Preliminary Conceptual Design Basis Document for an 894-TEU Jones Act AT/B Fully Cellular Hatchless Ocean & Coastal Container Carrier

For:

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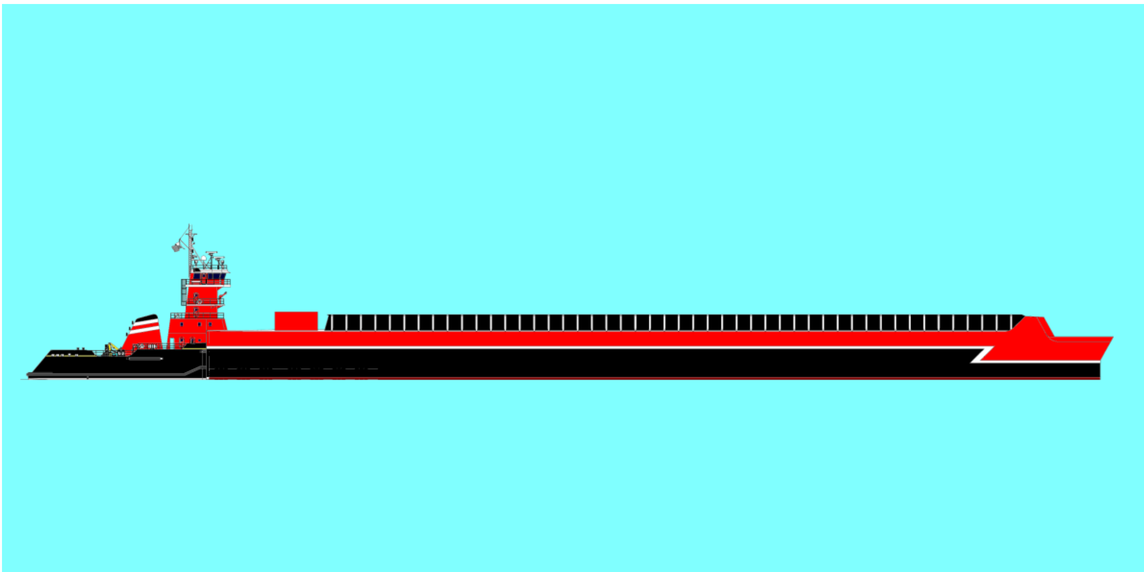


Introduction To The Concept Design Basis Document

Ocean Tug & Barge Engineering Corp. (OTBE) was contracted by the Maine Port Authority and McAllister Towing & Transportation to complete a conceptual design for an 894 TEU capacity hatchless/cellular ocean and coastwise AT/B (articulated tug/barge) container carrier. The vessel design was to be based on previous design efforts by the firm, and the basic design of the unit will be discussed in this outline document. The conceptual design, contained herein, was completed on October 12, 2013. The document and its appendices will contain information requested by the US Maritime Administration (MARAD), which is provided in support of the design presented herein. The document also explains the process used to arrive at the Concept Design.
The Service Design is planned to inform the Contract Design. This document outlines the process that OTBE will use to utilize the Concept Design in completing the Service Design.

Confidentiality/Intellectual Property Notice

1. Planned Cargo – General Statement

Standard ISO containers are to be the cargo carried aboard this unit. The container unit [CC1]is capable handling containers of 40 foot and 20 foot length as the "base case". The barge is designed however, with the flexibility to employ moveable cell guides in certain holds in order to handle containers of other lengths. This design flexibility will be fully developed in the Contract Design and will be be based on the Maine Port Authority (MPA) and McAllister (MCA) decisions as to the type of containerized cargo to be handled.

The AT/B is also fully outfitted to handle refrigerated containers in some holds, with electrical power generation capacity aboard the barge, and redundant capability for powering the barge to be provided by the tug's diesel/electric propulsion plant via a power umbilical to the barge from the tug.

2. Applicable Regulatory Standards for Vessel Design

The AT/B will be designed to the following domestic and international regulations and standards for safety, portions of which are found to be specifically applicable to hatchless and other container carriers, or to Articulated Tug/Barge Units, or Towing Vessels:

IMO (IDG)	Code for Carrying Liquefied Gases in Bulk
ABS	Rules for Building and Classing Steel Barges
ABS	Rules for Building and Classing Steel Vessels 2014 Including Chapter 5-Part 5C
ABS	Pub 165 – Application of HS Hull Structure Thick Steel Plates in Container Carriers
ABS	Assessment of Parametric Roll Resonance in the Design of Container Carriers
ABS	SafeHull for Container Ships
ABS	Rules for Building and Classing Steel Vessels Under 90M in Length
USCG	Navigation and Vessel Inspection Circular 10-82, 10-92
USCG	NVIC 2-81 – Tug/Barge Units – Dual-Mode AT/B
USCG	NVIC 12-82 - Time Weighted Noise Exposure Criteria Compliance with IMO Standard Noise Criteria.
ABS	"Guidance Notes on the Application of Ergonomics to Marine Systems"
IMO	International Convention on Load Lines 1966 with declaration Resolution A 231 (VII) and A 320 (IX)
IMO	International Convention on Tonnage Measurements 1969
IMO	International Telecommunication and Radio Regulator of 1973/1976 and 1982 including GMDSS - Rules 1999 For Radio Communication
IEEE-45	Recommended Practice for Electrical Installations on Shipboard
IES	Recommended Practice for Marine Lighting,
IEC	Electrical Installations In Ships
ILO	Maritime Labor Convention 2006
IACS	Container Ship Guide
ABS	Container Securing Guide
MSC	Annex 28 Recommendation Concerning Tonnage Measurement of Open Top Container Ships
IMO	FSA Dangerous Goods Transport With Open Top Container Vessels

US Environmental Protection Agency (40 CFR 140)
Federal Water Pollution Control Act (33 USCG 1251 et seq.)

ASTM Publication F1166 – Standard Practices for Human Engineering Design for Marine Systems, Equipment and Facilities - latest edition, as well as other ASTM Standards specifically called out in these Specifications
ANSI Standards, as specifically called out in the vessel Specifications
SAE Standards, as specifically called out in the vessel Specifications
Oil Spill Prevention Act of 1990
UL Standards, including, but not limited to UL 1581, Reference Standard for Electrical Wires, Cables and Flexible Cords
IMO International Convention for the Prevention of Pollution from Ships, MARPOL 1974/1978 Annexes I, IV, V resolution MEPC 14 (20) 07.09.84, resolution A 393 (x) and Annex VI with all current amendments and/or modifications
ISPS requirements
SNAME guidelines for conduct of tests and trials

Flag State requirements. (Assumed to be Jones Act, USCG/American Flag)

As the design evolves and both the American Bureau of Shipping (ABS) and the U.S. Coast Guard (USCG) are brought into the project, the applicability of some of the above regulations may be found to be unnecessary or new regulations will be imposed.

3.**Safety**

We as a company are fixated on safety where our vessel designs are concerned. As a naval architect I have a special desire to provide the safest possible working environment for the crew of this vessel and for the general public and other employees of MPA and MCA who will either work on or nearby to this vessel or who will encounter it passing through ports or under bridges or transiting populated areas. I do not see the vessels I design as a simple work product. I see them as a reflection on me personally in the areas of ethics, care for the environment, and concern for the people involved in the vessel's operation and those who may encounter it during their daily lives. The safety record of the vessels we have worked on reflects that philosophy.

Because this is a tug and barge combination, many rules applicable to single-unit ships will not apply to the tugboat because it is an independent vessel whose application of Rules is based on its' gross tonnage. However, for safety reasons, our view is that the unit should be designed for the maximum protection of the crew and the environment and therefore some ship-based regulations will be followed where such regulations assure a higher standard of safety.

In order to have a successful vessel, it was necessary to not only tackle the elaborate technical issues, but to also cover the practical issues that affect every-day operation of the boats. Our ultimate goal in designing these boats to the "Concept" level, was to create a vessel that is above all else, safe to operate in the trade intended. Our vessels are known for being not only well-designed from a technical point of view, but also designed so that they are easy to operate and maintain. This in turn makes them safer to operate. But in addition, the goal was to go beyond Rule requirements and given the hull structure design of container vessels and the special strength requirements, we elected to design this vessel as a "cut above" with regard to structure of the barge hull and therefore are designing her to the ABS SafeHull for Container Ships standard.

Safety Statement

- The vessels will comply with the highest international specifications and standards for protection of the environment from oil spills, cargo loss or fuel spills

- The optional LNG fuel system and storage tanks, if they are employed, will be designed to the highest safety standard based on OT&BE's extensive experience with AT/B gas carriers and drive systems.

- Components and systems are arranged with redundancy so that a single failure of any active component or system does not cause loss of the vessels maneuvering capability, cargo refrigeration support, gas-related piping systems, ballast treatment equipment, etc.

- For redundancy on a component level a single failure of an active component will not lead to a reduction of the output power for the main function served, as long as the main function is served by one system only.

- A single failure of an active propulsion component or system will not reduce the output power for the maneuvering function, served by the redundancy system, to less than 50% of the nominal output rated propulsion power.

- The machinery will be designed, installed and protected such that the risk of fire, explosions, accidental pollution, leakage and accidents thereof will be at an internationally acceptably level.

- The machinery will be designed and installed such that it is readily and safely accessible for preventive maintenance, inspection, and operation.

- Design safety audits will focus on reducing the risk of malfunctions in bridge operation which may cause sea pollution, collision, grounding and heavy weather damage.

- Primary maneuvering functions related to determination, execution and maintenance of course, speed and position of the vessel will have a consistent level of system reliability in operation under all operating conditions.

- The systems are designed to prevent fuel oil from being discharged overboard as a consequence of inadvertent operations.

