DREDGE WILLIAM A. THOMPSON REPLACEMENT PROJECT

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ABSTRACT

The St. Paul District, Corps of Engineers, Dredge William A. Thompson (Thompson) performs channel maintenance dredging on the Upper Mississippi River from approximately St. Paul, Minnesota to St. Louis, Missouri. The Corps of Engineers' involvement with Upper Mississippi River navigation began in the 1800s with the removal of snags from the main channel for steamboat passage in the settlement of the Midwest. In the late 1800s, channel structures were placed in the river to provide a more reliable channel. To augment the structures and remove shoals resulting from the ever-shifting river bottom, the St. Paul District introduced hydraulic and mechanical dredges. The district employed several dredges in the 1910 to 1930 era of Upper Mississippi River navigation. In 1936, in anticipation of more significant dredging requirements resulting from the newly authorized Nine Foot Channel Project and completion of 27 locks and dams, a larger, more powerful dredge, the Thompson, was built by Dravo Shipyard in Pittsburgh, Pennsylvania. That was 71 years ago, and the Thompson is still functioning, though now in a reduced mission because of its age. It is currently being replaced.

This paper discusses some of the issues and considerations in replacing the Thompson, how they were resolved, the vessels that have and will be replacing the Thompson, and their features.

Keywords: Dredges, equipment, dredge technology, electric driven, cutterhead

INTRODUCTION

The Thompson is a 50.8-centimeter (20-inch) cutterhead dredge. It is a self-propelled dredge with quartering and galley service for 60 people; the actual crew size ranges from 46 to 56 men and women. Crew size is dependent on workload schedule, either 5 days per week or 7 days per week, all 24 hours per day.

The Thompson has been working since 1937 when the locks and dams creating the Nine Foot Channel Project, along with the Dredges Thompson and Rock Island, were authorized by Congress. The Rock Island has long been decommissioned and scrapped.

The Thompson has also worked on occasion on the Lower Mississippi, Illinois, Ohio, Missouri, Red, Kaskaskia, and St. Croix Rivers. Records show that it has dredged nearly 96 million cubic meters (125 million cubic yards) of material. Material dredged is predominantly medium- to course-grained sand.

The Thompson was built in 1937. Its hull is wrought iron, and the deckhouse is wood. The following photograph (Figure 1) of the Thompson was taken in 2004.

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Figure 1. Dredge William A. Thompson.

At 70 years of age, the Thompson has exceeded its projected useful life by 20 years. It was repowered once, in 1965. A second repowering and updating had long been considered and was quickly becoming critical to continued government maintenance of the Upper Mississippi River.

To evaluate the needed dredging capability on the Upper Mississippi River, and the best way to provide it, four major areas were evaluated:

- Projected dredging needs for the Upper Mississippi River channel.
- Replacement of the Thompson with contract dredge service.
- Repowering and renovation of the Thompson.
- Replacement of the Thompson with government-owned equipment.

These alternatives are discussed below.

Projected Dredging Needs

This question was addressed through an analysis of the historic dredging data available over the last 50 years, together with consideration of existing and new non-dredging practices that might reduce requirements. Such practices might include the use of "wingdams," which were first used to establish a 1.22-meter(4-foot)-deep navigation channel for steamboats. Wingdams are rock and willow mat structures placed perpendicular to the river's flow to restrict the river's power into a narrower channel that would allow for self-scouring of the river bottom. Thousands of labor intensive wingdams were constructed on the Upper Mississippi River in the late 1800s and were quite effective in reducing the dredging and snagging requirements. Subsequent authorizations resulted in a 1.37-meter(4½-foot)-deep channel, and later a 1.83-meter(6-foot)-deep channel as river interests continued to compete with railroads.

Although the Nine Foot Channel Project and associated lock and dam structures built in the 1930s have reduced the wingdam benefits, “channel modification” practices are still used in the St. Paul District as wingdams are realigned, channel alignments are altered with new wingdams, and side channel closures and sediment traps are established.

The locks and dams greatly affected the channel morphology and resulted in 1.53 to 2.29 million cubic meters (2 to 3 million cubic yards) of dredging annually for the first 30 years following construction. Dredging has stabilized over the last 30 plus years at 0.76 to 1.53 million cubic meters (1 to 2 million cubic yards) annually within the same reaches of the river. Tributaries along the Mississippi River have an enormous amount of bed load from poorly managed soils within their basins, which will continue to contribute to Mississippi River dredging well into the foreseeable future.

