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US Army Corps of Engineers®
Marine Design Center

USACE MARINE DESIGN CENTER

Marine & Floating Plant Newsletter

Inside this issue:

WHEELER Repowering	1
YAQUINA Repowering	1
Machinery Alignment Expertise	2
Noise & Vibration	3
Hybrid Power Systems	3
Maritime Training	3
Abrasion Resistant Plate and Pipe	4
Environmental Update	4
Dredge MURDEN In Clearwater	5

Dredge WHEELER Gets New Engines

The New Orleans District and Marine Design Center have partnered to breath some new life into the Dredge WHEELER. She was commissioned in 1983.

Particulars:
Length Overall: 408'
Beam: 78'
Draft: Light- 28'
Loaded- 40'
Hull Depth: 52'
Height: 156'
Displacement: 10,614 Long tons
Capacity (Hopper Volume): 8256 CuYds

The dredge's primary mission is to help maintain the navigation channels in the southern passes of the Mississippi River from Venice, LA to New Orleans, LA. However, the vessel is capable of operating anywhere in the world.

The ship is scheduled to undergo repowering of the main propulsion engines and dredge generator engines. The existing original equipment Cooper Bessemer engines will be replaced with new Caterpillar C280 Tier II engines. All the new engines will be EIAPP (Engine International Air Pollution Prevention) Certified and much more fuel efficient.

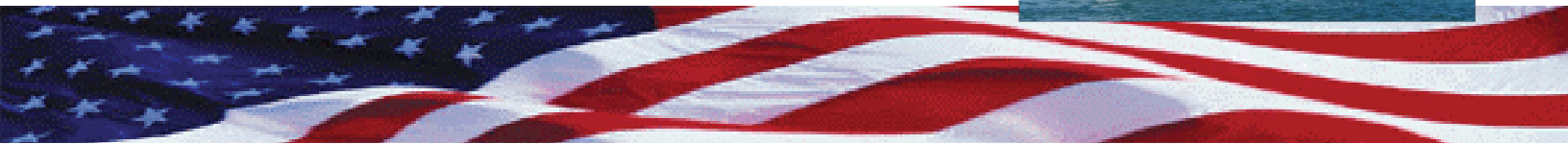
The dredge entered Signal Ship Repair in Mobile, AL on July 30 and was drydocked on August 8. (See more photos page 5)

Dredge YAQUINA Mid-Life Upgrades

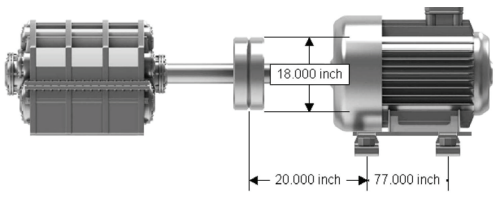
The Portland District, in conjunction with MDC, recently completed a four year process of upgrading the Dredge YAQUINA's machinery. YAQUINA was commissioned in 1981. Particulars:

Length Overall: 200'
Beam: 58'
Draft: Light 8' - Loaded 14' 8"
Depth: 17'
Depth Open Doors: 19' 2.5"
Height: 100'
Displacement: 2,001 tons
Capacity (Hopper): 1,042 CuYds

All upgrades were accomplished during the dredge's normal winter overhauls. In 2008 the dragarm winches and bow thruster engine were upgraded. Gensets were replaced in 2009, and main engines/drive train in 2010. In 2011 the dredge pump and engines were replaced. All new engines are manufactured by MTU to EPA Tier II standards. All cooling, controls, & monitoring were also entirely replaced.



Machinery Alignment Expertise



Motor to Gear Box Alignment

The alignment of machinery is always a critical step to a successful problem free installation. This is especially true aboard ship as the entire platform flexes in a seaway. Dredges present unique alignment issues. No other type of vessel loads and unloads its cargo 7-10 times per day experiencing repeated hull bending such as hopper dredges. Pipeline dredges are constructed on barge type platforms with extremely robust ladders which impart significant forces on the hull resulting in deflections that must be anticipated in the machinery alignment procedure.

The alignment procedure is critical as is the flexible coupling selection. Shipyards tend not to have the most modern specialized alignment equipment such as lasers, strain gages, and analysis software to achieve the necessary precision. Recent shipyard contracts have had great success with alignment experts from Aiman Alignment Services and Diehl Engineering, websites below.

Just being within coupling tolerances is often not good enough. The magnitude of deflections on either side of perfect alignment are often unknown, so the closer to perfect, the better. Aim small, miss small...

www.aimanalignment.com
www.diehlengineering.com

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Noise & Vibration

USCG Navigation & Vessel Inspection Circular (NVIC) No.12-82 “Recommendations On Control of Excessive Noise” contains the Coast Guard’s recommended guidelines to the U.S. maritime industry for addressing conditions of high noise.