- Systems and tanks are arranged so that leakage or operation of valves and the locations of through-tank fittings will not directly lead to increased risk of damage to machinery, ship or its personnel.

- The tug and the barge will each have a fixed fire-extinguishing system covering all machinery spaces as well as external fire fighting capability and the capability to fully deal with container fires in the cargo holds of the barge.
- The tug will be equipped with individually-controllable and electronically synchronizable flap type rudders. This creates a system where the loss of one rudder will not disable the other rudder and the unit can have significant steering ability even when one rudder is out of commission. It also allows the unit to be steered in ways optimal to the maneuvering need at the moment.

Additional:

- The combined unit will greatly exceed the maneuvering requirements of IMO resolution A.751(18)
- The combined unit will greatly exceed the visibility requirements of IMO resolution A.708(17)
- The combined unit will meet the emergency towing requirements of IMO resolution A.535(13)
- Oily-water separating equipment and oil-discharge monitoring and control systems will be provided as per IMO and USCG guidelines and recommendations.
- Ballast treatment and equipment and discharge monitoring and control systems will be provided as per IMO and USCG guidelines and regulations, with ballast treatment systems onboard the tug and the barge.
- Garbage handling in accordance with IMO and USCG requirements and recommendation.
- The combined unit will meet all EPA emissions and discharge requirements for the US coastal and GOM ECA's.
- Given the large amount of diesel fuel carried on both the tug and the barge, the unit will be equipped with "Oil Pollution / Oil Spill" appliances and oil spill dispersant according to requirements set by IMO, and have a Shipboard Oil Pollution Emergency Plan.

4.**Dimensional Information – Tug and Barge**

This vessel must transit various waterways, land at specified terminals to load and discharge cargo and carry a specified amount of cargo and crew. Together, these factors have determined the overall dimensions of the vessels and their general specifications. Working with MPA and MCA, we established the maximum dimensions for each unit based on such things as limiting drafts, turning basins, bridges, etc. The vessel dimensions below all fit inside those limits:

Barge:

Length OA (Mld)…………………………………… ...	506.948 ft.
Length LWL................................. ……………..…….	501.00 ft.
Beam, Maximum (Mld)…........................... …..…….	96.00 ft.
Depth, Molded (Baseline @ Midship Side)..........	51.00 ft.
Draft, Scantling................................	30.00 ft.
Unmanned Design Summer Loadline..........……… ..	30.00 ft.
Operational Draft With 894 Loaded TEU.……………	25.60 ft.

Tugboat:

Length OA (Mld)…………………………………… ...	138.91ft.
Beam, Maximum (Mld)…........................... …..…….	44.00 ft.
Depth, Molded (Baseline to Mn Dk@ Midship Side)..	24.00 ft.
Draft, Scantling (Mld)............................……………..	22.00 ft.
Operational Draft – Full Load (Mld)…………………...	20.75 ft.

(Note that the provision of a barge bow thruster is only tentative, as McAllister has harbor tugs available all along the planned service area.)

5.**Cargo Hold Configuration**

The barge will be set up with four (4) individual cargo holds, which are divided into two (2) bays each, for a total of eight (8) bays to hold containers. Seven will be designed for 40 foot boxes, with the first bay of the No. 1 hold set up with moveable guides to allow for 45 foot boxes. During the contract design phase, the extension of this hold to accommodate 48 foot or 53 foot boxes will be considered.

There is an opportunity to carry additional containers above the 894 TEU capacity noted above. These added 20 foot containers do not affect visibility from the tug but will increase draft due to the box weights/locations and the need for compensating ballast for trim.

Bay #8 18 additional
Bay #7 0 additional
Bay #6 0 additional
Bay #5 18 additional
Bay #4 18 additional
Bay #3 0 additional
Bay #2 0 additional
Bay #1 0 additional

TOTAL 54 ADDED BOXES.

With some minor changes in the coaming, to allow for pedestals outboard, an additional forty-four (44) 20 foot containers can be added.

TOTAL 44 ADDED BOXES.

So, the boat can be set up for as many as ninety eight (98) additional 20 foot boxes without affecting visibility; Fifty four (54) by just adding another layer in 3 holds and forty four (44) by adding outboard pedestals.

5a. Cargo Block/SpacesFire Protection

Consideration is being given to the provision of firefighting capability in the hold spaces based on the recommendations of "IMO publication FSA Dangerous Goods Transport With Open Top Container Vessels"

Given recent fire-related casualties on container ships, this will be explored in the Contract Design phase once the cargo types to be carried are finalized (i.e. will containers of cargo to be carried that fall under the IMDG code?) The above referenced IMO document, when dealing with firefighting on hatchless container vessels, notes the following:

> *Design aspects that are specific to open-top containerships:*
>
> *For open holds CO2 fire fighting systems are not feasible; hence water-based systems are in place. The following requirements on these systems that are specific to open-top containerships are specified in MSC/Circ. 608/Rev.1:*

"9.1 The fire protection system for open-top container holds shall be based on the philosophy ofcontaining the fire in the bay of origin and to cool adjacent areas to prevent structural damage.

9.2 Open-top container holds shall be protected by a fixed water spray system. The system shall be capable of spraying water into the cargo hold from deck level downward. The system shall be designed and arranged to take account of the specific hold and container configuration. […]

9.3 The water spray system should be able to effectively contain a fire in the container bay of origin. The spray system shall be subdivided with each subdivision to consist of a ring-line at deck level in an open cargo hold around a container bay.

9.4 The water spray system shall be capable of spraying the outer vertical boundaries of each container bay in an open cargo hold and of cooling the adjacent structure. The uniform application density should be not less than 1.1 litres/min/m2. At least one dedicated fire extinguishing pump for the hold water spray system with a capacity to serve all container bays in any one open-top container hold simultaneously shall be provided. The pump(s) shall be installed outside the open-top area. The availability of water to the water spray system shall be at least 50 per cent of the total capacity with adequate spray patterns in the open-top container hold and with any one dedicated pump inoperable. For the case of a single dedicated water spray pump this may be accomplished by an interconnection to an alternative source of water. The extinguishing system shall be supplemented by hose supply from the weather deck."

These requirements are extended by interpretations in MSC/Circ.1120:

"Water supplies for open-top container spaces in ships:

1 The water spray system required in paragraphs 9.2, 9.3 and 9.4 of MSC/Circ.608/Rev.1 […] will also satisfy the requirement for dangerous goods.

2 The amount of water required for fire-fighting purposes in the largest hold should allow simultaneous use of the water spray system plus four jets of water from hose nozzles."

5c. Other Barge Compartmentation

a.) Machinery Spaces

Underdeck machinery spaces are located under the foredeck, Frames 4 to 7 (including an optional bow thruster space, see (12.)), and aft there are two underdeck machinery spaces located from Frame 55 to the transom on either side of the notch, plus along the length of the barge there is a walking/access flat at 33'-10" ABL which provides a safe way to transit to the bow of the barge from the stern, and a dry place to run wiring and pipelines, plus it has the ballast pumps located therein on each side. This walking flat coincides with the bottoms of the main transverse box girders, allowing for transverse access/pipe/wire runs across the hull underdeck along the cargo hold length.

The aft machinery spaces contain the generators and related equipment, plus storage space on the upper level, and on the lower level, the optional LNG fuel tanks, LNG fuel equipment, and in a protected space, the barge's additional pumps. A small fidley house is located above the machinery spaces P/S. and contains ventilation equipment and access to the P/S spaces which are also connected at centerline in the spaces proper.

b.) Voids

Void spaces are located at the forepeak on centerline, and aft under the machinery spaces.

6. Power Generation - Barge

The barge will have its' own variable speed diesel generator package for providing power for the reefer containers that are carried (in Bays #7 and #8), plus it will be possible to feed power to the barge from the tug's diesel/electric plant. The sizing/number of gensets aboard will depend on the number of reefer containers to be carried. Given the generator space is astride the notch, it will be a simple matter to run cable to the space between Bay#7 and Bay#8 at the aft end of the barge. The variable speed gensets will allow for reduced fuel consumption and emissions.

The barge will also be set up for a shore power connection; the size of this will depend on what can be made available power-wise in both Portland and New York.

7. Barge Hull Structure

The barge hull structure for the concept design was created under the ABS SafeHull for Containerships standard and the SafeHull results and Midship section are found in the Appendix. Given the type of vessel we are creating, we feel that the barge rules did not give sufficient guidance to create a proper structure for the boat. In the Contract Design, not only will SafeHull be further employed, but we will also employ Maestro software to deal with global deflections in the hull and we will use NASTRAN for dealing with local stress/deflection issues.

8. Ballast Tanks/System Configuration

Both the barge and the tug will have a number of ballast tanks. On the tug they are located between and among other tanks.

On the barge they are created from the double side configuration that surrounds the cargo hold compartments. The ballast tanks on the barge have transverse boundaries coinciding with the cargo bay boundaries and will be divided at centerline. The vertical extent of the ballast tanks is the underdeck walking/pipe/cable run flat located 33'-10" ABL.

The tug ballast tanks will be similar, though it will have transverse ballast tank boundaries keyed to the fuel tanks.

The barge ballast pumps will consist of a pair of electric variable speed deepwell pumps, electrically driven with variable speed. Capacity will depend on the final desired de-ballasting time. Similar electric variable speed deepwell pumps for dewatering the cargo holds will be located on this flat at the fore and aft ends, P/S.

A suction/filling piping system composed of fiberglass pipe with steel bulkhead penetrations will be supplied to pump the tanks and fill them. A crossover loop will be provided to allow either pump to pull from either side for maximum redundancy and versatility. A full USCG/IMO-approved ballast treatment system will be installed to prevent unintended transfer of invasive species between ports. The clean ballast is discharged overboard via an above-waterline discharge or back through the bottom seachests. The seachests can also be used to gravity-fill the ballast tanks via free-flooding.

