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SOLUTIONS

Advancements in Capture and Treatment Technology for In-water Hull Cleaning

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Service Locations

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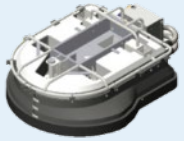
Environmentally Compliant Underwater Ship Maintenance

Pioneer of an Integrative Process in a Largely Undefined Market

Develop Innovative and Proprietary Technology



Understand Environmental Regulations & Strategically Choose Locations

Train Staff to Master Industry Requirements and Apply Value

Utilize Global Network with In-House Technology

Offer Planned and Managed Maintenance for Clients

Proprietary Equipment & Technology

Subsea has invested significant capital into research for its environmentally friendly hull cleaning and propeller polishing service offerings: Beluga, Remora, C-ROV cleaning systems and Whale Shark & EnviroHull treatment systems.

- ✓ Only company managing the strictest particulate and soluble metal requirements in the world
- ✓ Able to combine environmentally compliant hull maintenance with underwater vessel repair globally
- ✓ Both filtration systems can utilize the same brush cart and propeller polisher

Transport Canada In-Water Cleaning Technology Demonstration

Equipment & Process

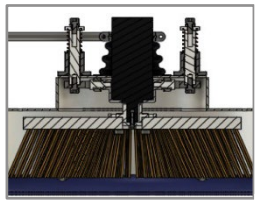
- ❑ Subsea Global Solutions Environmental Solutions shall test three (3) different underwater vehicles equipment with In-water Capture systems.
- ❑ All three (3) underwater vehicles shall be tested with the ***Whale Shark*** water filtration and processing system filtering particulates (organic and in organic) to one (1) micron and substantially removing ***soluble metals***.
- ❑ In-water Cleaning With Capture (IWCC) efficiency as well as ecological water impacts shall be tested.

Remora

- ✓ Diver driven cleaning vehicle
- ✓ In-Water Cleaning with Capture capable to clean all types of coatings with all degrees of biofouling

C-ROV

- ✓ Cleaning Remote Operated Vehicle
- ✓ In-Water Cleaning with Capture capable to clean all types of coatings with all degrees of biofouling



Beluga

- ✓ Diver operated Niche Cleaning and Propeller polishing
- ✓ In-Water Cleaning with Capture capable to clean all types of coatings with all degrees of biofouling

Local Regulatory Checklist

The following information determines environmentally compliant underwater maintenance feasibility

Vessel Type	✓
Vessel Trade Route	✓
Applied Coating/Paint	✓
Local Environmental Regulations	✓
Marine Biological Growth	✓
Underwater Maintenance & Record Evaluation	✓

Transport Canada In-Water Cleaning Technology Demonstration

Demonstration Requirements

Specific testing milestones must be met to meet demonstration requirements.