Replacement with Contract Dredge Service

In 2001, the St. Paul District decided to compete the workload of the Thompson for the sixth time in the last 30 years. Private dredging contractors thought to possibly have an interest in the work were invited to a meeting to discuss a scope of work that would allow for competitive bids and encourage interest in the work. Past attempts to determine the cost of performing the work were criticized for only including small business ventures or for being too short in duration for contractors to reasonably amortize equipment investment, primarily pipeline. The meeting was held with the intent of increasing participation.

A 3-year contract was advertised in November 2001. Only one private sector bid was received. The primary reason for the low number of bidders is thought to be the actual river dredging requirements on the Upper Mississippi River. The river dredging requirements are for multiple dredge sites at different river locations with small dredging amounts at each site. These requirements mean an extensive level of: effort, time and cost moving between sites, with low “production income” at each site. Overall, these requirements present an unattractive procurement scope, compared to a large single location dredging job.

Other reasons for the low bidder turnout are thought to include (1) a small number of contractors in the region, (2) a significant amount of non-channel maintenance work already available, (3) a high number of U.S. Coast Guard licensed crew members required for federal channel maintenance, and (4) labor issues that might arise from working in several different labor union areas along the river and in several states.

The private sector bid was compared to the Thompson costs, and the Thompson costs were determined to be lower.

Repowering and Renovation of the Thompson

The repowering alternatives ranged from replacement of the pump and pump engine only, to inclusion of propulsion horsepower improvements by basically cutting off the stern of the dredge and replacing with new larger propeller tunnels to increase propeller size and installing a traveling spud system. These approaches still did not address the maintainability issues associated with the riveted wrought iron hull or the safety issues associated with the wooden deckhouse for quarters.

The conclusion that was developed from these considerations was that the idea of repowering a 70-year-old dredge had many limitations and should be evaluated closely against the alternative of new modern dredging technology. New technology could improve on dredging efficiency, while eliminating serious maintenance and safety issues.

Replacement of the Thompson with Government-Owned Equipment

The government surveyed standard available dredging equipment with dredging production capability comparable to the Thompson. The survey quickly showed that the Thompson configuration – self-propelled with onboard quarters - was not current industry standard scope of supply and would not be readily available as new construction.

The common industry approach to the Thompson mission and capability was found to be separate-purpose built vessels; i.e., a (non-self-propelled) dredge, a quartersbarge, and a towboat. Each of these components – dredge, towboat, and quartersbarge, was in common use and was easily available.

The government's survey results were matched against recent government procurements. The results were as follows:

- A commercially available 50.8-cm (20-inch) cutterhead dredge could be constructed in a relatively short time and would provide the best available technology in dredging accuracy and efficiency.

- An existing government towboat contract for two towboats could be modified for a third boat for the St. Paul District. The new towboat would incorporate multiple state-of-the-art features in the areas of environmental protection, maneuvering power, fuel efficiency, habitability and crew safety.

- An existing government quartersbarge design could be readily adapted to the St. Paul District's needs. The barge design meets stringent U.S. Coast Guard passenger vessel safety standards.

This approach showed itself to be clearly superior to repowering of the existing Thompson in a number of major areas:

- Best dredging technology provided in the context of industry standard designs.

- Thompson hull maintenance and safety issues eliminated.

- Greatly improved crew safety.

- Greatly improved environmental safety.

- Multiple mission flexibility for the non-dredge vessels (towboat and quartersbarge).

- Separate towboat provides flexibility to be able to use the towboat for other missions, such as delivery of plant to other locations, without interrupting dredging operations, and use of the towboat during winter lock chamber dewatering efforts at the numerous locks and dams on the upper river.

- Separate quartersbarge allows use for other missions, especially lock dewatering and maintenance (in winter) and emergency operations.

- Separate towboat and quartersbarge also allows replacement of each piece separately as it becomes more costly to maintain. The dredge may very likely need to be replaced before the towboat or quartersbarge simply because of more use and wear.

- Quieter quarters, away from the dredge engines, were determined to be a side benefit. Prior to the Thompson, district dredges were also supported by quartersbarge arrangements, with separate steamboats to move the dredges.