The tug will have two pumps capable of transferring its' ballast. A ballast pump in the tug engine room pulling from a ballast manifold extending suctions and fill lines into each tank, backed up by the tug's fire and general service pumps.

Tug ballast will go overboard without treatment through the side shell or in the event of a failure of the tug's BWT system, can be pumped to the barge's #8 ballast tank for treatment before sending it overboard from the barge. Like the barge, the tug's sea chests can be used to gravity-fill the ballast tanks part-way.

The barge will employ a pair of ballast tanks and a cofferdam as an anti-roll tank when required.

9.**Dirty Oil and Oily Bilge Retention**

Tanks will be provided on both the tug and the barge to retain dirty/used oils and bilge water that may be oil-contaminated from machinery in the various spaces. Independent systems on both vessels consist of an oil-water separator, oily bilge tank, dirty oil holding tank, dirty oil transfer pump with hose reel, and associated piping. The bilge system will pump oily bilge water to the oily water holding tank – various pumps and the OWS will feed oils to the dirty oil tanks. The OWS will be used to process the fluids in the oily bilge tank.

10.**Fuel Transfer Systems**

Distribution and transfer of fuel is to be done through the fuel transfer system. Transfer between tanks to be accomplished by 2 fuel transfer pumps on each vessel, each taking suction from the fuel transfer manifold via a simplex strainer then discharging back through a fuel meter to the manifold.

Fuel is to be loaded onto the barge via a fill line located aft on the side of the barge most likely to be facing the docks. The barge will also be able to be fueled via a fill connection from the tug at the stern notch. The tug is to be filled with fuel via its fuel fill connection at the tug's fill station.

A portion of the inner-side on the tug and the space under the machinery flats on the barge, shall be configured as an overflow tank for the fuel transfer and loading system. These tanks, with a capacity of 5,000 gallons each, shall be the terminus of the fuel tank vent headers, and will receive any overflow from filling the Tug's tanks, and day tank as well as similar tanks on the barge. These tanks are to be normally empty, and arranged to alarm at 10% full, and at 95% full, each with a distinctive tone. This arrangement will guarantee that a spill during fueling due to an overfilled tank will be virtually impossible to create.

11.**Tug/Barge Connection System**

We will employ either the ARTICOUPLE AT/B KVC-7080 type connection system aboard the tug and the barge, or the Intercon Heavy 50" Type connection. Both are highly proven and extremely reliable systems that will allow this unit to operate in the same weather/sea states as any ship can do and will insure complete weather-reliability over this trade route at all times of the year.

12. Powering & Maneuvering

Propulsion and Fuel Efficiency.

We are proposing a tug/barge design that is efficient in both shallow and deep water, as well as a tug propulsion system that will save on both fuel and emissions while being easy to maintain and from the safety point of view, provides for excellent redundancy. We will work with MCA in the Contract Design phase to provide a wholly "Green" design on all levels that everyone can be very proud of.

The design of this AT/B's hull shapes are directly derived from a class of AT/B's we have been involved in designing for many years. The hulls of this proposed unit were recently extensively model tested at the large NRC tank in Newfoundland, where we have done a large number of AT/B model tests. The self-propelled AT/B model involved was large, with a scale of 1:22.112.

In addition, we have two nearly-identically sized AT/B's with the same shape/proportions out there running which were delivered in 2012. So we have a full model test program that predicted speed and maneuverability, plus was have two units in the real world that prove the tests to be spot-on. These boats are the results of over 30 years of AT/B design experience among the principal designers.

In addition, there are a number of other AT/B's at work, dating back to 2004, that employ the same shapes, though proportioned differently. All are great successes.

Quoting the recent model test report for the proposed hulls, with regard to powering:

> *Powering Prediction*
>
> *Data from the resistance experiments demonstrated that the maximum resistance of the AT/B unit at 12 knots was 51.5 LT, and 49.8 LT for the heavy and light loading conditions, which corresponded to an effective power of 4249 hp and 3968 hp, respectively. Residuary resistance*
> *data from the resistance experiments demonstrated that the hull has good wave-making characteristics and low wave-making resistance. Low values of resistance were observed over*
> *both load conditions when at the economic speed of 12 knots. Dynamic trim and sinkage were not significant.*
>
> *Self-propulsion experiments demonstrated that the AT/B's wake was quite clean and there did not appear to be a significant amount of energy going into wake generation. A maximum delivered power of 7140 hp and 6420 hp will be required to propel the AT/B at 12 knots in ballast and loaded conditions, respectively. The quasi-propulsive coefficients at that speed were 0.5925 and 0.6156 for the ballast and loaded conditions, respectively. At available delivered power of 9000 hp, the AT/B unit is expected to achieve 12.77 knots and 12.96 knots for the ballast and loaded conditions, respectively.*
>
> (See "Table 1" below.)

Table 1: Self-Propulsion Results (appended ATB; ahead)

Analysis Type	Propeller Type	TEST,COND	V_S	n_{Ship}	Propeller and Nozzle Thrust, Per Side	Total Torque per Side	P_{DS}	P_{ES}	R_{TS}
			knot	rpm	kN	kN*m	hp	hp	kN
Standard ITTC 57 Resistance and Powering Prediction	Kaplan 4-70 Propeller with 19A Nozzle	Ballast, 6 knots	5.99	77.9	69.78	39.7	870	499	120.8
		Ballast, 8 knots	7.98	102.5	120.92	70.4	2030	1163	211.3
		Ballast, 10 knots	9.98	128.4	191.4	109.4	3950	2330	338.3
		Ballast, 12 knots	11.99	156.8	291.38	162.2	7140	4233	511.9
		Ballast, 14 knots	13.99	189.1	430.14	237.5	12610	7413	768.1
		Load, 6 knots	5.99	79.7	67.74	40.8	910	489	118.3
		Load, 8 knots	7.98	106.5	120.31	68.4	2040	1120	203.6
		Load, 10 knots	9.98	132.6	190.46	105.7	3940	2232	324.2
		Load, 12 knots	11.99	156.3	267.24	146.3	6420	3955	478.2
		Load, 14 knots	13.99	193.2	423.91	230	12480	7019	727.2

The unit achieved very nearly the same speed at the same power, in both ballasted and fully loaded conditions. The economy of the unit in both fuel and emissions is clearly evident in that by reducing speed and by employing an innovative diesel/electric VSG/PMM drive system, large savings are possible, even though the full speed HP values are exceptionally low.

This is particularly true in waves. If speed is reduced to 10 knots, a smooth water HP of 3940 DHP is all that is required at full load; and HP is increased by only 19.5% in SS5 for the same speed. This means that on roughly ½ her available power, the proposed unit can make an actual and realistic 10 knot service speed in Sea State 5. (See "Table 2" Below)

Table 2: Powering Data from Speed Loss Experiments

Test Condition	Significant Wave Height	Speed % Change	Torque % Change	Thrust % Change
Load, SS5, 6 knots	3.25	-38.7%	1.8%	18.9%
Load, SS5, 8 knots	3.25	-21.9%	3.4%	12.5%
Load, SS5, 10 knots	3.25	-19.9%	3.2%	10.8%
Load, SS5, 12 knots	3.25	-14.4%	-0.6%	9.8%
Load, SS5, 14 knots	3.25	-12.2%	-3.3%	8.6%
Load, SS7, 6 knots	7.3	-73.2%	6.2%	38.1%
Load, SS7, 8 knots	7.3	-46.6%	6.5%	26.0%
Load, SS7, 10 knots	7.3	-43.2%	8.2%	25.9%
Load, SS7, 12 knots	7.3	-42.9%	5.1%	29.3%
Load, SS7, 14 knots	7.3	-34.9%	1.0%	22.0%
Ball, SS5, 6 knots	3.25	-34.5%	-2.1%	9.8%
Ball, SS5, 8 knots	3.25	-25.0%	-2.8%	6.1%
Ball, SS5, 10 knots	3.25	-19.8%	-5.2%	4.2%
Ball, SS5, 12 knots	3.25	-11.6%	-6.0%	1.3%
Ball, SS5, 14 knots	3.25	-7.3%	-6.3%	0.7%
Ball, SS7, 6 knots	7.3	-69.8%	-52.9%	29.7%
Ball, SS7, 8 knots	7.3	-53.4%	-13.2%	19.8%
Ball, SS7, 10 knots	7.3	-43.1%	-8.4%	16.4%
Ball, SS7, 12 knots	7.3	-42.6%	-19.0%	8.4%
Ball, SS7, 14 knots	7.3	-27.0%	-9.8%	11.6%

Maneuverability

"Maneuvering experiments were completed at the AT/B speeds of 6 and 12 knots and have shown that the ship is controls–fixed directionally stable at both speeds and in the two loading conditions. The AT/B unit demonstrated excellent maneuverability and satisfied all of the IMO criteria by a large margin".

Taken together, these two observations mean that the unit will not only be highly fuel efficient, but will also be highly maneuverable. The following gives some added data behind the observations regarding maneuvering.

Under OT&BE's direction, various rudder/steering configurations were tested and the results analyzed to identify the most efficient configuration for this AT/B. This configuration was then applied to the self-propelled model for final maneuvering tests. The goal was to meet, or preferably do much better than the IMO 751 maneuvering performance requirements.

