Hyde GUARDIAN®
Ballast Water Treatment System

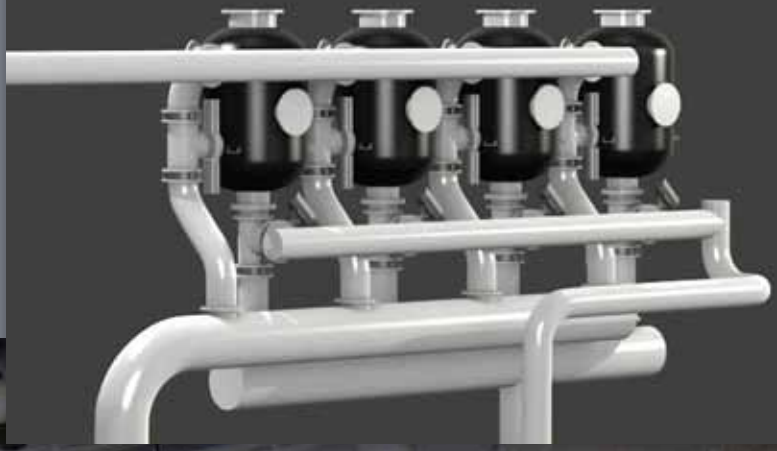
Lloyd's Register TYPE APPROVAL

THE TYPE APPROVED SOLUTION

The Hyde GUARDIAN® Ballast Water Treatment System is the simple and cost effective solution which exceeds international ballast water discharge requirements. Lloyd's Register and MCA Type Approval, April 2009.

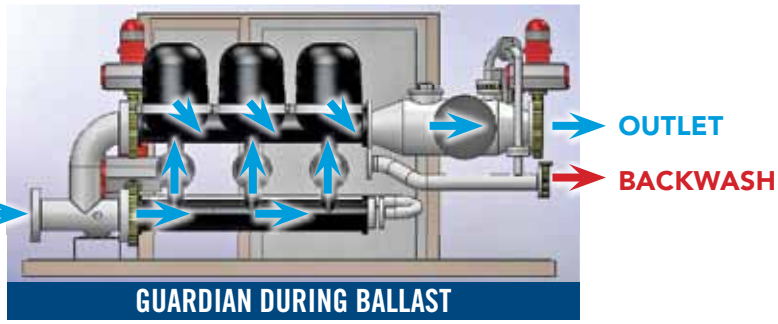
The GUARDIAN features a two-stage process; an efficient depth filter to remove sediment and larger organisms, and a powerful UV disinfection unit to kill or inactivate smaller plankton, bacteria and other pathogens.

New SUPERFLOW Filter for high ballast flow rates

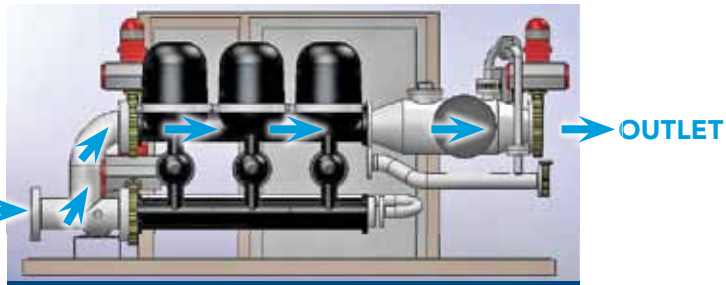


In designing the GUARDIAN system, Hyde selected the most robust and reliable components available. Our filter and UV technology has been proven in thousands of challenging water and wastewater treatment applications, ensuring the highest performance for this essential shipboard operation.

The Hyde GUARDIAN is integrated into the ship's ballast system so that treatment occurs automatically, with minimal effect on crew compliment or vessel operations. Simple and straightforward.



GUARDIAN DURING BALLAST



GUARDIAN DURING DE-BALLAST

SMALL SPACE AND EASE OF INSTALLATION

The flexible, modular design of the GUARDIAN allows it to be installed in even the most crowded machinery spaces. The filtration system can be delivered in small modules to be configured in a variety of shapes to fit available space. The Hyde GUARDIAN system is designed for minimum pressure drop, allowing use of existing ballast pumps. The modest energy consumption of the UV system in most cases allows installation of the system without major upgrades to the electrical generating and distribution system. Interface with the existing ballast system is simple and many installations are completed without requiring drydock and even while the vessel is in commercial operation.