An economic analysis was conducted to establish the viability of the three vessel approach. The analysis considered maintenance costs, labor, depreciation, lodging, and increment estimated for the next 30 years and, with a relatively small annual inflation rate of 3%, was used to quantify benefits and cost savings of new equipment. (Increment is the amount paid back plus an inflation factor to the Corps plant replacement and improvement program to cover future replacement at current prices once the equipment again exceeds its useful life.) The analysis showed a positive benefit-to-cost ratio. This result culminated in the decision to replace the Thompson with a new dredge, new towboat, and new quartersbarge. This decision was approved in late 2001 following the competitive bid opening.

The three vessels are described below.

DREDGE GOETZ

Technical Requirements and Procurement

To replace the Thompson, a new dredge would need the following characteristics:

- Should swing a 76.2- to 91.44-meter(250- to 300-foot)-wide cut in relatively strong current.
- Should pump material at least 2,286 meters (7,500 feet).
- Should be automated as much as possible.
- Should be on the leading edge of environmentally safe operation. (The majority of the Thompson's operating season is spent in a nationally recognized fish and wildlife refuge managed by the U.S. Fish and Wildlife Service).

With these parameters as guidance, a contract specification was prepared for advertisement and solicitation of bids. To take advantage of commercial dredge builders' expertise, the contract was set up as a Request for Proposal in which builder preferences and designs proprietary to their company could be better used.

Basic requirements were spelled out as described below; however, builders were allowed great latitude in using their expertise and successes in determining how to design and build the requested dredge.

The contract required that the dredge have the following capabilities:

- Pumping distance, with medium grained sand, up to 3,048 meters (10,000 feet).
- Production rate of 765 cubic meters (1,000 cubic yards) per hour at 3,048 meters (10,000 feet).
- 76.2-meter(250-foot)-wide cut within a swing angle of 0.52 to 0.70 radians (30 to 40 degrees).
- Maximum draft of 1.83 meters (6 feet) and beam of 12.19 meters (40 feet) for efficient locking with the dredge fleet.
- Operation in typical conditions of 8.05-kilometer(5-mile)-per-hour flows and 48.28-kilometer(30-mile-per-hour) winds.
- Design and construction to meet American Bureau of Shipping and U.S. Coast Guard requirements.

The procurement by the Corps of Engineers was a "Best Value" format, with a "reverse auction." It was structured in three steps. The first step was evaluation of technical proposals from prospective bidders. The second step was establishing the best pricing from each bidder through the online auction. The third step was evaluation of each bidder's overall package of technical features and cost to determine the Best Value.

In the reverse auction online, bidders were given a chance to anonymously bid, and lower their bid, based on other anonymous bids they were allowed to view within the 30-minute process. The process resulted in lowering of the best value bid by about $700,000.

Technical factors used in the product evaluation criteria included (1) the builder's selection of proven, reliable equipment and materials; (2) machinery arrangements that facilitate ease of maintenance and operation; (3) use of current dredge technology in design of the dredge pump and related features such as dredging controls; (4) use of robust features and materials; (5) environmentally friendly features to minimize the possibility of spills, oil leaks, noise, and engine exhaust emissions; and (6) enhanced safety features as well as use of standard components and availability of system wear parts.

Expected performance of the dredge was evaluated on dredge production; pump efficiency ratings given certain restrictions like a large impeller sphere clearance to accommodate excessive debris in the river; swing winch performance in line speed and pull; cutterhead performance in torque and horsepower; and pump control features that maximize the dredge efficiency, ease, and reliability of operation were preferred.

Proposed features that prevent the contamination of the waterway, features to reduce noise and vibration, stability provisions, fire alarm and protection systems, joinery work, type of deck fittings, tank capacities, make and model of engines, reduction gears, cutter design features, and all aspects of the proposed dredge were also considered.

The specifications asked for a dredge that would be either diesel or electric driven, include twin diesel engines each capable of providing sufficient power itself at maximum capacity, an identical engine powering a skid-mounted booster pump, a traveling spud system, and variable speed control over everything. In addition, the booster would be remotely controlled and monitored from the dredge control room up to 1.61 kilometers (1 mile) away. Other features requested included a deck crane over the pump pit for clean-outs, 30.48-centimeter (12-inch) half pipe rubrails for hull protection, ladder power sufficient to pull the cutterhead out from under 1.52 meters (5 feet) of material if necessary, a vacuum relief valve near the intake, ability to rotate all discharge pipe for extended wear, and a Programmed Logic Control based system that could be automatically set if desired.