In all cases and under all criteria, this unit vastly outperformed the IMO requirements,

(See "Table 3" below)

Table 3: Maneuvering Characteristics Summary and IMO Criteria

Parameter	Loaded Condition V_S=6	Ballast Condition V_S =6	Loaded Condition V_S =12	Ballast Condition V_S =12
TURNING ABILITY				
Entry Speed (knots)	6.0	6.0	12.0	12.0
Helm Angle, Port (deg)	35	35	35	35
Advance (ship lengths)	3.03	3.13	3.06	3.18
Advance Criteria (< 4.5 ship lengths)	PASS	PASS	PASS	PASS
Tactical Diameter (ship lengths)	4.04	4.53	3.95	4.37
Tactical Diameter Criteria (< 5 ship lengths)	PASS	PASS	PASS	PASS
INITIAL TURNING ABILITY				
Entry Speed (knots)	6.0	6.0	12.0	12.0
Helm Angle (deg)	10	10	10	10
Advance @ 10°Heading (ship lengths)	1.49	1.51	1.45	1.54
Advance Criteria (< 2.5 ship lengths)	PASS	PASS	PASS	PASS
YAW CHECKING AND COURSE KEEPING ABILITY (10-10 ZIGZAG)				
Entry Speed (knots)	6.0	6.0	12.0	12.0
Helm Angle (deg)	10	10	10	10
First Overshoot Angle (deg)	2.0	0.8	2.7	1.1
First Overshoot Criteria (< 10 deg)	PASS	PASS	PASS	PASS
Second Overshoot Angle (deg)	2.2	0.8	2.9	1.0
Second Overshoot Criteria (< 25 deg)	PASS	PASS	PASS	PASS
YAW CHECKING AND COURSE KEEPING ABILITY (20-20 ZIGZAG)				
Entry Speed (knots)	6.0	6.0	12.0	12.0
Helm Angle (deg)	20	20	20	20
First Overshoot Angle (deg)	4.1	1.9	5.6	2.9
First Overshoot Criteria (< 25 deg)	PASS	PASS	PASS	PASS
STOPPING ABILITY				
Entry Speed (knots)	6.0	6.0	12.0	12.0
Helm Angle (deg)	0	0	0	0
Engine Setting	Full Astern	Full Astern	Full Astern	Full Astern
Advance (ship lengths)	5.3	3..55	5.7	3.78
Advance Criteria (< 15 ship lengths)	PASS	PASS	PASS	PASS

The unit achieved very nearly the same speed at the same power, in both ballasted and fully loaded conditions. The economy of the unit in both fuel and emissions is clearly evident in that by reducing speed and by employing an innovative diesel/electric VSG/PMM drive system, large savings are possible, even though the full speed HP values are exceptionally low.

This is particularly true in waves. If speed is reduced to 10 knots, a smooth water HP of 3940 DHP is all that is required at full load; and HP is increased by only 19.5% in SS5 for the same speed. This means that on roughly ½ her available power, the proposed unit can make an actual and realistic 10 knot service speed in Sea State 5 when operating along the New England coast, for the majority of the year. It is capable of normal operation in virtually any of the larger seas that will be seen in the balance of the year, and in fact is fully ocean-capable as to seakeeping.

In short, it can do anything a ship can do.

13.**The Tugboat**

The tug will be constructed from the OT&BE Corp. “ATLANTIC V” class design. This is an evolution of the class first constructed for PENN MARITIME in 2003 (6000 HP), with two additional of the class built in 2006/2007 for VANE BROS (6000 HP), and a further two (8000 HP) built for OSG in 2009/2010. Then two more of the class, with added beam and 6000 HP were built for Kirby Ocean Transport and delivered earlier this year. All are pushing barges that have a similar hull design to this unit, though the sterns are of a simple rake design on all except the two Kirby units’ barges, which have very nearly the same hull as this unit has.

All of the tugs of the parent class have been highly successful. Both the OSG and KIRBY versions have high performance nozzles, as will this design. The Kirby boat is a bit wider and has a full length forecastle. This boat is most similar to the Kirby tug, but has a diesel-electric propulsion plant of 9000 HP, is 13 feet longer and 2 feet wider.

The propulsion plant consists of three (3) engines with each driving a permanent magnet variable speed propulsion generator. In addition, the tug has a pair of variable speed 150kW ship service generators which can be employed when the tug is in port. The tug is set up for shore power and can send upwards of 750 kW to the barge.

LNG/Gas Fuel

The EMD engines will be capable of being converted to natural gas with relatively simple kits that will allow the engines to burn a natural gas/diesel mixture, greatly reducing fuel cost and emissions. Gas will come from the barge via a proprietary Argent Marine tug to barge gas connection (patent pending) developed during the design OT&BE did with Argent/Maersk on their AT/B’s. Space has been designed into the barge to provide a location for LNG storage tanks sufficient to do a round trip. As a container barge, this unit can also take advantage of containerized LNG and the design is easily modified to deal with that fuel source.

14.**Other Salient Features**

**** Design of all hull structures aimed primarily at safety/longevity, not lightest steel weight possible.***

We feel strongly that we do not want to be over-emphasizing steel weight and cost. Steel weight is a primary concern in meeting our draft targets, but we'd like to be able to use ship-like scantlings in the barge design, not coastwise barge structures. Also, we strongly advise based on our experience, that both tug and barge be fully and doubly continuously welded. Steel is cheap compared to the cost of structural problems and the resulting downtime necessary to remedy the issues caused by over-optimized structural design and excessive use of thinner, high strength steel.

**** Visibility from tug pilothouse must include seeing all deckhands on deck, as well as max. visibility possible of the barge when mooring. Visibility in ballasted condition to exceed IMO requirement and be set to 1.5 barge lengths ahead, min – better if possible.***

The proposed trade route covers a lot of territory where pleasure boats abound in the warm weather months. For this reason I think it is wise to make this tug's sight lines such that they exceed IMO requirements.

**** Do we want the tugboat to meet SOLAS requirements ? We feel, yes.***

This is vital if you ever want her to be able to trade internationally, and also vital for resale value of the tug….not to mention it makes for a safer vessel for the crew and provides an extra layer of safety oversight during construction and operation. We also feel the state and Federal regulatory bodies involved in the areas of operation will appreciate the added safety. Therefore the tug design will be fully SOLAS-certifiable. The barge, being unmanned will not need to meet SOLAS requirement, however we will in most all instances design her as if she were to meet many of the SOLAS requirements.

**** "Green", Safe and Ergonomic Design:***

The concept design of the tug and the barge were accomplished in a manner which ensures the highest standard of environmental safety (OT&BE's standing corporate mission) while promoting reasonable construction cost. In the tug Contract/Functional design, "green" design features shall be further examined to assure the vessel is as environmentally-friendly as possible and in a way that meets MPA and MCA corporate goals and policies regarding environmental responsibility.

As noted previously, both tug and barge have a Ballast Treatment System to comply with the recently released USCG Proposed Rulemaking, and will meet International standards for such systems to aid in prohibiting the vessel from spreading invasive species to sensitive waters. All of the barge's fuel tanks will be in protected locations to prevent spills from grounding damage.

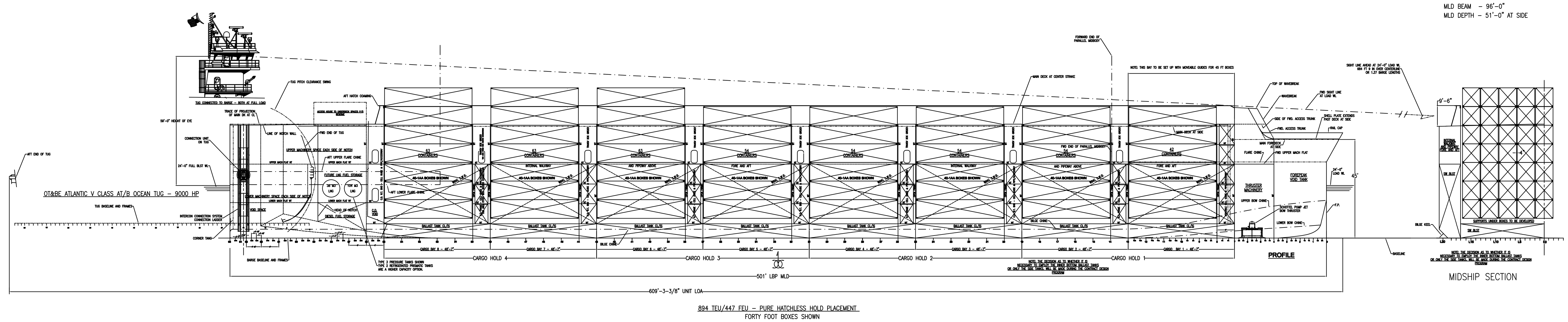
An electric drive system aboard the tug will save both fuel and emissions, and the barge bow thruster (if provided) will also be electrically-driven, eliminating the need for a diesel engine and supporting fuel and lube tanks forward. This means that there is no chance of a severe oil spill from a collision at the bow. The main generator and ship service generator engines on the tug and the generator engines on the barge will meet EPA Tier III or Tier IV requirements, based on when the unit is built.

The connection system rams will be lubricated with a food-grade grease. The tug will have sewage, gray water and oily bilge holding tanks as well as a full treatment system.

The tug also takes advantage of the latest in ergonomic design and will feature greatly reduced noise and vibration via the diesel/electric drive system employed as well as improved fire and sound insulation. Crew living spaces will be state of the art, and accommodation will be made for female crew. An exercise room is provided and the barge will have a “clear-path” running track designed-in. The galley and mess will be well-outfitted and a crew lounge is provided.

The tug is designed to be equipped with the very latest in navigation, collision-avoidance and bridge electronics as well as engine room automation for added safety. The electric drive system is a state-of-the-art advancement with modular design and outstanding redundancy.

The tug is designed for International Service, and will meet all IMO, MARPOL and SOLAS requirements for certification.