Hyde GUARDIAN®

STANDARD MODEL	CAPACITY M3/H (GPM)	POWER (KW) NOMINAL/MAXIMUM
HG60	60 (264)	10/15
HG150	150 (660)	10/15
HG250	250 (1100)	18/25
HG300	300 (1320)	24/34
HG350	350 (1540)	36/50
HG450	450 (1980)	36/50
HG500	500 (2200)	36/50
HG600	600 (2640)	36/50
HG700	700 (3080)	53/75
HG800	800 (3520)	53/75
HG900	900 (3960)	53/75
HG1000	1000 (4400)	53/75
HG1250	1250 (5500)	78/114
HG1350	1350 (5940)	78/114
HG1488	1488 (6550)	78/114
CUSTOM MODELS		
HG1600	1600 (7040)	106/150
HG1800	1800 (7920)	106/150
HG2000	2000 (8800)	156/228
HG2500	2500 (11000)	156/228
HG3000	3000 (13200)	234/342
HG4000	4000 (17600)	312/456
HG5000	5000 (22000)	312/456
HG6000	6000 (26400)	424/600

FILTERS

ECONOMY

The affordable Hyde GUARDIAN system has a low installation cost, low operating cost and extremely low consumables cost over the life of the vessel. The low pressure drop of the system ensures minimal effect on vessel ballasting rates and turn-around time. The resulting low total cost of ownership ensures that Hyde GUARDIAN owners achieve compliance while gaining a competitive edge in their core business.

SYSTEM OPERATION

The Hyde GUARDIAN system is fully integrated into the ship's control and automation system. During ballasting, water is processed through both the filter and UV stages as it is pumped from the sea chest to the ballast tanks. All solids and organisms captured by the filters are discharged during backflushing to the location they entered. During de-ballasting, the filter is bypassed and water flows only through the UV system before discharging overboard. Hyde GUARDIAN system and ballast operation data are automatically logged. Hyde can advise clients on the design and installation of water sampling ports in accordance with IMO G2 Guidelines.

Ballast water is a particularly challenging filtration application due to the constantly changing biological and sediment loading, the corrosive nature of seawater, and the high flow required compared to power and space available. After years of testing dif ferent filter technologies for ballast water treatment, Hyde selected a unique stacked-disk filtration system as the standard for the Hyde GUARDIAN. This technology combines the performance and efficiency of a depth filter with reliable automatic backflushing capability superior to that of a barrier filter.

Other important benefits include corrosion-free materials of construction, low pressure drop, ability to handle heavy sediment loading, low maintenance requirements, and modular design that allows flexibility to install Hyde GUARDIAN in existing machinery spaces.

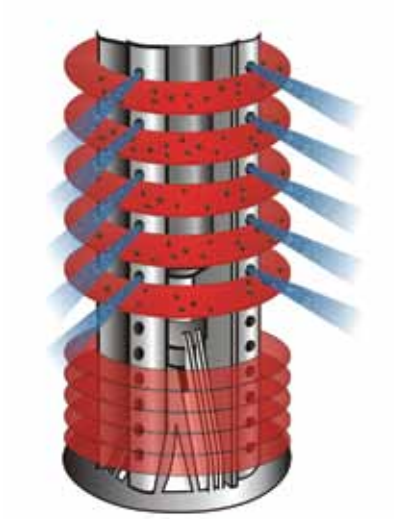
FILTER SYSTEM

The Hyde GUARDIAN filter is ideal for seawater applications and will deliver reliable operation over the life of the ship. The modular design allows Hyde engineers to specify a configuration and capacity to suit any operational requirement.

The filtration system is delivered in "filter trains" of 3 or more pressure rated modules. Each module encloses a number of 10 m^3/hr stacked-disk filter elements. Modules from 1 to 8 elements are produced in 100% polymeric materials. Superflow filter modules, with 50 to 90 elements, are rubber lined steel with all polymeric internals.

THE STACKED-DISK FILTER DESIGN

The filter elements are comprised of nylon disks, stacked on a piston spine and compressed by a spring. The disks have a precise pattern of diagonal grooves of a specific micron size, formed in opposite directions, top and bottom. When the disks are tightly compressed, intersections of the grooves form a 3 dimensional filter matrix. During ballasting, sea water flows between the disks into the core, while contaminants are captured both on the surface of the elements and at thousands of stopping points within each filter. The resulting depth filtration increases removal efficiency and solids holding capacity while maintaining low pressure drop and high average flow rate.



