도 : 장비 정량적 성능 평가
5. 시료명 : 수중 모바일 로봇
6. 시험 방법
   ○ 의뢰자 제시기준
7. 시험 환경 : 실내/수조 시험 환경
8. 시험 결과 : 붙임 참조

비고 : 1. 위 보고서는 의뢰자가 제출한 시료에 대한 시험결과입니다.
2. 우리 연구원의 서면 동의 없이 전체 및 복사를 할 수 없습니다.

확인	작성자 성명	강한범 (인)	기술책임자 성명	조기용 (인)
	승인자 성명	양치훈 (인)		

주 : 1. 본 보고서는 해당제품 및 해당시험법에만 유효함.
2. 본 보고서는 각장마다 철인 또는 펀칭 등 위변조 방지된 원본만을 조증함.
3. 본 보고서의 일부 또는 요약내용이 해당 책임자의 문서화된 승인없이 법률 행위나 광고용으로 사용될 수 없음

발행일자 : 2020년 06월 22일

건설기계부품연구원장
(우 54004) 전라북도 군산시
전화 :+82-63-447-2500, 팩스 : +82-63-467-0520

시험성적서

KSEL 한국아이티평가원

성적서 번호	시험 유형
KSEL-PT-R-2020-011 (페이지 1/12)	KSEL Tested

1. 신청기관
   - 기 관 명 :
   - 주 소 :
   - 신청일자 : 2020년 5월 25일
2. 시험성적서의 용도 : 정부과제 제출용
3. 시험대상 : 선제관리서비스 플랫폼 (V.1.0)
4. 시험기간 : 2020년 6월 11일 ~ 2020년 6월 22일
5. 시험방법 : 신청기관이 제시한 시험기준 및 절차에 따라 시험
6. 시험결과 : 시험결과 및 시험결과보고서(KSEL-PT-R-2020-011-TR01) 참조

확 인	시험자 성명 : 이 효 반	기술책임자 성명 : 윤 여 종

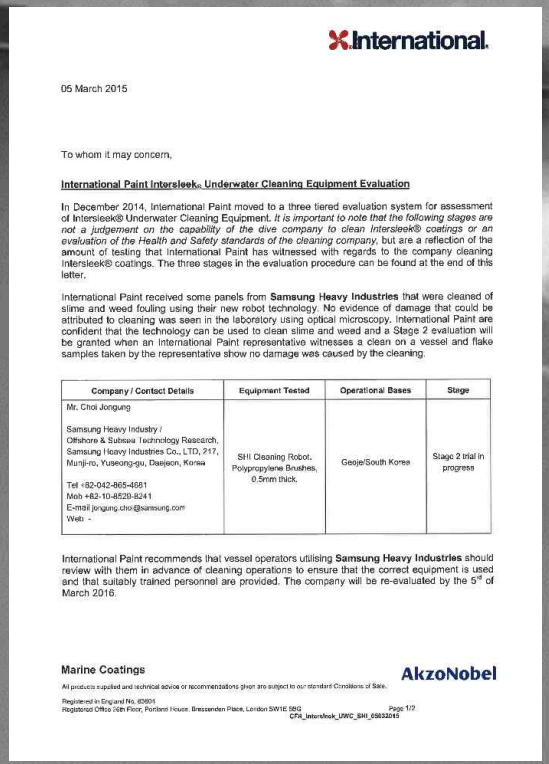
2020년 6월 26일

주식회사 한국아이티평가원 대표이사

PACIFIC OCEAN MARINE INDUSTRIES CO., LTD

PACIFIC OCEAN
Pacific Ocean Marine Industries Co., Ltd.

Painter Certification: AkzoNobel, Jotun, PPG SSC



International

05 March 2015

To whom it may concern,

International Paint Intersleek® Underwater Cleaning Equipment Evaluation

In December 2014, International Paint moved to a three tiered evaluation system for assessment of Intersleek® Underwater Cleaning Equipment. *It is important to note that the following stages are not a judgement on the capability of the dive company to clean Intersleek® coatings or an evaluation of the Health and Safety standards of the cleaning company*, but are a reflection of the amount of testing that International Paint has witnessed with regards to the company cleaning Intersleek® coatings. The three stages in the evaluation procedure can be found at the end of this letter.

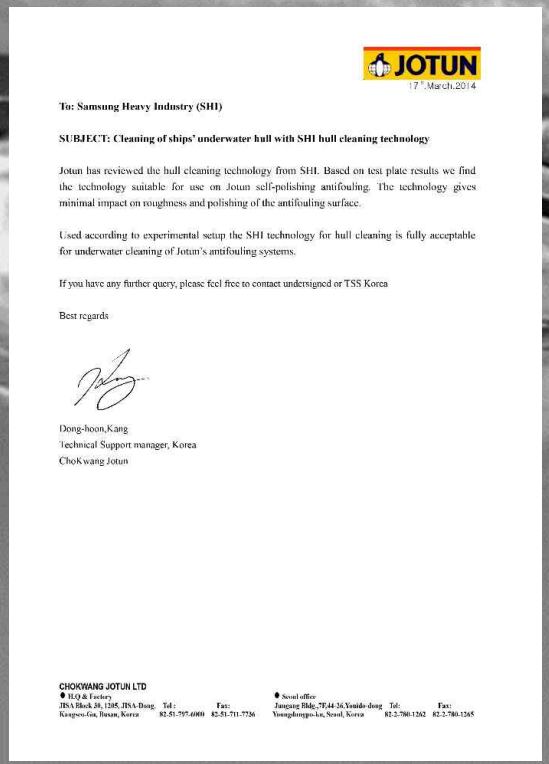
International Paint received some panels from **Samsung Heavy Industries** that were cleansed of slime and weed fouling using their new robot technology. No evidence of damage that could be attributed to cleaning was seen in the laboratory using optical microscopy. International Paint are confident that the technology can be used to clean slime and weed and a Stage 2 evaluation will be granted when an International Paint representative witnesses a clean on a vessel and flake samples taken by the representative show no damage was caused by the cleaning.