The effect of noise on hearing is a function of the actual noise level, its component frequencies, and the duration of exposure. The Coast Guard has concluded that the most meaningful method of evaluating excessive noise in the maritime industry is by measuring the cumulative noise exposure during the complete 24-hour day. In addition to consideration of the normal work time noise exposure, the 24-hour exposure measurement considers the time after exposure to high noise to evaluate whether sufficient quiet time is provided to allow for recovery from temporary threshold shift (an elevation in the lowest level of sound detectable to the ear). The term used to express this measurement is the "24-hour effective exposure level," or $L_{eff}(24)$. NVIC 12-82 provides examples how to calculate $L_{eff}(24)$. Each crewmember's $L_{eff}(24)$ should be constrained to a maximum of 82 dB(A). The maximum $L_{eff}(24)$ can be achieved by any combination of engineering controls, administrative controls or hearing protective devices.

Examples of engineering controls include acoustic insulation on boundaries, isolating machinery vibration from its foundation, enclosures around high noise producers, etc.

Administrative controls include restricting personnel’s time in proximity to high noise or limit the time that high noise producing machinery is allowed to run.

The difficulty in design is predicting the actual noise level after construction. Many shipyards have subcontracted with Noise Control Engineering, Inc. in Billerica, MA. They specialize in shipboard generated noise and vibration and the treatment of the same.

www.noise-control.com

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Hybrid Power Systems

There have been several developments that are moving marine hybrid power beyond the realm of demonstration projects and into the realm of economic reality.

The first is marine emissions. Boats discharge a significant amount of exhaust gases into the atmosphere. Clean air regulations are a driving force for improving diesel combustion technology. The combustion setting for best emissions is not the most fuel efficient setting. If a vessel could run a portion of its operating profile without running the diesels, fuel is saved and emissions are reduced .

The second factor is the cost of energy storage systems (ESS). Battery storage systems as well as kinetic energy storage (flywheel) is progressing to the point where the investment can be economically feasible given the appropriate application and operating profile. The huge weight of a battery system is usually detrimental in the ship design, but low speed workboats can use batteries as ballast to increase stability and level the trim. Batteries can also provide a "buffer" against spike loads that exceed the power available from the generators online, which is very reassuring for the Captain and Ch Eng.

A third factor is DC Power Technology. Where in the past we have always used AC electrical generation and distribution, new developments in DC circuit protection and distribution have ushered in a new electrical paradigm. A DC Power bus eliminates the need to synchronize generators to match frequency and allows the generators to run at variable speed. The variable generator speed allows each generator engine to be programmed to run at the most fuel efficient RPM for any load applied. Also, a DC Main Bus provides low electromagnetic emissions/ harmonics. The generator control/switchgear or AC synchronizing equipment is not necessary. Combining these advantages with a Power Management System allows the use of all available power onboard in a very efficient manner.

More about this in future newsletters.

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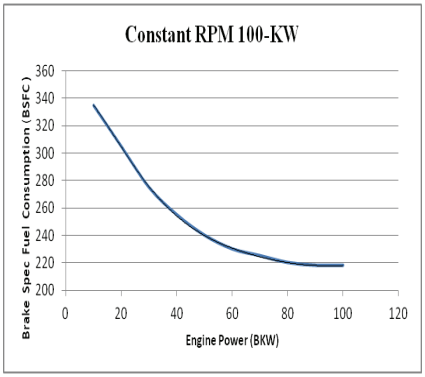

TOP— Typical Generator Load vs BSFC

Below - 6.5 Kw-Hr Lithium Ion Battery (Photo Corvus)

Maritime Training

Most USACE mariners are probably already aware of the outstanding training opportunities available from the schools operated by the maritime unions. Marine Engineers Beneficial Association (MEBA), the International Organization of Masters, Mates & Pilots (MM&P), and the Seafarers International Union (SIU) offer outstanding maritime training at their facilities:
http://www.mebaschool.org/
http://mitags-pmi.org/
http://www.seafarers.org/paulhallcenter/phc.asp

The USACE supervisors and managers responsible for our boat operators and engineers may not be aware that these resources are available to them to improve the performance and professionalism of our mariners.

Courses are offered in Diesel Technology, Marine Electronics, Instrumentation, Fire Fighting, Welding, Hazardous Materials, Marine Electric Propulsion/ High Voltage Safety, AIS, ECDIS, Environmental Regulations including EPA VGP training, Safety, Medical, and all of the license upgrade and training for other qualifications. This is just a short list of what is available. They can also design courses based on specific needs. Most of the training is directed toward oceangoing but many of the courses crossover and are applicable to rivers too.

Abrasion Resistance Plate & Pipe

The dredging industry is a maintenance intensive environment. We are constantly on the lookout for new technologies, processes, and materials that will reduce maintenance and increase the durability of the components that the Corps fleet consumes in the field. This article summarizes some of the advancements made in the area of abrasion resistant materials applicable to the dredging industry and provides links to those products.

Cross-Linked Polyethylene Pipe (PEX) is formed from HDPE into tubing, but contains cross-linked bonds in the polymer structure, changing the thermoplastic to a thermoset (the entire pipe is one big molecule). Both the low and high temperature properties of the polymer are improved as are chemical resistance, impact and tensile strength, abrasion resistance, and resistance to brittle fracture. Currently it is only available up to 20". For more information visit www.pexgol.com or www.castart.nl.