AUTOMATIC BACKWASH

What makes this filter truly unique is its patented, self-cleaning design. During ballasting operation, water flows through all filter modules in parallel until a preset differential pressure is reached. Two alternative backwash processes are offered: internal source, which uses the vessel's ballast pump by temporarily restricting or closing the outlet valve and boosting the system pressure; or external source, in which a dedicated pump supplies the full flow of high pressure water to clean one module while the others remain on-line.

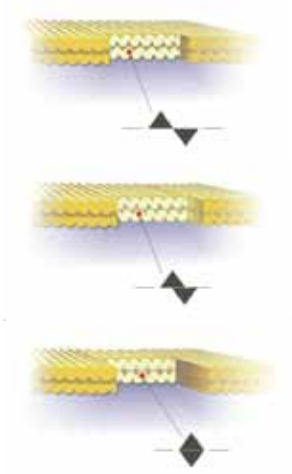
The fully automatic backwash starts by closing the inlet valve and opening the drain line. This causes high pressure water from the clean side to flow backward, pushing the spine pistons up and allowing disks to separate. Tangential jets of high pressure water spray from nozzles on the spines out through the disks, which are free to spin and flex.

Contaminants are quickly and efficiently flushed out through the drain and immediately sent overboard, where they originated. The high energy spray completely cleans each module in 10 to 20 seconds. This process is repeated one by one until the entire system is clean.

SIZING

The chart below shows the maximum flow for each filter model in the Hyde GUARDIAN range including the Superflow filter modules for very high ballast flow rates. Designers can select the size and number of modules in each filter train as well as the arrangement and number of trains to provide the required capacity and fit into the available machinery space.

FILTER MODULE SIZE	3"	4"	6"	SUPERFLOW	SF50	SF70	SF90
Max Flow/per module (m3/hr)	10	50	80		500	700	900
Number of spines	1	5	8		50	70	90



FILTER COMPARISON

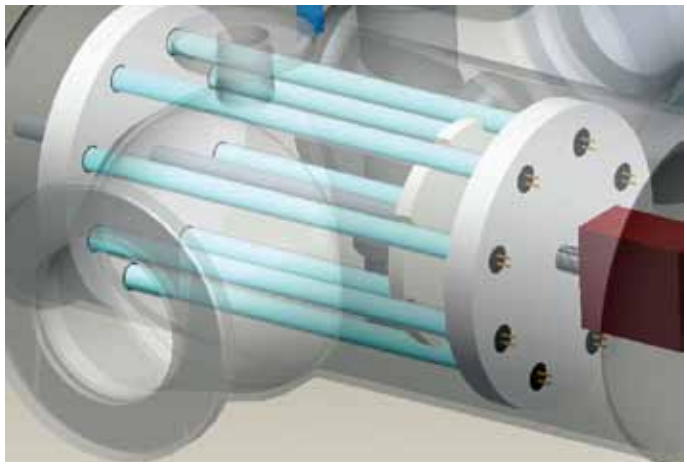
PARAMETERS	GUARDIAN™ DISK (DEPTH) FILTER	HYDRO CYCLONE	SCREEN FILTER
Filtration Large Sediment	**Excellent**	Fair	Fair
Filtration Large Organisms	**Excellent**	Poor	Fair
Back-Flush Volume	**Excellent**	Poor	Fair
Energy Conservation	**Excellent**	Poor	Fair
High Sediment Loading	**Excellent**	Fair	Poor
Pressure Drop	**Excellent** (<1 bar)	Poor (2.5-5.0 bar)	Fair (>2.0 bar)

The Hyde GUARDIAN uses a high intensity ultraviolet (UV) treatment as a means of disinfection. The UV chamber is carefully designed for minimum pressure drop, maximum retention time, and compatibility with the marine operating environment.

UV dosage is a combination of lamp power, UV transmission, distance from the lamp sleeves, and exposure time. The flow velocity through the UV chamber is optimized to be within the range of 0.5 m/s to 3.0 m/s.