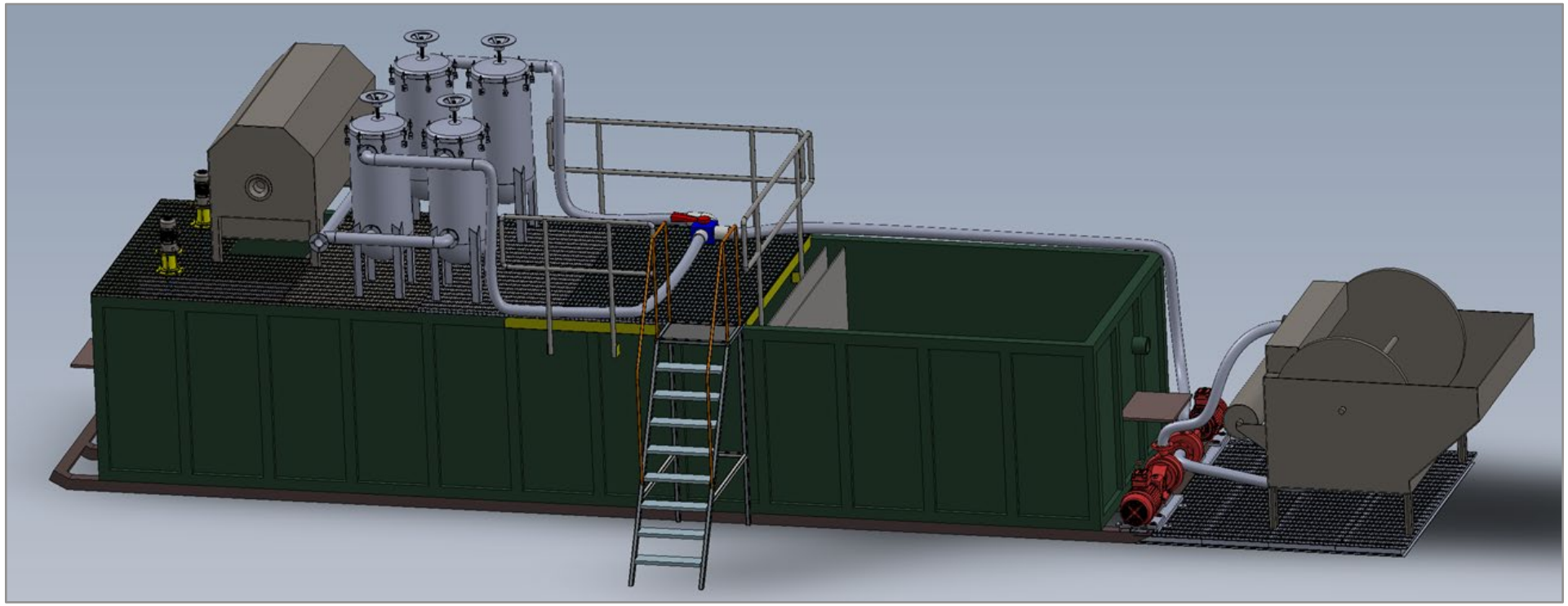
Close coordination between Transport Canada and Subsea Global Solutions necessary.

Vessel Selection	✓
Pre-Cleaning Activities	✓
Demo / Water Sampling	✓
Post-Cleaning Activities	✓
Data Management	✓
Reporting	✓

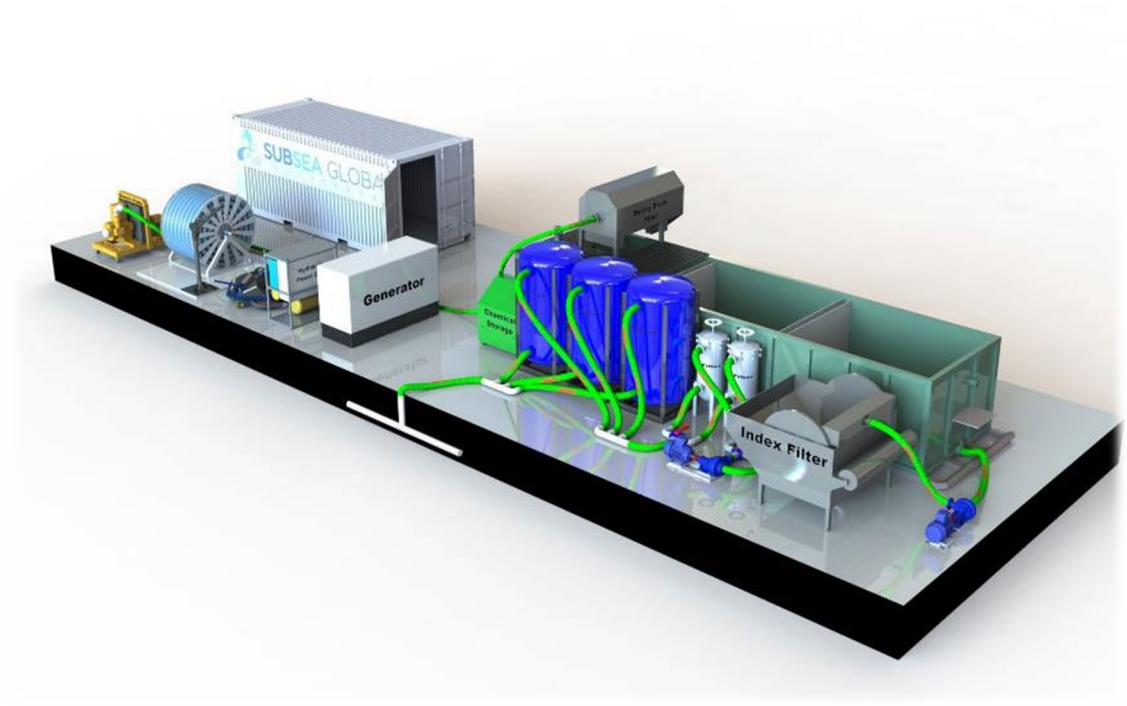
Transport Canada In-Water Cleaning Technology Demonstration

