MARINE AND FLOATING PLANT Sub-COMMUNITY OF PRACTICE NEWSLETTER

Marine Design Center

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Issue #12 –August 2010

Greetings,

The purpose of this Newsletter is to keep all USACE people who are involved in the marine industry informed about new marine information, products, and services. Sorry it's been so long between issues, but a few major MDC projects needed that personal technical touch, and attention to the newsletter suffered.

Please forward this to those in your organization who would benefit from it. If anyone wants to be added/removed from this Newsletter, please reply with instructions. Also, please review the addressee list and let us know of new persons in positions vacated by those listed. We will be adding the Newsletter to our website in the future (http://www.nap.usace.army.mil/mdc/).

The following items are addressed in this issue:

- Antenna Design – Does the antennae layout on top of your pilothouse look like antenna seeds randomly germinated? Problems with reception? Transmission? Maybe MDC can help.
- UHMWPE Marine Applications – Shrinkable Ultra High Molecular Weight Polyethylene (UHMWPE) applications around moorings and on vessels.
- Mooring Rehab Project – St Louis District needed a new mooring facility…
- Using 3D Laser Scan for Marine Retrofits – New tool available to enhance shipchecks and redesign of congested compartments for repowerings and retrofits.
- Dredge Pump Casting Development – New patented technology from an American company greatly improves wear life, while maintaining efficiency and suction performance.

Any questions or suggestions for the next issue can be referred to either of the following by phone, at (215) 656-6850, or by email:

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Special Expertise From MDC

- Safety/Fatality Investigations
- Claims Investigations
- Noise and Vibration
- Thermal Imaging
- Hull Thickness Surveys (In-water and on drydock)
- Dredging Systems
- Marine repair support (in advance of yard availability and during)
- Inclinings, Stability, Load Curves, Weight Handling
- Marine Electrical Systems
- Drydock and Blocking
- Model Testing
- Design/Construction of floating plant
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Antenna Design - MDC has technical expertise in the area of antenna engineering and can provide solutions to the Corps of Engineers in the development of antenna selection, specifications and installation. Vessels have antennas for various types of communication systems, including marine VHF radios, radar units, satellite television, GPS and data transmission/reception. Typical antenna specifications require definition of parameters such as frequency range, center frequency, impedance, VSWR (voltage standing wave ratio), directivity, efficiency, gain and power rating.

Antenna impedance is a measure of the real resistance and imaginary reactance of an antenna. Impedance is expressed as a ratio of antenna voltage to antenna current. The industry standard reference for antenna impedance is 50 ohms. Factors affecting antenna impedance include antenna length, wire size, height above ground or water surface, distance from other antennas, sources of electromagnetic fields from equipment and circuit board components in the antenna's transmitting/receiving equipment.

VSWR is a ratio of maximum and minimum voltages, caused by reflection of the initial alternating current voltage applied to the antenna as it travels along the transmission line back to the source. VSWR measures how well an antenna is matched between source and antenna impedances. The importance of impedance matching is to provide the maximum energy to the antenna. A perfect antenna radiates all of the transmitted source energy into free space, which results in a VSWR ratio of 1:1. However, impedance mismatches occur between the antenna and the source since no antenna is 100% efficient, which results in a VSWR ratio that is greater than 1:1. It is desired to have a VSWR as close to 1:1 as possible. Some typical antenna VSWR ratios are 2:1, 1.5:1 and 1.2:1. The major factors affecting VSWR is antenna and transmission line impedance.

Antenna performance is represented by radiation patterns, which are typically shown as polar plots in elevation and horizontal planes. Antenna performance is dependent upon efficiency which is a function of the antenna impedance and VSWR.

Antenna directivity measures an antenna's maximum radiated power density in a particular direction, relative to a reference radiator with an equal source power. Directivity is expressed as a ratio of the maximum power density to the reference radiator source of equal power. Directivity is expressed in decibel units (dB) and is more specifically addressed in terms of dBi, dBd, "Marine dB", dBiL or dBic.

Antenna gain is directly related to directivity and is one of an antenna's most important specifications. Gain is the directivity of the antenna, reduced by antenna losses and may be expressed as the product of antenna efficiency and directivity. Gain is also measured in decibel units and is the most direct measurement of an antenna's actual performance.

Antenna specifications may also include environmental parameters such as vibration, ship motions, shock, temperature, ice, humidity and rain.

Vibrations generated by vessel equipment or wind increase stresses in the antenna structure due to increased deformations caused by mechanical resonances, which may negatively affect antenna structural strength. Vibrations may also negatively affect antenna radiation performance due to input of mechanical energy into the antenna, which affects the geometry of the antenna during transmission and reception modes.

Ship motions such as roll, pitch and heave affect antenna line of sight to either the horizon or satellite. Satellite antennas can be mounted on stabilized platforms, to maintain line of sight between the antenna and satellite during ship motions. However, VHF "whip" antennas are typically mounted directly to the vessel without a stabilized platform are therefore are more susceptible to the effects of ship motions, especially during roll conditions, as the signal is no longer within the antenna radiation pattern.