CLASSIFICATION

Barge: ABS + A1 (E), Ocean Container Barge, Unlimited Service UWILD
Tug: ABS + A1, Towing Service, Unlimited Service ,UWILD

MAIN DIMENSIONS

Length over all Barge + Tug	appr. 609' 6"
LBP - Barge	501' 0"
LBP - Tug	137'-0"
Breadth mld - Barge	96' 0"
Depth mld. at side - Barge	51' 0"
Draft - Full Load - Barge	24' 0"
Light Ship Weight	ABT 8500 LT
Gross Tonnage	TBD GT
Net Tonnage	TBD GT

DEADWEIGHT

31,301 LT

SPEED

B4 Water Speed max. 13.6 kn

CRUISING RANGE

appr. 7,500 nm at service speed

CONSUMPTION (USG/day) #2 Diesel Fuel Smooth Water w/% Loss Value in Beaufort 4

Knots	TUG HP	BARGE	% SPEED LOSS B4
10.0	3940	250	19.9
12.0	6420	250	11.6
13.6	9900	250	7.3

TANK CAPACITIES (Total Unit)

Diesel Fuel Oil	appr.	350,000 USG
LO	appr.	5,000 USG
Fresh Water	appr.	17,000 USG
Ballast Water	appr.	10,000 LT

HATCH COVERS

None, the design is of the hatchless type, however it is fully adapatable to the employment of hatch covers if desired.

DANGEROUS CARGO

All Cargo Holds; no flammable gas cargoes, but the barge can be easily equipped for both fixed cargo hold extinguishant systems and on-deck water fire fighting..

CONTAINER CAPACITY

All slots in holds for 8'6" high by 8' wide.

Max TEU loading :

On Deck (IMO visibility)	194
Below Deck	700
Total	894

STABILITY

Meets all USCG requirements for an unmanned barge, unlimited service, including damaged stability.

THRUSTER & UNIT MANEUVERING

Schottel Pump Jet Type 2,000 HP, Elec Drive
VanDerVelden BARQUE rudders, independently steerable.
Fully redundant HPU's and steering piping.
PM Motor/VSG electric propulsion drive system.

MAIN PROPULSION GENSETS

3 X EMD 12-710 (LNG-CONVERTIBLE)
9,000 BHP Available 24/7/365 (2-Stroke)

SSDG

2 X 175 kW (Tug)
1 x 125 kWe, 1800 rpm Emergency Generator (Tug)

BARGE GENERATORS

2 x EMD 8-710 1,500 kWe each.
1 x 210 kWe, 1800 rpm Emergency Generator

COMPLEMENT

Crew of 10 in single and double cabins

ANCHOR AND MOORING EQUIPMENT

2 Electric comb. Anchor Mooring Winches
6 Electric single Drum Mooring Winches

894 TEU/447 FED – PURE HATCHLESS HOLD PLACEMENT
FORTY FOOT BOXES SHOWN

CONFIDENTIAL INFORMATION
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REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED

APPROVALS

OWNER LETTER	00/00/00
ABS LETTER	00/00/00 REV.00
USCG LETTER	00/00/00 REV.00
MANUF. LETTER	00/00/00 REV.00
YARD LETTER	00/00/00 REV.00

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258 MAIN STREET, MILFORD, MA - 01757
TEL: 508-473-0545 - ON THE WEB AT WWW.OCEANTUGBARGE.COM

MAINE PORT AUTHORITY
MC ALLISTER BROTHERS TOWING & TRANSPORTATION
OCEAN OPEN CELLUAR CONTAINER AT/B
PURE HATCHLESS CONFIGURATION
GENERAL ARRANGEMENT

CAD FILE NAME	SIZE	PROJECT NO.	DWG NO.	REV
13050-B1- REV-.dwg	D+	13050	13050-B1-S1	-
CAD FILE FORMAT: ACAD2000	PER SCALE BAR	DRAWN RPH	DATE 9/1/13	SHEET 1 OF 3

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PURE HATCHLESS CONFIGURATION
GENERAL ARRANGEMENT

CAD FILE NAME	SIZE	PROJECT NO.	DWG NO.	REV
13050-B1- REV-.dwg	D+	13050	13050-B1	-

CAD FILE FORMAT ACAD2000

PER SCALE BAR | DRAWN RPH | DATE 9/1/13 | SHEET 2 OF 3

894 TEU/447 FED – PURE HATCHLESS HOLD PLACEMENT

TIGHT BOUNDARIES

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APPROVALS	
OWNER LETTER	00/00/00
ABS LETTER	00/00/00 REV.00
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MANUF. LETTER	00/00/00 REV.00
YARD LETTER	00/00/00 REV.00

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PURE HATCHLESS CONFIGURATION
GENERAL ARRANGEMENT

CAD FILE NAME	SIZE	PROJECT NO.	DWG NO.	REV
13050-B1- REV-.dwg	D+	13050	13050-B1	-

CAD FILE FORMAT: ACAD2000

PER SCALE BAR | DRAWN RPH | DATE 9/1/13 | SHEET 2 OF 3

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ABS LETTER	00/00/00 REV.00
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MANUF. LETTER	00/00/00 REV.00
YARD LETTER	00/00/00 REV.00

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PURE HATCHLESS CONFIGURATION
UNIT OUTBOARD PROFILE

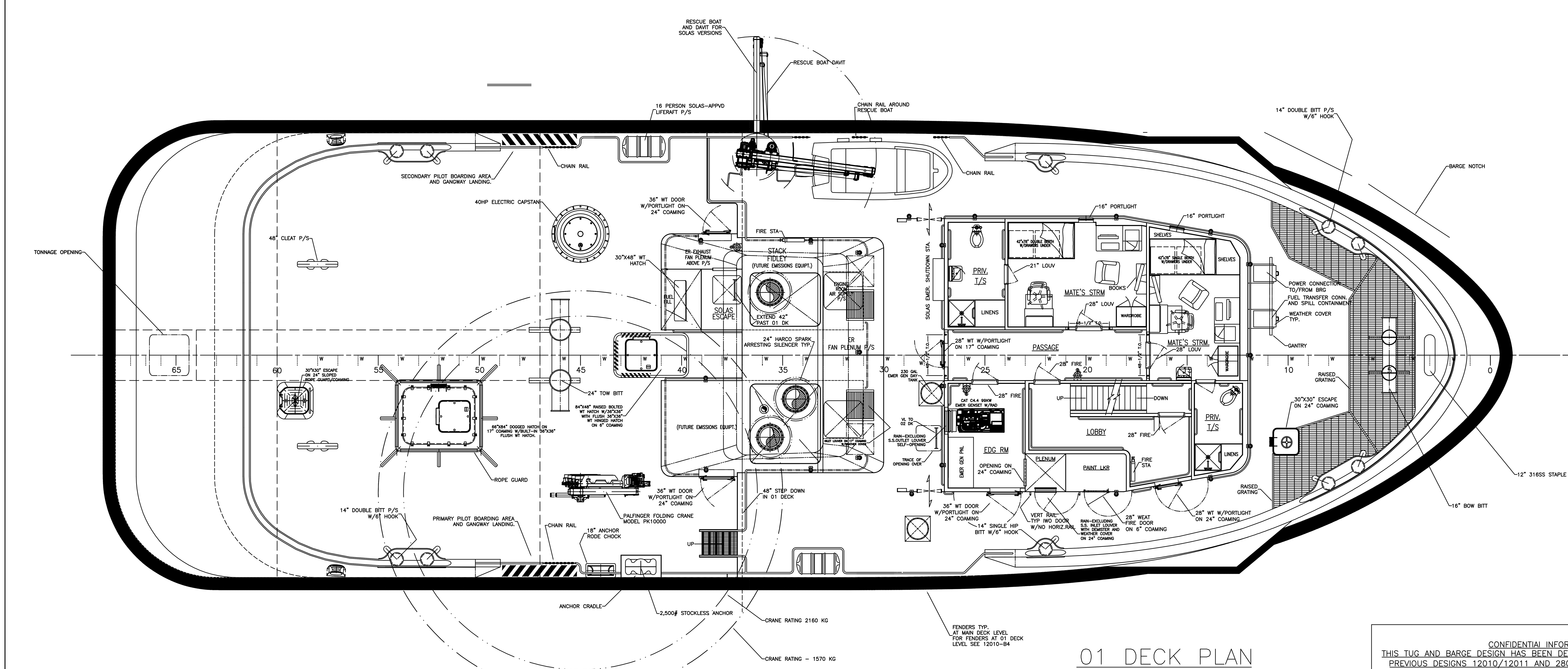
CAD FILE NAME	SIZE	PROJECT NO.	DWG NO.	REV
13050-B2- REV-.dwg	D+	13050	13050-B2	-