Demonstration to be completed within 2-years.

- First testing was completed in the Fall of 2024, testing is planned to resume and finish next month
- Initial testing identified areas for improvement for the cleaning tool and treatment system, as well as some challenges associated with the testing protocols



Introducing Whale Shark



Why did we introduce the Whaleshark system

To provide Hull Cleaning solutions in locations where the filtering of particulate matter AND the treatment of soluble metals was required to meet local environmental regulations

- ✓ in locations where “hull cleaning" is restricted,
- ✓ to provide greater location flexibility for vessel efficiency and compliance,
- ✓ Allows Hull Cleaning even on heavily fouled vessels with combined environmental safeguards.

Working principles: Whale Shark

Reclaiming material

A surface mounted pump, with its suction hose mounted to the machine, reclaims the removed material from to the surface.

Reclaim to surface

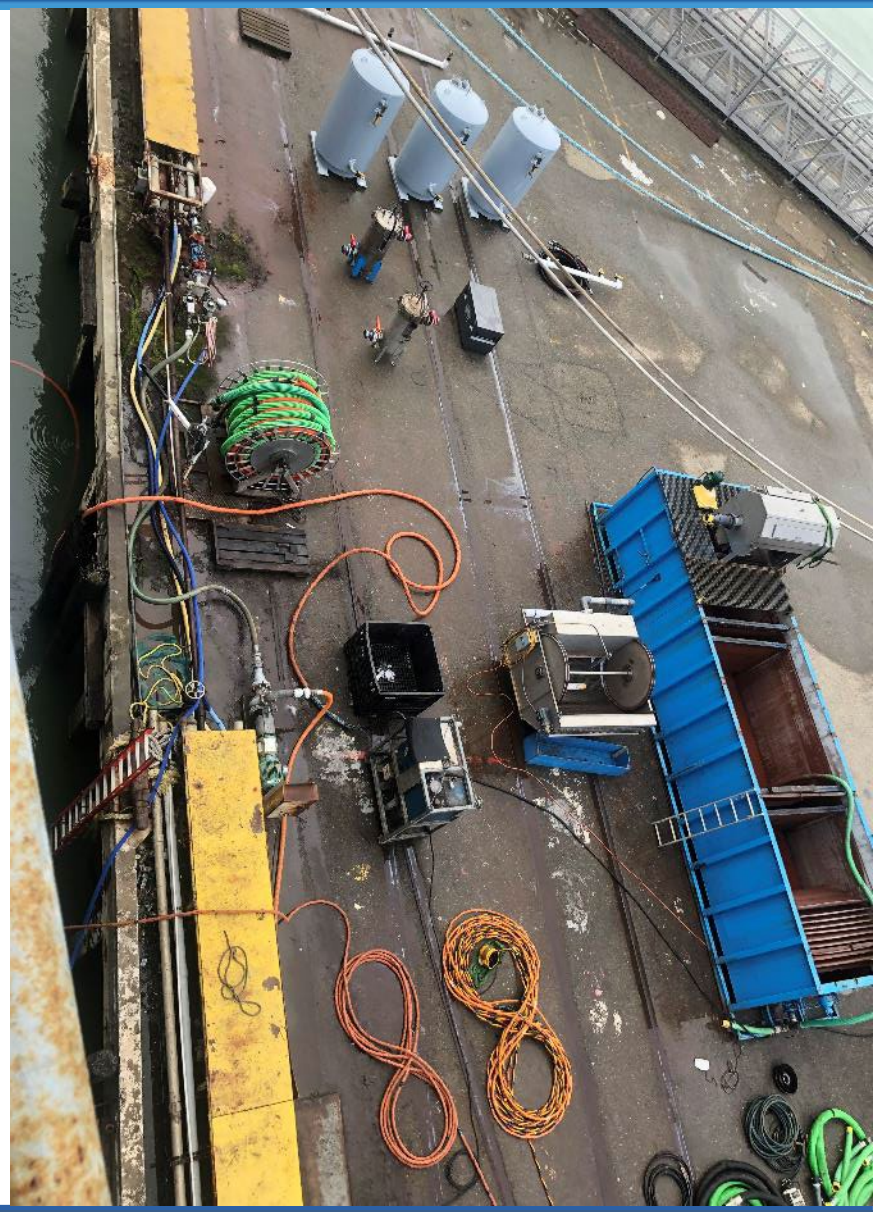
Greater than 97%* reclaim efficiency of released materials vacuumed to surface.