As Built

In August 2003, the Contracting Officer awarded a contract for construction of a 50.8-centimeter (20-inch) cutterhead dredge to Rowan Companies and its subsidiary companies Oilfield Electric Marine (OEM) of Houston, Texas, and LeTourneau Steel Fabricating in Vicksburg, Mississippi. OEM's expertise is heavy-duty electric motors and drives while LeTourneau's experience lay in the construction of off-shore drilling rigs. LeTourneau was to be the hull fabricator for the dredge, and OEM and subcontractor Digital Automation and Control Systems, Inc. (DACS), was to be the designer and project manager.

Purely physical characteristics of the dredge and machinery are as follows:

Table 1. Physical characteristics of the dredge Goetz and its machinery.

Component	Specification
Dredge Goetz	
Hull length	60.96 meters (200 feet)
Ladder length	11.58 meters (38 feet)
Beam (molded)	11.89 meters (39 feet)
Hull depth	2.44 meters (8 feet)
Draft	1.52 meters (5 feet)
Fuel capacity	113,562.36 liters (30,000 gallons)
Potable water	3,785.41 liters (1,000 gallons)
Digging depth	8.53 meters (28 feet)
Ladder angle	0.7854 radians (45 degrees)
Cut width at 7.62-meter (25-foot) depth	76.2 meters (250 feet)
Production	764.55 cubic meters (1,000 cubic yards) per hour
Without booster	1.524 meters (5,000 feet) of pipeline
With booster	3,048 meters (10,000 feet) of pipeline
Discharge pipe diameter	50.8 centimeters (20 inches)
Machinery	
Main generators	(2) Caterpillar 3,516 DG Sets, 1,200 rpm
Dredge pump	Vosta model HPD 550
Dredge pump drive	(2) 1,150 HP, 600-Volt AC Vector Duty Motors
Dredge pump control/drive	OEM V31800. True Vector IGBT Drive
Dredge pump gearbox	Haley Gears, HADU 1800, 1.4:1
Cutter drive	300 HP, 600-Volt AC Vector Duty AC motor
Cutter drive/controls	OEM Variable Speed AC Drive
Spud hoist winches	IHC 100 HP 480 VAC Vector Duty AC motor
Traveling spud carriage	Rack and pinion driven (2) 30 HP, 480 VAC motor
Swing winches	IHC 100 HP 480 VAC Vector Duty AC motor
Ladder hoist	IHC 100 HP 480 VAC Vector Duty AC motor
Winch drives/controls	OEM 3000 DBM Variable Speed AC Drive
In-port generator	Cat C-9 DG set

As indicated in the listing of characteristics, the Dredge Goetz is diesel electric. Diesel electric is the most modern and efficient system for dredging service.

Interesting features of the Goetz include the use of rack and pinion advance of the traveling spud instead of the proposed hydraulic system.

The Goetz' operation in a national wildlife refuge provided extra emphasis and focus on the need to avoid oil spills. In response, OEM proposed a system that avoided hydraulics and the attendant oil. The system is an adaptation of the Marathon LeTourneau system for jack-up oil rig legs. It is the first such system known to be incorporated into a U.S. dredge. It is driven by an electric motor, as are the spud winches.

Another interesting feature of the design is the large (27.43-centimeter (10.8-inch)) spherical clearance on the pump impeller. This feature specifically addresses the debris in the Upper Mississippi River. The large clearance results in 74 percent pumping efficiency, which is slightly less than the optimum that could be provided with an impeller providing less spherical clearance. However, overall efficiency is actually improved as a result of the reduced down time from pump clogs.

Vosta and Mobile Pulley provided the suction system, including suction and discharge piping and elbows, a suction gate valve to prevent water from entering the pump pit, a suction relief valve near the cutterhead to control slurry density, and a cleanout for removal of debris not able to be passed by the three-vane impeller. A pump priming system was not needed because the pump is located below the waterline. A separate pump pit void with a water tight door to the in-hull engine room provides additional protection. A discharge line check valve downstream of the pump prevents discharge line water from returning into the pump when the pump is stopped. A filtered gland flushing system using a 40-HP motor cools the pump packing and flushes the back side of the main dredge pump impeller.