CAD FILE FORMAT: ACAD2000

PER SCALE BAR | DRAWN RPH | DATE 10/15/13 | SHEET 1 OF 1

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED



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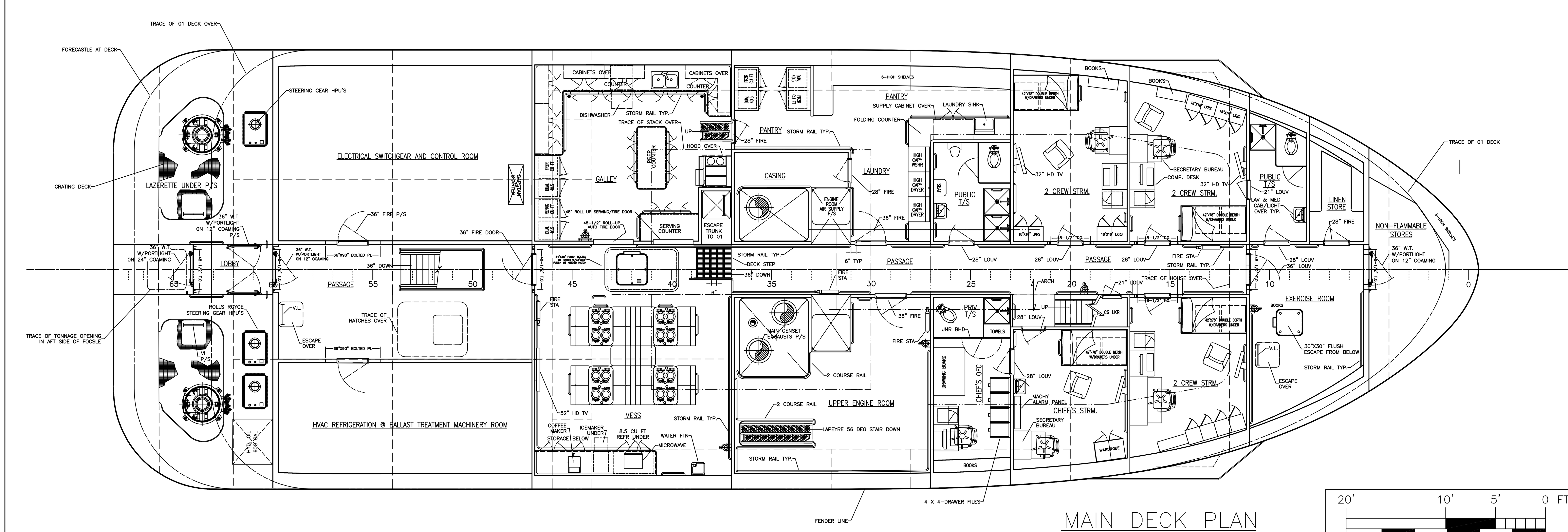

20' 10' 5' 0 FT
5 4 3 2 1 0 m

REVISIONS

REV.	ZONE	DATE	DESCRIPTION	DRAWN BY	APP'D BY

GENERAL NOTES

APPROVALS

OWNER LETTER	00/00/00 REV.00
ABS LETTER	00/00/00 REV.00
USCG LETTER	00/00/00 REV.00
MANUF. LETTER	00/00/00 REV.00
YARD LETTER	00/00/00 REV.00

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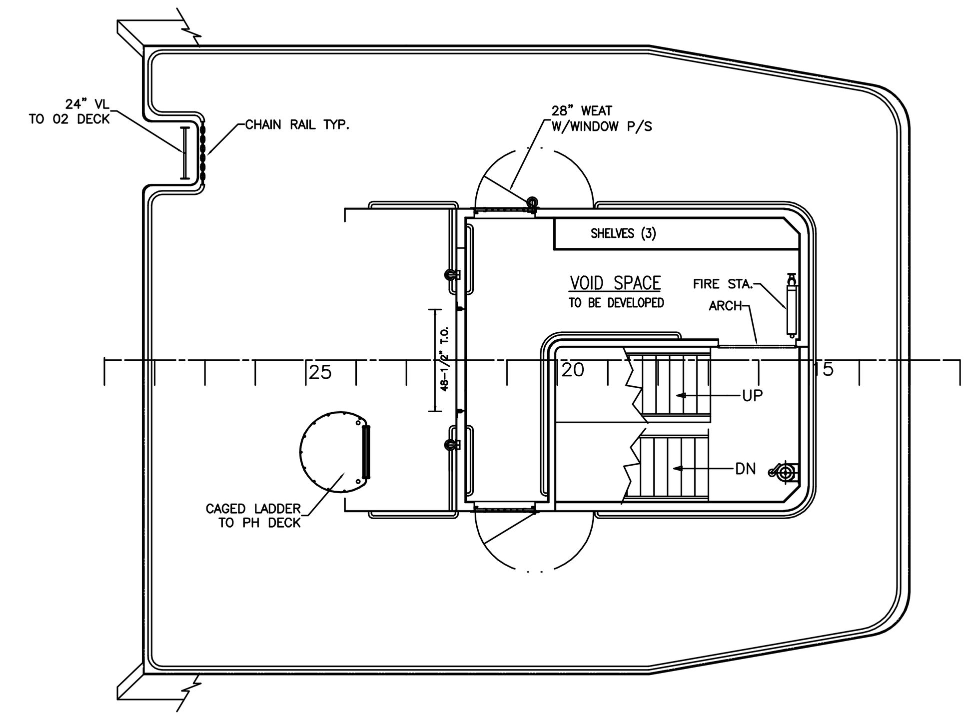
ATLANTIC V CLASS 9,000 BHP AT/B OCEAN TUG
DIESEL-ELECTRIC MULTIGEN DRIVE
GENERAL ARRANGEMENT – MAIN AND 01 DECKS

CAD FILE NAME	12010-B2 REV-.DWG
CAD FILE FORMAT	ACAD2000
SIZE	D
PROJECT NO.	12010
DWG NO.	12010-B2
REV	–
SCALE	PER BAR
DRAWN	RPH
DATE	10/11/13
SHEET	1 OF 1

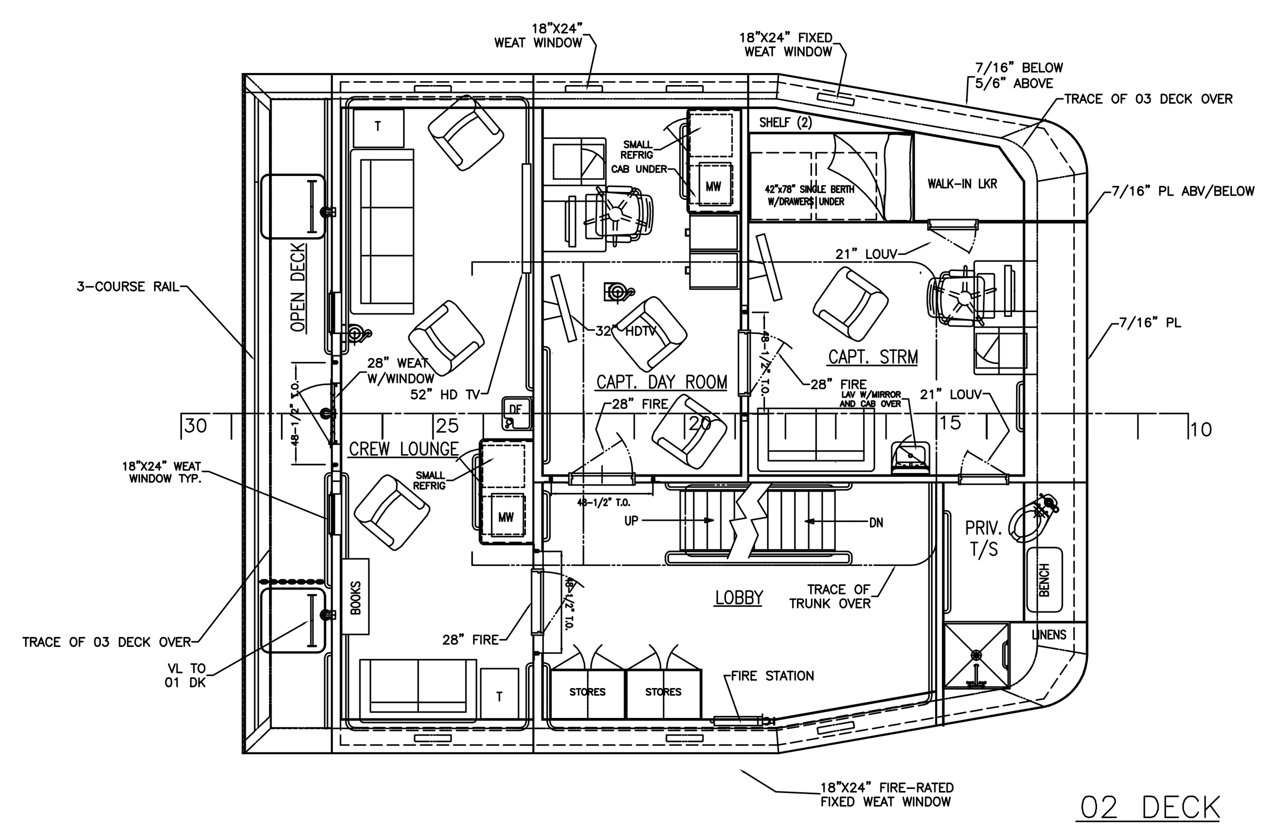
REVISIONS

REV.	ZONE	DATE	DESCRIPTION	DRAWN BY	APP'D BY

GENERAL NOTES



03 DECK



02 DECK

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20' 10' 5' 0 FT
5 4 3 2 1 0 m

APPROVALS

OWNER LETTER	00/00/00	REV.00
ABS LETTER	00/00/00	REV.00
USCG LETTER	00/00/00	REV.00
MANUF. LETTER	00/00/00	REV.00
YARD LETTER	00/00/00	REV.00