Super C and TriBraze are both registered trademarks of Kennametal Tricon Metals & Services, Inc. TriBraze is a quenched and tempered, thru-hardened, high impact, superior abrasion resistant alloy steel. Super-C is a composite plate consisting of a low carbon steel base plate and an alloyed super wear resistant cladding. The base plate enables the plate to be welded, bolted or studded to existing structures, while the cladding provides a premier wear surface capable of working in the most hostile environments. More products to come. Stay tuned.

Environmental Update

MDC recently attended the 2012 Marine Log Global Green Ship Conference and Expo in Washington, D.C. to become familiar with new developments in environmental technology for the maritime industry.

Since LNG is very abundant, clean burning, and low cost, it was the topic of a discussion panel: *Bringing LNG-fueled vessels to the U.S. Market.* The panel consisted of members from ABS, USCG, Wartsila, and TY Offshore.

Several hurdles need to be overcome. One major obstacle is that the LNG fuel infrastructure does not exist on U.S. waterways. Mr. Nuss (TY Offshore) presented an offshore supply vessel that they are currently building for Harvey Gulf. The vessel will be powered by an LNG fueled diesel electric plant. Harvey Gulf has lined up 7 different suppliers for LNG. The initial plan will be to bunker by trucking the fuel to the pier and may eventually evolve into bunkering from an LNG fuel barge.

Another obstacle is regulatory— the USCG currently does not differentiate between LNG being transported as a cargo or used as a fuel. The current USCG process for reviewing LNG fueled ship designs is to use IMO MSC-285(86) as the interim guideline for these reviews until the actual USCG code is released, which is expected in 2014. Additional information is available at http://www.uscg.mil/hq/cg5/cg521/.

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Dredge MURDEN Digging in Clearwater, FL

The split-hull shallow draft Dredge MURDEN arrived at its first dredging job in Clearwater, Florida on its way home to Wilmington District, N.C.

Although the design is similar to the Special Purpose Vessel CURRITUCK, which is a converted split-hull hopper barge, the MURDEN is a cargo ship with a USCG Subchapter I Certificate of Inspection and ABS Classification. Marine Design Center worked with Wilmington District to establish the design objectives and concept design. Jensen Maritime Consultants prepared the contract design. Conrad Indusries, Morgan City, La., was awarded the construction contract. Conrad received detailed design support from Bristol Harbor Group, Inc.

The mission of the MURDEN is to dredge the low-use shallow water inlets and the Intracoastal Waterway along the East Coast. This presented some significant design hurdles to overcome. For instance, how do you arrange 10 lbs of machinery into a 5 lb dredge and maintain a 4'-3" light draft? In addition, the ship needs sufficient propulsion and steering power to handle the winds and currents on North Carolina's Outer Banks ocean bars. The design also needed to be structurally robust since the dredge will spend much of its time "touching" the bottom.

MURDEN will operate as a day boat so it has no quarters on board, and comes to the dock every night. The dredging control and monitoring system is DQM Certified.

All hydraulic fluids on board are environmentally friendly. In fact, the system which opens and closes the two split hulls is water powered by BOC Water Hydraulics, Inc.

Vessel Particulars:

Length: 156'
Beam: 35'
Depth: 10'-9"
Draft Light: 4'-3"
Draft Loaded: 9'-0"
Hopper Volume: 512yd^3
Propulsion: ZF/HRP 4111 Azimuth Stern Drive
Main Engines: Cummins QSK19-M, 760HP
Dredge Pumps: Mobile Pulley 100 HP VFD Electric Drive
Bow Thrusters: (2) Wesmar 100 HP VFD Electric Drive
Generators: (2) Cummins QSM11-DM 250 KW
Navigation Suite: Radio Holland
Dredging Controls: DACS, Inc.

MURDEN During Dredging Trials

The new dredge is a great addition to the Corps' fleet and a welcomed relief to the small ports along the East Coast.

Hopper Loading

MURDEN Delivering Sand to the Beach in Clearwater

WHEELER Engine Removal

WHEELER in Drydock, engine and ship prepared for removing in one piece

Cooper 16 Cyl Propulsion Engine on rails outside the hull. Weight Approx. 50 Ton

Spreader Beam Attached to Main Engine

Main Engine Clearing The Drydock

US Army Corps of Engineers Marine Design Center

The Marine Design Center is the Corps of Engineers center of expertise and experience for the development and application of innovative strategies and technologies for naval architecture and marine engineering. We provide total project management including planning, engineering, and shipbuilding contract management in support of Corps, Army, and national water resource projects in peacetime, and augments the military construction capacity in time of national emergency or mobilization.

Special Expertise From MDC

- Safety/Fatality Investigations
- Marine repair support (in advance of yard availability and during)
- Claims Investigations
- Inclinings, Stability, Load Curves, Weight Handling
- Noise and Vibration
- Marine Electrical Systems
- Thermal Imaging
- Drydock and Blocking
- Hull Thickness Surveys (In-water and on drydock)
- Model Testing
- Dredging Systems
- Design & Construction of Floating Plant

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