Staged Filtration and Water treatment

The reclaimed wastewater mixture with debris is processed in the 3-stage filter unit and through a water treatment process to eliminate both particulate matter and soluble metals.

Return to Sea

With all materials greater than **1 micron (1 µm)** removed, the filtered and polished water is returned to the sea.



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Rijkswaterstaat Approved Filtration System

Staged Filtration

The reclaimed wastewater mixture with debris is processed with a multi-stage filter unit to eliminate particulate matter to **1 micron (1 µm)**.

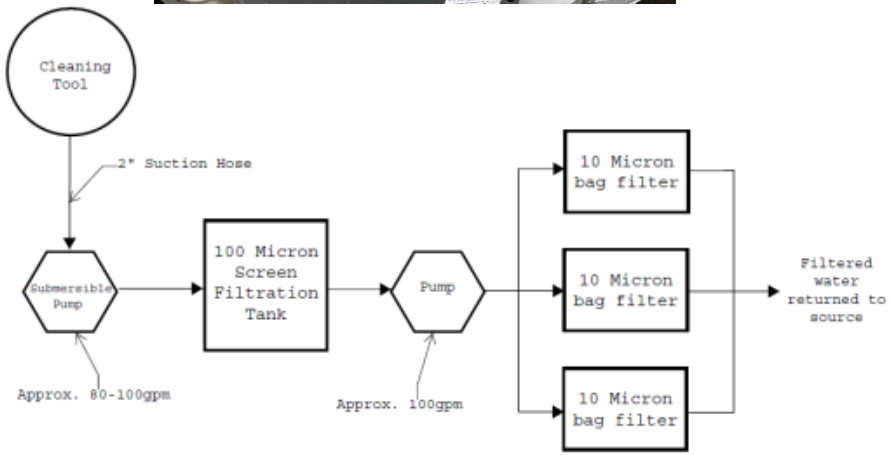
Disinfection

The filtered water is passed through a UV filter to kill any remaining organisms.

Pending Advancements

Addition of soluble metal treatment

Beluga Treatment System



- Designed to manage the filtration of particulates (invasive species and particulate matter to 5 microns as required)
- Adaptable tools that are interchangeable for use with Beluga reclaim pump and filtration.