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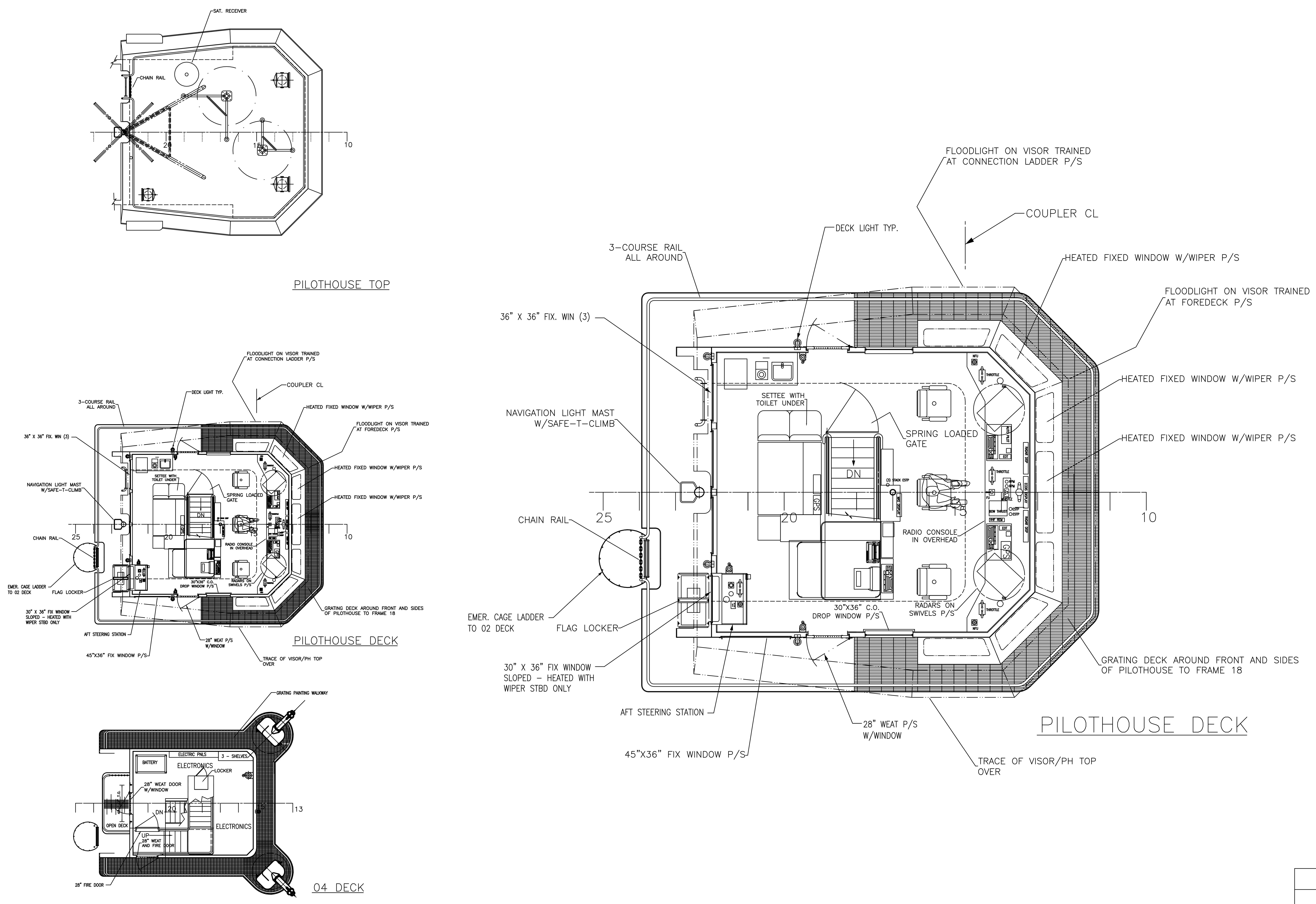
ATLANTIC V CLASS 9,000 BHP AT/B OCEAN TUG
DIESEL–ELECTRIC MULTIGEN DRIVE
GENERAL ARRANGEMENT – 02 DECK AND ABOVE

CAD FILE NAME: 13051–B3 REV–.DWG
CAD FILE FORMAT: ACAD2000

SIZE	PROJECT NO.	DWG NO.	REV
D	13051	13051–B3	–

SCALE PER BAR	DRAWN RPH	DATE 7/1/13	SHEET 1 OF 2



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20'	10'	5'	0 FT
5 4	3	2 1	0 m

REVISIONS

REV.	ZONE	DATE	DESCRIPTION	DRAWN BY	APP'D BY

GENERAL NOTES

APPROVALS

OWNER LETTER	00/00/00 REV.00
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YARD LETTER	00/00/00 REV.00

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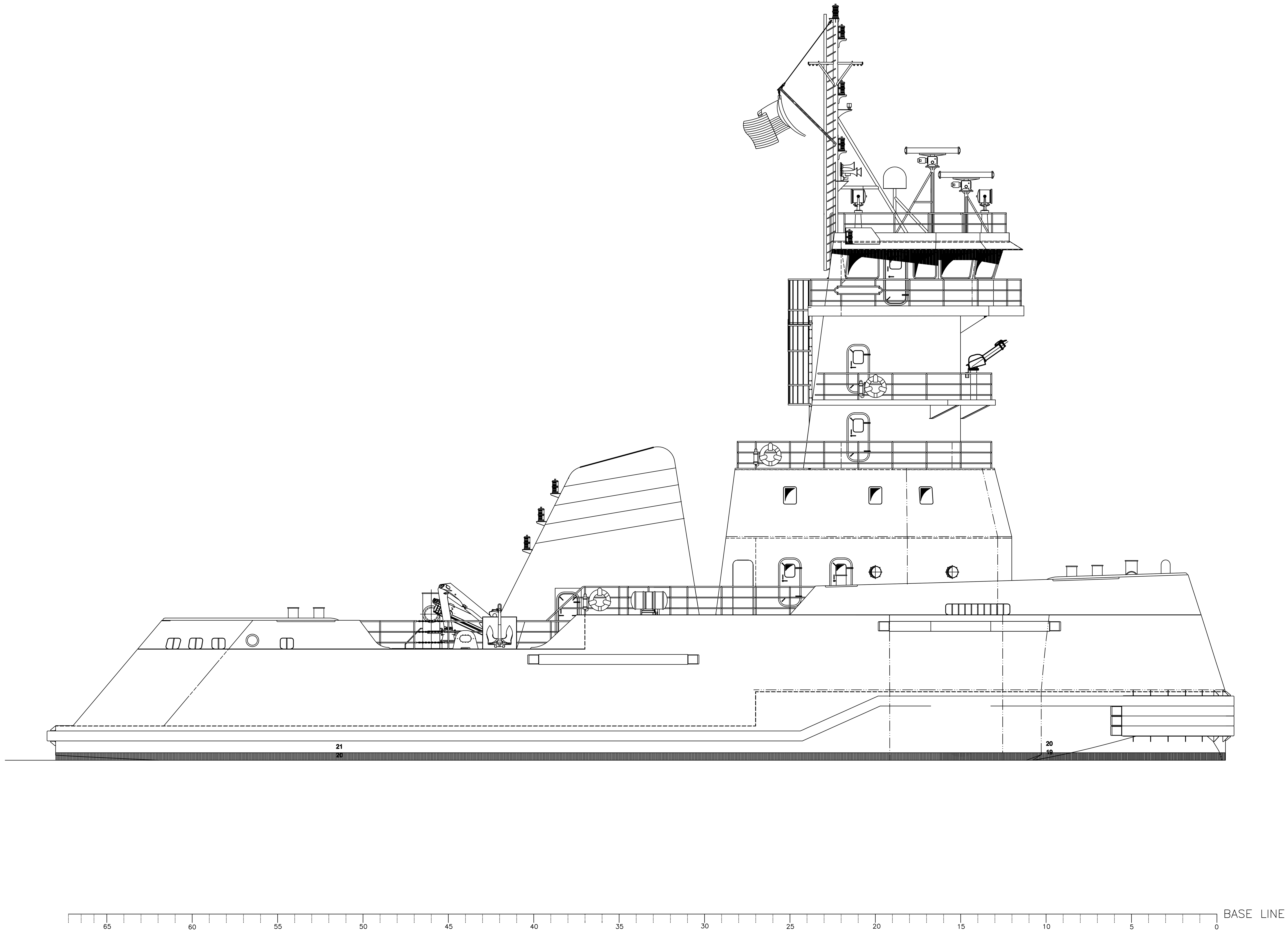
ATLANTIC V CLASS 9,000 BHP AT/B OCEAN TUG
DIESEL-ELECTRIC MULTIGEN DRIVE
GENERAL ARRANGEMENT – 02 DECK AND ABOVE

CAD FILE NAME 13051-B3 REV-.DWG	SIZE D	PROJECT NO. 13051	DWG NO. 13051-B3	REV –
CAD FILE FORMAT ACAD2000	SCALE PER BAR	DRAWN RPH	DATE 10/11/13	SHEET 2 OF 2



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20' 10' 5' 0 FT
5 4 3 2 1 0 m

REVISIONS

REV.	ZONE	DATE	DESCRIPTION	DRAWN BY	APP'D BY

GENERAL NOTES

APPROVALS

OWNER LETTER	00/00/00 REV.00
ABS LETTER	00/00/00 REV.00
USCG LETTER	00/00/00 REV.00
MANUF. LETTER	00/00/00 REV.00
YARD LETTER	00/00/00 REV.00