The advantages of using UV rather than chemical disinfection include:

- UV runs automatically with very little operator attention
- UV does not contribute to corrosion like chemical oxidants
- UV does not require transportation, storage or handling of hazardous material
- UV requires minimal space for chemical storage equipment and contact chamber
- UV has no danger of overdosing
- Organisms cannot build resistance against UV
- UV does not require dilution or deactivation
- UV has no known toxic or significant nontoxic by-products
- UV is 100% safe without side effects

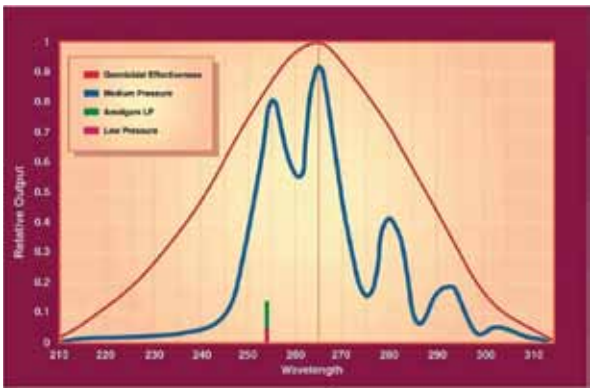


UV LIGHT

Ultraviolet light is the part of the electromagnetic spectrum just below the visible portion and it can be further broken down into four smaller bands:

- UV-A 315nm-400nm
- UV-B 280nm-315nm
- UV-C 200nm-280nm
- UV-Vac 10nm-200nm

The portion that is known as germicidal is the region of UV-C from 240-280nm, with a peak at 264nm. UV-C light deactivates or damages the DNA of organisms, killing them or making them unable to reproduce.



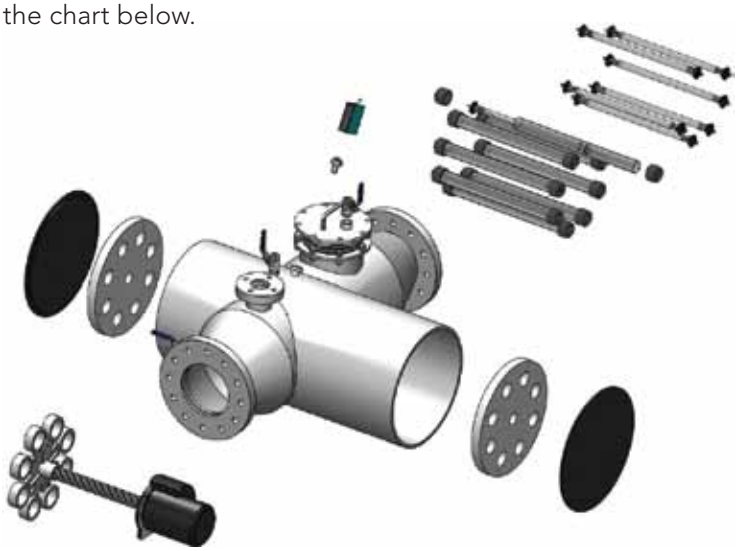
UV light is produced using mercury vapor lamps. There are two basic types of UV lamp technology. The first is called a low pressure lamp. It excites the mercury molecules to a relatively low level resulting in a monochromatic output at 254nm. The medium pressure lamps that the Hyde GUARDIAN utilizes produce a polychromatic output across the entire spectrum of the germicidal curve. The relative germicidal effectiveness is shown on the diagram above. The UV lamps used in the Hyde GUARDIAN have an expected service life of 8000 hours, which is many hundreds of ballasting cycles.

TREATMENT CHAMBER

The Hyde GUARDIAN UV system includes a specific number and size of UV lamps depending on the total ballast water flow to be treated. These lamps are housed in high quality quartz sleeves, which pass through the corrosion resistant treatment chamber. The system employs an automatic wiping mechanism to keep deposits from accumulating on the sleeves. In addition there is a temperature sensor to monitor water temperature, a UV sensor to measure the relative intensity of the UV lamps, a drain, and air relief valves. For routine checks, maintenance and replacement of the quartz sleeves and wipers, the chamber has an inspection and access hatch.

SIZING

The UV treatment system in each Hyde GUARDIAN model is sized to provide a minimum average dose, at maximum rated ballast flow, at the end of the lamp life. Sizing is according to the chart below.