Shock loading from vessel impact loading causes increased stresses in the antenna structure and therefore, negatively affect antenna structural strength.

Environmental conditions in locations within the vessel's area of operations may be affected by temperature, humidity and rain. These conditions can cause degradation in signal propagation through the atmosphere and therefore, may require adjustments in antenna selection or specification required for antenna performance, such as specifications for antenna structure materials.

Ice collection on the antenna also degrades antenna radiation performance, as its affects the antenna electrical properties and surface geometry.

Additional environmental conditions include ultraviolet rays and space weather. Ultraviolet rays from sunlight may degrade the antenna's exterior construction and therefore, may require use of more highly resistant materials. Space weather can occur in the forms of geomagnetic storms, solar radiation storms or radio blackouts and are caused by solar activity, which in turn, cause disturbances in the earth's magnetic field and electric currents in the earth's ionosphere. Geomagnetic storms affect the accuracy of GPS readings. Radio blackouts affect marine high-frequency (ship-to-shore) communications. However, space weather does not appear to affect communications in the marine band of VHF frequencies.

Antenna installation is affected by location with respect to other antennas or other sources of electromagnetic fields such as searchlights, radar units and other electrical equipment. The separation distance affects antenna impedance and therefore, affects antenna performance.

Antenna selection for vessel voice and data communications, GPS, radar and televisions systems is contingent upon knowledge of the vessel's geographic area of operation, terrain, environmental conditions, vibrations, ship motions and shock loading in addition to required system performance requirements. Vessel space limitations and external height restrictions may affect antenna locations and negatively affect system performance. MDC can provide its customers with the technical assistance necessary for antenna selection, specifications and installation, to meet system performance requirements. P.O.C. – Robert Samuel.

UHMWPE Marine Applications – What is UHMWPE? Ultra High Molecular Weight Polyethylene. A company in Maryland, Fluoron Inc., has patented a version of this material that is heat shrinkable and have developed a number of marine application called M.A.R.S.™ M.A.R.S.™ is tougher than steel.

Fluoron's Maritime Application Rope Savers (M.A.R.S.™) bridge the gap between brand new, high-tech synthetic lines and worn deck equipment. As most of you know, synthetic lines can be safer, lighter, faster, and can have the same tensile strength as wire rope. Though a worthwhile investment, synthetic lines can be quickly damaged by weathered and worn deck equipment. M.A.R.S.™ is essentially a cover that installs directly over your worn and weathered deck equipment.

M.A.R.S.™ provides a smooth, durable, corrosion-resistant surface. It demonstrates extreme wear resistance, even better than steel. Fluoron, Inc. has a patent on heat shrinkable M.A.R.S.™ roll covers and is now utilizing their expertise to develop solutions for marine corrosion and wear issues.

Advantages of Fluoron's Maritime Application Rope Savers:

- Restores rusted rollers to a wear-resistant surface
- Prevents corrosion, therefore eliminating line chafing
- Eliminates maintenance; stays clean
- One-time installation takes just minutes
- Available in black or white
- One-time installation takes just minutes

See other applications like piling covers and roller fairlead covers at http://fluoron.com/srs.htm.

Mooring Rehab Project - St.Louis District Fleet Mooring Rehabilitation Project

The Marine Design Center has been working closely with the St. Louis District to replace the CEMVS Service Base fleet moorings, extend its railroad trestle and construct a new access ramp from the trestle to the fleet. The project plans, specifications and engineering design was completed under A/E contract by Moffatt-Nichol, Walnut Creek California.

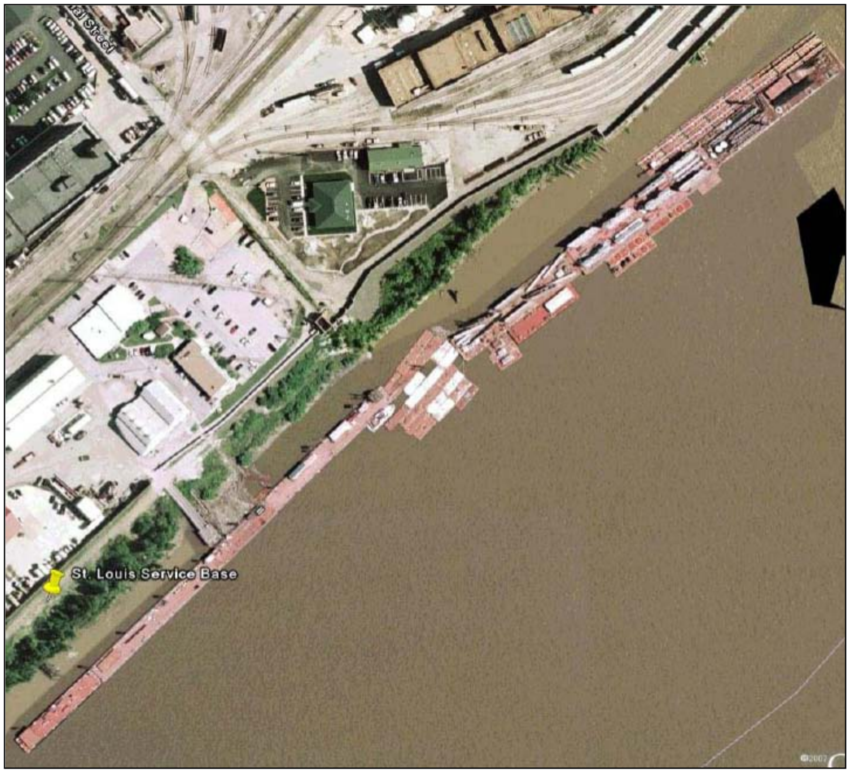


Figure 1 - Existing Conditions - St. Louis Service Base Main (left) & Upper (right) Fleeting Areas