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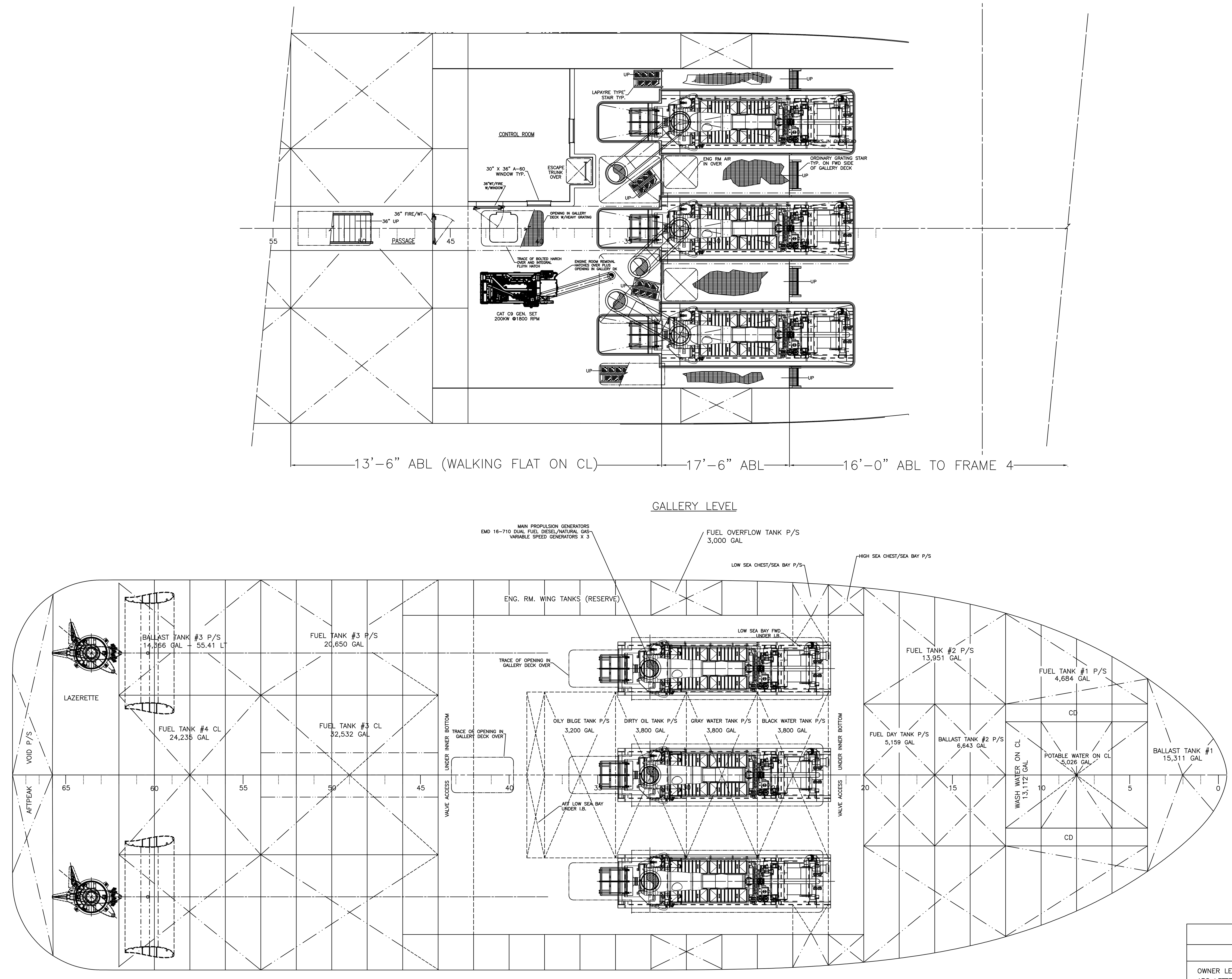
MAINE PORT AUTHORITY
MC ALLISTER BROTHERS TOWING & TRANSPORTATION
ATLANTIC V CLASS 9,000 BHP AT/B OCEAN TUG
DIESEL–ELECTRIC MULTIGEN DRIVE
GENERAL ARRANGEMENT – OUTBOARD PROFILE

CAD FILE NAME 13051–B4 REV–.DWG
CAD FILE FORMAT ACAD2000

SIZE	PROJECT NO.	DWG NO.	REV
D	13051	13051–B4	–

SCALE PER BAR	DRAWN RPH	DATE 10/11/13	SHEET 1 OF 1



98,067 GAL AFT FUEL – 307.51 LT
28,732 GAL AFT BALLAST – 110.8 LT

47,588 GAL FWD FUEL 149.22 LT
28,597 GAL FWD BALLAST – 110.3 LT

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20' 10' 5' 0 FT
5 4 3 2 1 0 m

REVISIONS

REV.	ZONE	DATE	DESCRIPTION	DRAWN BY	APP'D BY

GENERAL NOTES

APPROVALS

OWNER LETTER	00/00/00 REV.00
ABS LETTER	00/00/00 REV.00
USCG LETTER	00/00/00 REV.00
MANUF. LETTER	00/00/00 REV.00
YARD LETTER	00/00/00 REV.00

CAD FILE NAME 13051–B5 REV–.DWG
CAD FILE FORMAT ACAD2000

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OCEAN AND HARBOR TUG DESIGN – OCEAN BARGE DESIGNS
TRANSPORT STUDIES * CONSULTING * CONVERSIONS
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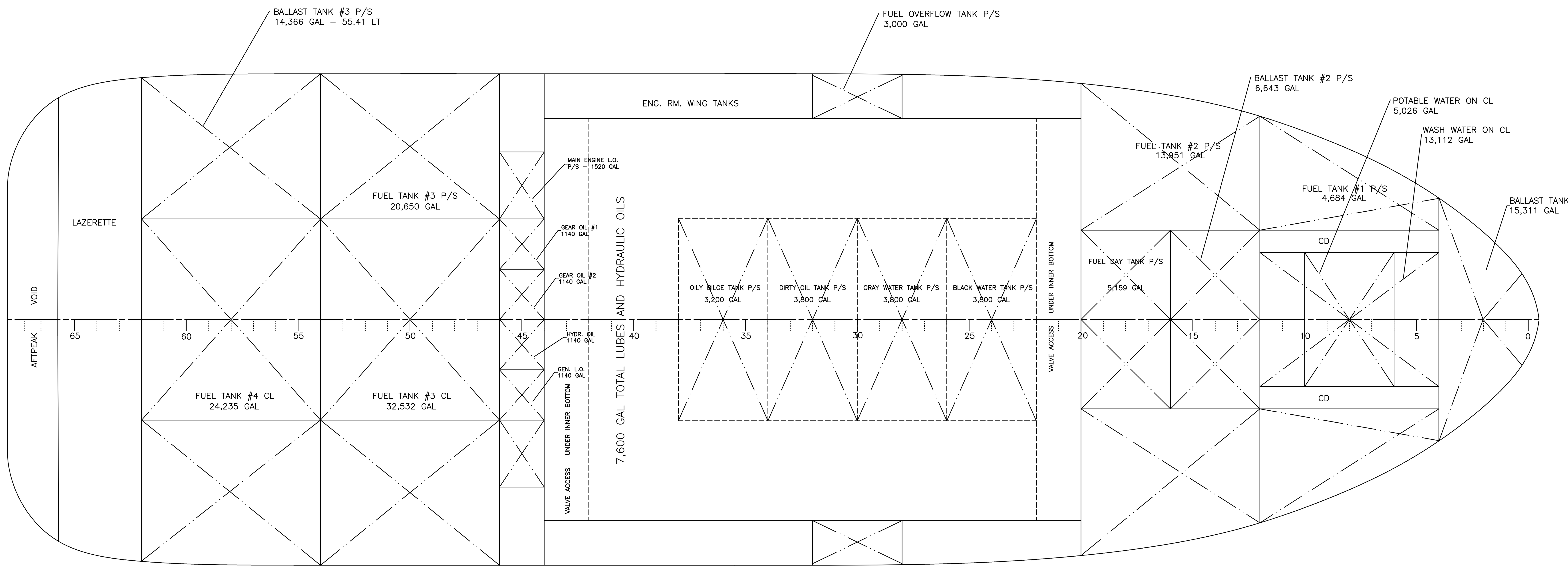
MAINE PORT AUTHORITY
MC ALLISTER BROTHERS TOWING & TRANSPORTATION
ATLANTIC V CLASS 9,000 BHP AT/B OCEAN TUG
DIESEL–ELECTRIC MULTIGEN DRIVE
GENERAL ARRANGEMENT – MAIN MACHINERY

SIZE	PROJECT NO.	DWG NO.	REV
D	13051	13051–B5	–

SCALE PER BAR	DRAWN RPH	DATE 10/11/13	SHEET 1 OF 1



98,067 GAL AFT FUEL – 307.51 LT
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47,588 GAL FWD FUEL 149.22 LT
28,597 GAL FWD BALLAST – 110.3 LT

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REVISIONS

REV.	ZONE	DATE	DESCRIPTION	DRAWN BY	APP'D BY

GENERAL NOTES

SCALE: 20' 10' 5' 0 FT / 5 4 3 2 1 0 m

APPROVALS

OWNER LETTER	00/00/00 REV.00
ABS LETTER	00/00/00 REV.00
USCG LETTER	00/00/00 REV.00
MANUF. LETTER	00/00/00 REV.00
YARD LETTER	00/00/00 REV.00

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OCEAN TUG & BARGE ENGINEERING CORP.
ARTICULATED TUG/BARGE UNITS FOR OFFSHORE SERVICE
OCEAN AND HARBOR TUG DESIGN – OCEAN BARGE DESIGNS
TRANSPORT STUDIES * CONSULTING * CONVERSIONS
MILFORD COMMON PROFESSIONAL BLDG. – SUITE 401
258 MAIN STREET, MILFORD, MA – 01757

MAINE PORT AUTHORITY
MC ALLISTER BROTHERS TOWING & TRANSPORTATION
ATLANTIC V CLASS 9,000 BHP AT/B OCEAN TUG
DIESEL–ELECTRIC MULTIGEN DRIVE
GENERAL ARRANGEMENT – UNDERDECK TANKS

CAD FILE NAME 13051–B7 REV–.DWG	SIZE D	PROJECT NO. 13051	DWG NO. 13051–B7	REV –
CAD FILE FORMAT ACAD2000	SCALE PER BAR	DRAWN RPH	DATE 10/11/13	SHEET 1 OF 1