Remora technical outline

- The first Remora prototype was built in 2015.
- Original concept was to build a machine for use on normal trade fouling on merchant ships and recover the spoils to the surface for surface treatment.
- The design of the Remora considers a variety and types of marine growth and thickness.
- Built out of anodized marine grade aluminum and composite materials.
- Simple hydraulic / mechanical suspension system was chosen specifically designed around fouling release type coatings giving the Remora the ability of hovering.
- Single hydro mechanical adjustment point allows for the perfect balance between the brush pressure and drive wheel contact against the hull.
- Speed is controlled manually by operator during operations

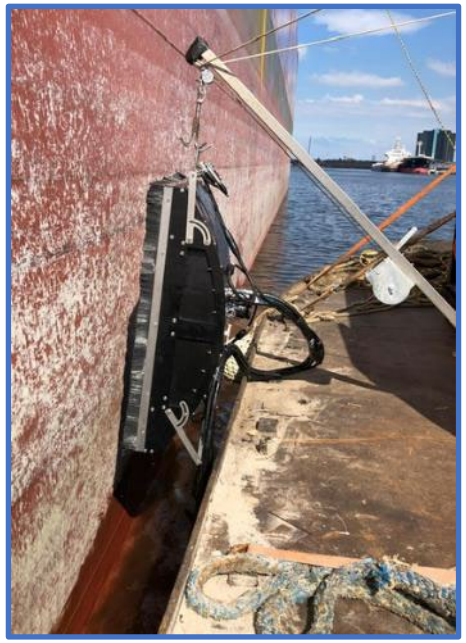
Notes: The level of biofouling, and current or swell can influence actual speed of cleaning operations.

Introducing the Cleaning ROV (C-ROV)

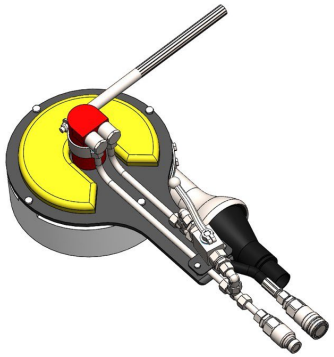
Why did we introduce the Cleaning-ROV

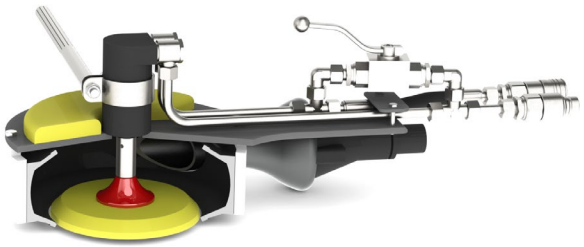
The **C**leaning - **R**emote **O**perated **V**ehicle (**C-ROV**) expands our hull cleaning global footprint by allowing hull cleaning services

- ✓ in locations where "manned" diving is restricted,
- ✓ to be provided at greater depths, with no time restrictions - including night operation,
- ✓ and allows diver-less hull cleaning operations to take place in environmentally sensitive locations that require spoils reclaim



“BELUGA” Propeller Polishing and Niche area cleaning system





The Beluga is a diver operated reclaim-capable tool for niche area cleaning and propellor polishing.

- **Single diver operation**
- **Can use polishing disks or cleaning brushes of varying stiffness**

Biofouling: Hull surface factors

Types of fouling and paints

The C-ROV and Remora have different brushes available for different coatings, and different degrees of fouling. The units can clean all degrees of fouling with up to 100% Macrofouling coverage.

Fouling capacity

- ✓ Microalgae (diatoms)
- ✓ Micro fouling (biofilms)
- ✓ Slime (mature biofilm)
- ✓ Macro fouling
- ✓ Monster Barnacles*