Model No.	160620	160635	160835	161235	201235	201835	201850
Max Flow (m3/hr)	153	255	331	488	694	1033	1488
No. of lamp	6	6	8	12	12	18	18
Type of lamp	B2035	B3535	B3535	B3535	B3550	B3550	B5050
Lamp Power (W)	1500 to 2240	2650 to 3750	2650 to 3750	2650 to 3750	2650 to 3750	2650 to 3750	3900 to 5700
Max Power (kW)*	15	25	34	50	50	75	114

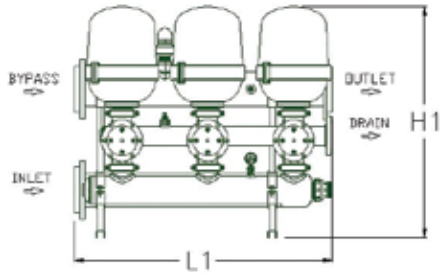
* Maximum power is typically only drawn when the system is in the highest power level, during the last ¼ of the lamp's life or when UV transmission is low due to exceptionally poor ballast water quality.

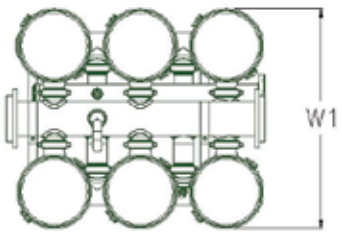
SPECIFICATIONS

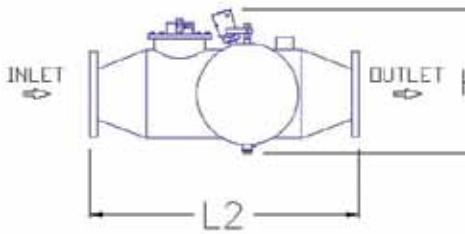
MAIN COMPONENTS WEIGHTS AND DIMENSIONS[1]

Hyde GUARDIAN®	Filter	UV	FILTER			UV		
			L1	W1	H1	L2	W2	H2
60	3″ x 8	080620	1100	900	1290	800	800	500
150	4″ x 4	160620	1000	1100	1250	1100	900	600
250	4″ x 6	160635	1500	1100	1250	1100	900	600
300	4″ x 8	160835	2000	1100	1250	1100	900	600
350	4″ x 8	161235	2000	1100	1250	1100	900	600
450	4″ x 10	161235	2500	1100	1250	1100	900	600
500	4″ x 12	201235	3000	1100	1250	1300	1100	800
600	6″ x 8	201235	2700	1900	1900	1300	1100	800
700	6″ x 10	201835	3300	1900	1900	1300	1100	800
800	6″ x 12	201835	3900	1900	1900	1300	1100	800
900	6″ x 12	201835	3900	1900	1900	1300	1100	800
1000	6″ x 14	201835	4500	2100	2100	1300	1100	800
1250	6″ x 16	201850	5200	2100	2100	1300	1100	800
1350	6″ x 18[4]	201850	5800	2100	2100	1300	1100	800
1488	6″ x 20[4]	201850	6500	2100	2100	1300	1100	800
1600 (HG800x2)	6″ x 24[4]	201835 x 2	[2]	[2]	[2]	1300	1100	800
2000 (HG1000x2)	6″ x 28[4]	201835 x 2	[2]	[2]	[2]	1300	1100	800
2500 (HG1250x2)	6″ x 32[4]	201850 x 2	[2]	[2]	[2]	1300	1100	800
3000 (HG1000x3)	6″ x 42[4]	201835 x 3	[2]	[2]	[2]	1300	1100	800
4000 (HG1350x3)	6″ x 56[4]	201850 x 3	[2]	[2]	[2]	1300	1100	800
5000 (HG1250x4)	6″ x 64[4]	201850 x 4	[2]	[2]	[2]	1300	1100	800
6000 (HG1250x5)	6″ x 80[4]	201850 x 5	[2]	[2]	[2]	1300	1100	800

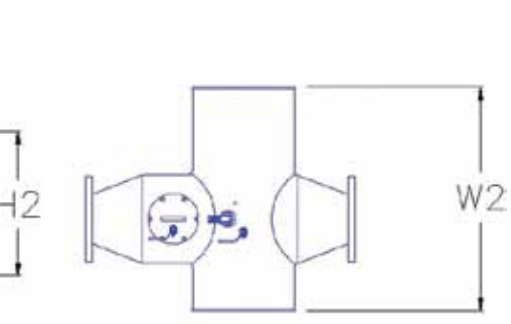
1 - For reference only, technical specifications are subject to change without notice.
2 - Consult factory
3 - Skid mounting is not an option due to size of system
4 - SUPERFLOW Filter Modules available for ballast rates greater than 1350 m³/hr.