Other features of interest include the Caterpillar 3516B 16-cylinder engines running at a low 1,200 RPM. Lower specific fuel consumption is expected. Each engine in overload capacity can adequately power either or both inline 900-HP cutterhead motors. Total installed horsepower on the dredge is 4,100.

Regarding current state-of-the-art technology, another major contribution to improved dredge efficiency is the automated control system. The DACS automation package includes monitoring of slurry density and velocity, swing control, and production monitoring. Flow control maintains hydraulic transport system velocity at a predetermined point typically just above the critical speed for solids suspension. By controlling velocity and pressure and maximizing density, production is maximized with the minimum of power consumption and equipment wear.

Swing control complements flow control with the automatic maximization of density with the pumping system. The dredge's swing rate changes according to set parameters. Swing radius limits are also entered. The Programmed Logic Control system constantly monitors the dredge production data as well as a number of operator set parameters and mechanical limits, and it adjusts the speed of the swing winches to get the maximum production with the mechanical and operational limits. At the end of each swing, the dredge will slow down and stop at the end of the dredge cut. The operator has the choice to swing either automatically or manually. On the dredging screen, the operator will see any dredge production data, such as vacuum, pressure, velocity density, and amp readings, as well as swing direction and speed. The microprocessor calculates input data and outputs motor speed command.

A complete set of manual dredge controls is also provided. Joysticks control ladder and swing. Cutter control will be via lever or knob. Spud winch controls will be pushbutton with speed pot. Spud travel will be via pushbutton. Instrumentation will minimally include gauges for vacuum, discharge pressure, pump rpm, pump amperes, swing amperes, and ladder amperes. Digital readouts on the dredge screen will include swing heading, slurry velocity, density, spud carriage position, ladder depth, swing rpm, and other critical parameters. A rubber-lined stainless steel magnetic flow tube gives the velocity signal needed to control flow and calculate production, and a low gamma radiation nuclear density meter assists with automatic control of production. Tied to the intake suction relief valve, consistent slurry production can be realized.

The remotely controlled booster pump is also worth review. It is now possible to control and monitor the system remotely from any desired location and also to integrate the booster pump into the automated production control system. Through the integrated automated control, the operator will be relieved from having to constantly adjust the booster pump speed as flow and pressure vary, thereby enabling him/her to concentrate more on the dredging duties at hand. The pump speed will regulate around the measured inlet pressure and adjusts itself based on the flow/pressure relationship of the main dredge pump, never allowing the booster to fall below a predetermined value. In other words, the self-regulating function will prevent booster inlet pressure from ever decreasing to vacuum.

The following photograph (Figure 2) is of the new Dredge William L/ Goetz.

Figure 2. Dredge William L. Goetz.

THE TOWBOAT GENERAL WARREN

The Goetz fleet consists of the Thompson pipeline, the Quartersbarge Goetz, and smaller ancillary vessels. Tow resistance calculations for the Goetz fleet were compared to actual operating experience. These two indicated that a towboat of approximately 2,800 BHP would be needed for the Goetz fleet.

During this time period, the Corps of Engineers Marine Design Center was awarding a contract for two new 3,000-HP towboats, one for the Pittsburgh District and one for Huntington District. The contract was awarded to Orange Shipbuilding (OSB) in Orange Texas. OSB is a subsidiary of Conrad Industries, a well established boat builder with several shipyards in the Gulf of Mexico area.

In September 2002, an option for a third towboat for the St. Paul District was awarded to OSB. The option award provided the advantage of having a set of completed conceptual engineering and design drawings and a contract already in place. This arrangement allowed cost sharing and extensive standardization for all three boats in the OSB contract.

Features of the towboat incorporate the Corps' extensive experience with towboat construction and operation. The Corps' experience over construction of numerous towboats has resulted in continuously evolving and improving towboat design, which has continually improved vessel capability.

Much of this ongoing improvement process has been implemented in close coordination with the commercial industry towboat design expert CT Marine. CT Marine is the designer of the Corps towboats under contract at OSB.

The following key technical features were implemented in the Towboat General Warren:

- Kort nozzles for maximized shallow water thrust and efficiency.
- Double steering and flanking rudders for maximum practical steering and flanking power.
- Rudder interlock with engine control to maximize flow to propellers in all steering modes.
- Fuel tanks isolated from hull sides and bottom.
- Built to ABS Maltese Cross A-1 requirements.
- One compartment damage survivability.
- Extensive structural fire protection, with almost total elimination of wood in crew areas.