Paint types

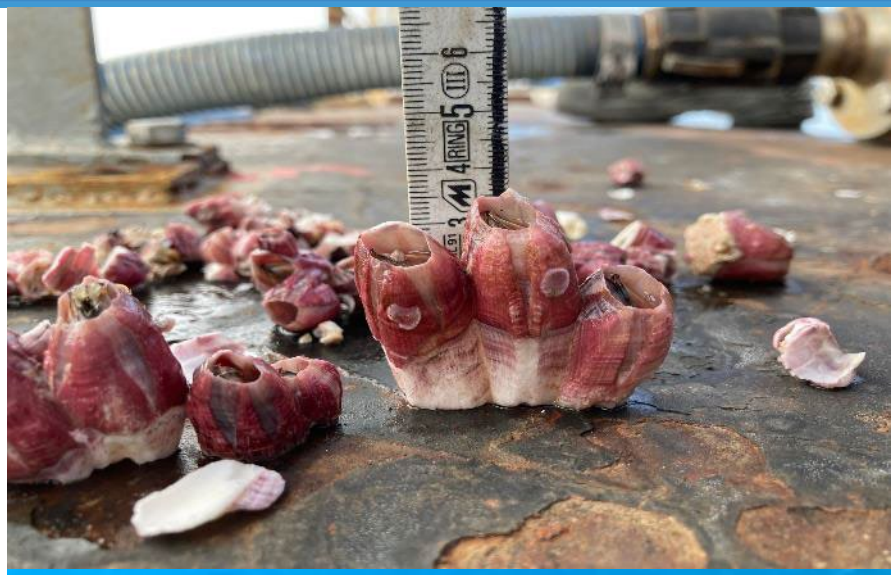
- ✓ Hard Coatings
- ✓ SPC Coatings
- ✓ FRC Coatings

Brushes

- ✓ Nylon
- ✓ Plastic POM-C
- ✓ Steel

Capable of removing:

- ✓ Microfouling- IMO Ratings 0-1
- ✓ Macrofouling- IMO Ratings 2-4
- ✓ Safe / OEM test process



Operators

Equipment Operators

- All Subsea Global Solutions personnel are responsible for pollution prevention, not just on hull cleaning operations,
- Personnel who undertake in-water cleaning are aware of regulations and requirements for the conduct of in-water cleaning, including regulations regarding the discharge of chemicals into the marine environment and the location of sensitive areas (such as marine protected areas).
- Dive teams and ROV operators are trained to perform cleaning operations and are familiar with the relevant clause for Underwater Ship Husbandry and Hull Fouling Discharges of the VGP (Clause 2.2.23 Underwater Ship Husbandry and Hull Fouling Discharges, VGP) and IMO Biofouling Guidelines.

Training of personnel includes:

- Instructions on the application of biofouling management and treatment procedures.
- Maintenance of appropriate records and logs.
- Impacts of invasive aquatic species from ships' biofouling.
- Benefits to the ship of managing biofouling and the threats posed by not applying management procedures.
- Biofouling management measures and associated safety procedures.
- Relevant health and safety issues.

Notes: The level of biofouling, and current or swell can influence actual speed of cleaning operations.

Ongoing Industry Advancements

Class Certification Efforts

- Lloyds' Register has started an Enhanced Coating Type Approval process for coating manufacturers
- The Type Approval can include approval of cleaning technologies at a non-proprietary level, allowing cleaning companies to implement solutions without requiring significant testing
- LR is starting a certification process for cleaning technologies
- DNV is working on their own biofouling management program, as others may be as well

Coating Company Efforts

- Coating companies are increasing their engagement with cleaning service providers to identify optimal solutions.
- Some companies are identifying "approved" or "preferred" cleaning technologies and/or vendors (either independently or through an organization like LR)
- More non-biocidal coatings are appearing on the market, however cost remains a significant factor in uptake of these solutions.

Notes: The level of biofouling, and current or swell can influence actual speed of cleaning operations.

Cleaning Industry Status

- Most cleanings worldwide are STILL being conducted by divers using traditional aggressive cleaning solutions with no reclaim
- The forward-leaning companies understand that **coating preservation** is a significant factor for shipowners and coating companies – not just biofouling removal
- Advancement is often coming from outside the dive industry (not exclusively though)
- The robots are coming!!!
  - In-transit solutions for proactive cleaning
  - Multi-robot cleanings pier side or at anchor
  - Niche Cleaning capabilities
  - Decision making at the machine level

Notes: The level of biofouling, and current or swell can influence actual speed of cleaning operations.

Thank you for your attention.

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For questions?

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