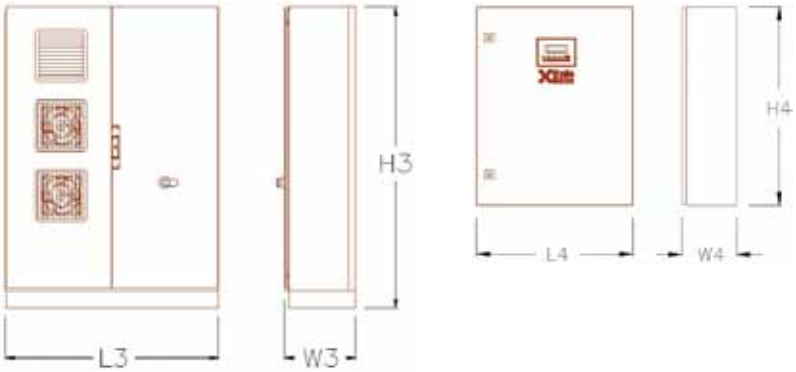






POWER PANEL				CONTROL CABINET			TOTAL WEIGHT	SKID			
L3	W3	H3	Qty	L4	W4	H4	kg	L5	W5	H5	kg
800	400	1200	1	600	210	760	441	2100	1500	150	550
800	400	1200	1	600	210	760	832	2300	2000	150	600
1200	400	1900	1	600	210	760	968	2800	2000	150	700
1200	400	1900	1	600	210	760	1150	3300	2000	200	950
1200	400	1900	1	600	210	760	1250	3300	2000	200	950
1200	400	1900	1	600	210	760	1386	3800	2000	200	1100
1200	400	1900	1	600	210	760	1673	4500	2000	200	1400
1200	400	1900	1	600	210	760	2036	3	3	3	3
1200	400	1900	2	800	300	1000	2850	3	3	3	3
1200	400	1900	2	800	300	1000	3145	3	3	3	3
1200	400	1900	2	800	300	1000	3145	3	3	3	3
1200	400	1900	2	800	300	1000	3941	3	3	3	3
1200	400	1900	3	800	300	1000	4236	3	3	3	3
1200	400	1900	3	800	300	1000	4532	3	3	3	3
1200	400	1900	3	800	300	1000	5700	3	3	3	3
1200	400	1900	4	800	400	1900	6291	3	3	3	3
1200	400	1900	4	800	400	1900	7882	3	3	3	3
1200	400	1900	6	800	400	1900	8473	3	3	3	3
1200	400	1900	6	1200	400	1900	11800	3	3	3	3
1200	400	1900	9	1200	400	1900	13868	3	3	3	3
1200	400	1900	12	1200	400	1900	16850	3	3	3	3
1200	400	1900	15	1200	400	1900	21014	3	3	3	3





Hyde GUARDIAN®

THE HYDE GUARDIAN® ADVANTAGE

		COMPARE FOR YOURSELF	
ECONOMY			
Total Cost of Operation - Low	☑		
Power Consumption – Low	☑		
Pressure Drop – Low	☑		
Consumables – Low	☑		
Moving Parts – Few	☑		
Existing Ballast Pump Compatible	☑		
Footprint - Small, Modular	☑		
EFFICIENCY			
IMO Type Approved	☑		
Meets Future Higher Standards	☑		
Filter System – High Efficiency Disk	☑		
Sediment Removal	☑		
Ballast Water UV Treated	☑		
De-ballast Water UV Treated	☑		
Backflush – Automatic at Site	☑		
ENVIRONMENT			
Chemicals or Active Substances	☒		
Chemical/Active Substance Storage	☒		
Hazardous for Crew	☒		
Special Training for Crew	☒		
Added Risk of Corrosion	☒		

L E A V E N O T H I N G B U T Y O U R W A K E .

Hyde Marine

Ballast Water Management Technology

A CALGON CARBON COMPANY

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