Twin Caterpillar 3512B engines rated at 1,500 BHP @ 1,200 RPM provide a total of 3,000 BHP. This capability is much greater than the vastly underpowered Thompson.

Propellers are five blades, 203.2 centimeters (80 inches) in diameter in 205.74-centimeter (81-inch) Kort nozzles. Props have a design speed of 10.47 kilometers per hour (6.5 miles per hour) and rotate inboard at the top. Clean water sumps at each stuffing box preclude the seepage of water into the shaft alleys.

As mentioned above, the steering rudder system is somewhat unique in that, instead of simply one steering rudder per propeller, there are two off center of the propeller shafts. This configuration provides approximately 30 percent more steering thrust than the more frequently seen single steering rudder configuration.

Also mentioned above is the steering engine control interlock. The interlock is automatic. It centers the flanking or steering rudders automatically when the engine is in ahead or astern mode, respectively. This feature minimizes blockage of water flow to the propellers from hard over rudders, which improves thrust and steering power while reducing vibration.

Tank capacities on the General Warren include 121,133 liters (32,000 gallons) of fuel, 43,154 liters (11,400 gallons) of potable water in a 304 stainless steel tank, and 20,441 liters (5,400 gallons) for either/or black or gray water. As mentioned above, the fuel oil tanks are totally isolated from the hull bottom and side shell to provide double hull protection against oil spill.

Length of the vessel is 37.80 meters (124 feet), width is 10.36 meters (34 feet), molded depth is 3.05 meters (10 feet) at midship, and the draft is 2.44 meters (8 feet) fully loaded. Delivery of the MV General Warren is expected in spring 2007.

Figure 3 shows the new Towboat General Warren.

Figure 3. Towboat General Warren.

THE QUARTERSBARGE TAGGATZ

The Quartersbarge Taggatz design is developed from earlier (larger) quartersbarges designed and built for the Vicksburg District revetment fleet. Three quartersbarges were built for Vicksburg in the last 10 years. The Vicksburg barges are proven in service and, therefore, provided a good basis for the Taggatz design.

The revision of the Vicksburg design to meet the requirements for the smaller Taggatz was done by John J. McMullen Associates (JJMA). The Taggatz design meets American Bureau of Shipping requirements for accommodation barges and also meets U.S. Coast Guard requirements for Subchapter H passenger vessels.

The Taggatz procurement was started in March 2006 using a Best Value procurement format along with a technical specification developed by the Corps of Engineers Marine Design Center and vessel drawings developed by JJMA.

A contract was awarded August 2006 to Patti Shipyard of Pensacola, Florida. Patti Shipyard has built a number of vessels for the Corps of Engineers, including the latest quartersbarge for Vicksburg. The Taggatz is under contract and is expected to be finished by spring 2008.

The Taggatz is 48.77 meters (160 feet) long and 12.19 meters (40 feet) wide. It has a two-level house with living quarters for a crew of 60 and mess capability for 40 persons at one sitting.

With the exception of single berths for the captain, pilot, chief engineer, and visiting guest, rooms are generally set up with two bunks each. The two-bunk quarters have sufficient space for an additional two bunks if needed for emergency operations.

The Taggatz will have office space to perform administrative work and an engineer room where all dredge and booster barge parameters can be remotely monitored and the quartersbarge systems can be closely supervised.

A satellite communication system equipped to receive encrypted data transmissions to and from Corps facilities will also vastly improve communication from the cell phones and radios currently in use on the Thompson. The large mess room will serve dual duty as a training and meeting venue in addition to providing family-style dining for the crew. A lounge and exercise room in the hold, as well as communication capability in each stateroom, will provide for personal time when not on shift.

As mentioned before, the separate vessel configuration allows for multiple missions beyond dredging. The secondary mission for the Taggatz is lodging for St. Paul District crews during winter lock chamber dewatering efforts on the Upper Mississippi River. The Taggatz can also be called into duty as an emergency operations center if required on other parts of the river or nation.

As with the dredge and towboat, the Taggatz' fuel tanks are isolated from the hull bottom and sides providing double hull spill protection.

Virtually all systems in the barge are tied to the Machinery Alarm and Monitoring Systems (MAMS) including the fuel system, potable water systems, bilge pumps, and the engine/gensets. The MAMS also monitors engine conditions and systems on the dredge and the booster barge from the engineer's room in the quartersbarge hull as well as the chief engineer's stateroom.