Company / Contact Details	Equipment Tested	Operational Bases	Stage
Mr. Choi Jongung Samsung Heavy Industry / Offshore & Subsea Technology Research, Samsung Heavy Industries Co., LTD, 217, Munji-ro, Yuseong-gu, Daejeon, Korea Tel +82-042-865-4681 Mob +82-10-8520-8241 E-mail jongung.choi@samsung.com Web -	SHI Cleaning Robot. Polypropylene Brushes, 0.5mm thick.	Geoje/South Korea	Stage 2 trial in progress

International Paint recommends that vessel operators utilising **Samsung Heavy Industries** should review with them in advance of cleaning operations to ensure that the correct equipment is used and that suitably trained personnel are provided. The company will be re-evaluated by the 5th of March 2016.

Marine Coatings

AkzoNobel



JOTUN

17th March 2014

To: Samsung Heavy Industry (SHI)

SUBJECT: Cleaning of ships' underwater hull with SHI hull cleaning technology

Jotun has reviewed the hull cleaning technology from SHI. Based on test plate results we find the technology suitable for use on Jotun self-polishing antifouling. The technology gives minimal impact on roughness and polishing of the antifouling surface.

Used according to experimental setup the SHI technology for hull cleaning is fully acceptable for underwater cleaning of Jotun's antifouling systems.

If you have any further query, please feel free to contact undersigned or TSS Korea

Best regards

Dong-hoon, Kang
Technical Support manager, Korea
ChoKwang Jotun

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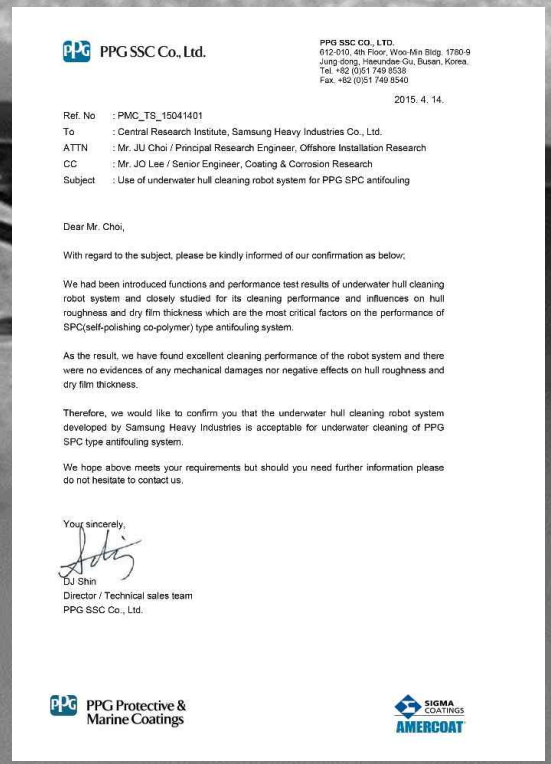
Jungang Bldg.,7F,44-36,Yeoido dong, Youngdeungpo-ku, Seoul, Korea Tel: 82-2-780-1262 Fax: 82-2-780-1265



PPG SSC Co., Ltd.

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Fax. +82 (0)51 749 8540

2015. 4. 14.

Ref. No : PMC_TS_15041401
To : Central Research Institute, Samsung Heavy Industries Co., Ltd.
ATTN : Mr. JU Choi / Principal Research Engineer, Offshore Installation Research
CC : Mr. JO Lee / Senior Engineer, Coating & Corrosion Research
Subject : Use of underwater hull cleaning robot system for PPG SPC antifouling

Dear Mr. Choi,

With regard to the subject, please be kindly informed of our confirmation as below;

We had been introduced functions and performance test results of underwater hull cleaning robot system and closely studied for its cleaning performance and influences on hull roughness and dry film thickness which are the most critical factors on the performance of SPC(self-polishing co-polymer) type antifouling system.

As the result, we have found excellent cleaning performance of the robot system and there were no evidences of any mechanical damages nor negative effects on hull roughness and dry film thickness.

Therefore, we would like to confirm you that the underwater hull cleaning robot system developed by Samsung Heavy Industries is acceptable for underwater cleaning of PPG SPC type antifouling system.

We hope above meets your requirements but should you need further information please do not hesitate to contact us.

Your sincerely,

DJ Shin
Director / Technical sales team
PPG SSC Co., Ltd.

PPG Protective & Marine Coatings

SIGMA COATINGS
AMERCOAT

PACIFIC OCEAN

Thanks a lot

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