The Taggatz is equipped with two 13.72-meter (45-foot) spuds and two electric-driven spud winches to anchor the quartersbarge at the dredge site.

To accommodate the potable water needs of 50 people, a fresh water production system using heat from one or both of the boilers provides a minimum of 18,927 liters (5,000 gallons) of fresh water daily. All gray and black water is processed through a U.S. Coast Guard-approved Type II biological, fixed media, marine sanitation device complete with associated dechlorination to produce effluent containing not more than 25 milligrams per liter Carbonaceous Biochemical Oxygen Demand and 30 milligrams per liter of Total Suspended Solids. Effluent can then be piped to the gray water holding tank or overboard, if allowed.

The heating, ventilation, and air conditioning system is worthy of description on a vessel occupied by a 50-person crew. All spaces requiring air conditioning, except for the stores and exercise room in the hull, are to be outfitted with Packaged Terminal Air Conditioners (PTAC) fitted with direct expansion (DX) coils for air conditioning and hydronic coils for heating. The stores and exercise room are provided with a split air conditioning system consisting of an outside air-cooled condensing unit and an inside air handling unit having a DX coil and a hydronic heating coil. Non-air conditioned spaces have hot water space heaters served by a two pipe hydronic system. Air conditioning condensation pipes drain to the gray water holding tanks. To feed the hydronic heating system throughout the barge, two commercial grade hot water boilers and a boiler water circulating system is provided. The system is arranged to supply a 50 percent solution of water and propylene glycol to the PTACs, the fan coil unit in the exercise room, and the hot water duct and space heaters in other zones of the barge. As previously mentioned, all systems are connected to the MAMS for monitoring and safety.

The Taggatz will be delivered with American Bureau of Shipping Class, and with American Bureau of Shipping certification of compliance with U.S. Coast Guard Subchapter H requirements.

The following photograph (Figure 4) is a conceptual view of the Quartersbarge Taggatz.

Figure 4. Conceptual view of the quartersbarge Taggatz.

DREDGE THOMPSON – ITS NEW MISSION

To complete the Dredge Thompson Replacement Project, the Thompson itself had to be disposed of in manner appropriate for its age. Foreseeing the end of an era on the Upper Mississippi River, Corps staff initiated efforts to record the lifestyle and work on the 70-year-old vessel. By chance, the owner of the media firm hired to film dredge operations asked what would happen to the Thompson once the new equipment arrived. When told it would be put on surplus to the government's needs through the General Services Administration, the media company owner began working with other business owners in the Winona, Minnesota, area to seek endowments for acquisition of the Thompson as a museum piece.

After organizing itself as a nonprofit tax entity, the group prepared a business plan to submit to the General Services Administration for consideration as a state-endorsed recipient for the Thompson as a museum exhibit. The Corps carefully worked with the General Services Administration, the Winona group, and other groups interested in acquiring the dredge and surplused the dredge with the caveat that it would continue to be used for dredging operations until all new equipment is received.

The new Minnesota Marine Art Museum opened in July 2006 with four main exhibits: an exclusive world class collection of maritime paintings and artifacts dating to the late 1700s; a unique collection of whimsical wood carving depicting the local river ecology; a historic collection of late 1800 photos by a Corps cartographer with uncanny composition ability; and, in 2008, the Dredge William A. Thompson.

CONCLUSIONS

The replacement of the 70-year-old William A. Thompson with three modular vessels provides the same dredging capability. It also provides improved efficiency, better environmental protection, new flexibility and multi-mission capability.

The Dredge Goetz, the Towboat General Warren, and the Quartersbarge Taggatz provide the government and the nation with an environmentally friendly and efficient dredge fleet to lead the St. Paul District into its next 50 years of channel maintenance dredging on the Upper Mississippi River. Together with those new vessels, the Thompson will still serve the nation in its new capacity as a valued part of the new Minnesota Maritime Art Museum, preserving an important historical link to the Upper Mississippi River.

The new vessel names also contribute to valued historical continuity. Bill Goetz was Chief of the St. Paul District's Construction-Operations Division for nearly 30 years; General Gouverneur K. Warren was a Civil War hero and the St. Paul District's first District Engineer; and Harold Taggatz was Bill Goetz's long-time Assistant Division Chief and trusted union and management stalwart.

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