The main fleeting area of the St. Louis District service base is approximately 960 feet long and consists of five fleet barges that are 153 linear feet in length each and one additional barge that is approximately 200 linear feet. The barges are moored to a series of wooden pile clusters, some of which have failed over the past several years. The main fleeting area supports the Dredge POTTER and attendant plants, MV PATHFINDER and Shop and Yards emergency crew plant and equipment (push boats and cranes).

The upper fleeting area of the St. Louis District service base is approximately 1,050 feet long and consists of various stop log, crane and work barges, dredge pipe pontoons and work flats. The southern end of the upper fleeting area is moored to two pipe pile clusters while the northern end of the upper fleeting area is secured by caissons attached to the barges.

A series of data collection efforts were undertaken to properly characterize the site. These efforts included:

- Land-based survey
- Hydrographic survey
- Geotechnical Investigation
- Hydrologic Study

Once the data collection effort was completed, a berthing analysis and engineering design was conducted to optimize the design and minimize costs. The final design features include:

1) Fleet Barge Alignment: The fleet barges (Main and Upper) will be aligned parallel to the shoreline. The upper fleet barges will consist of 20 excessed U.S. Navy Lighterage Barges. These barges were originally designed and used by the Navy to create modular floating causeways.

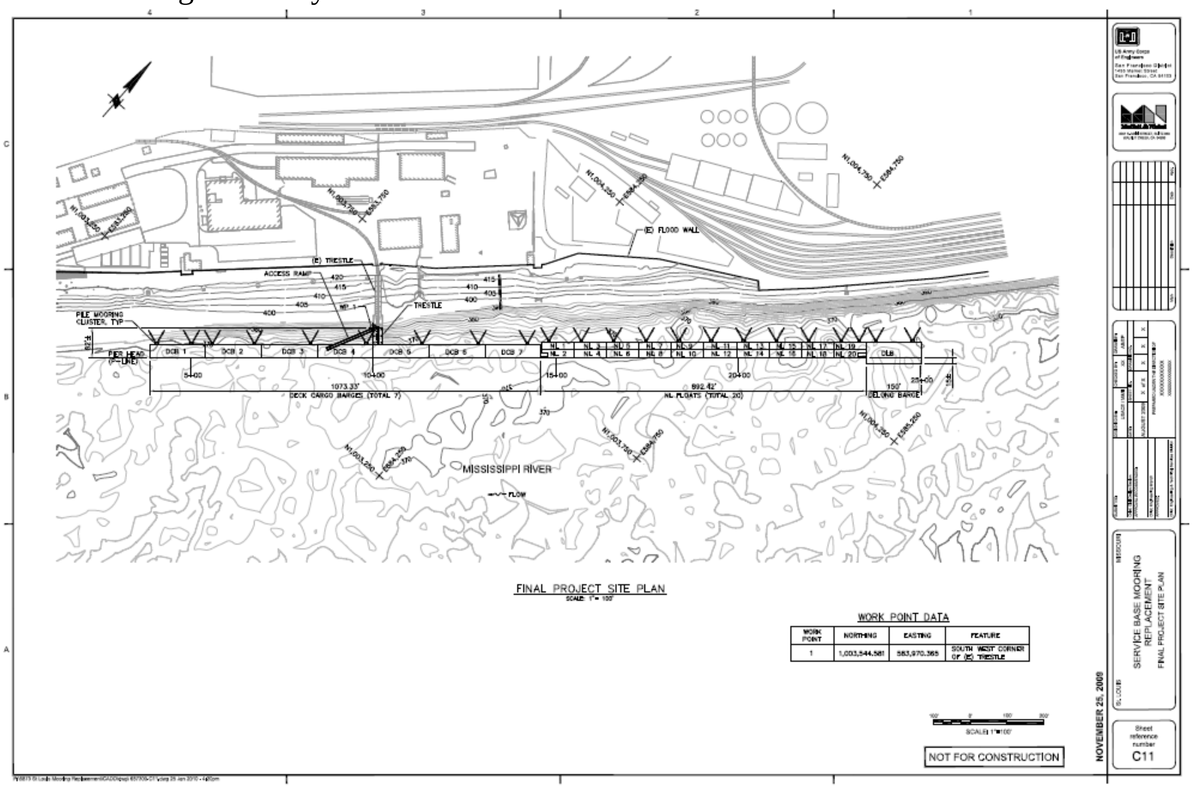


Figure 2 - Proposed Fleet Barge Alignment

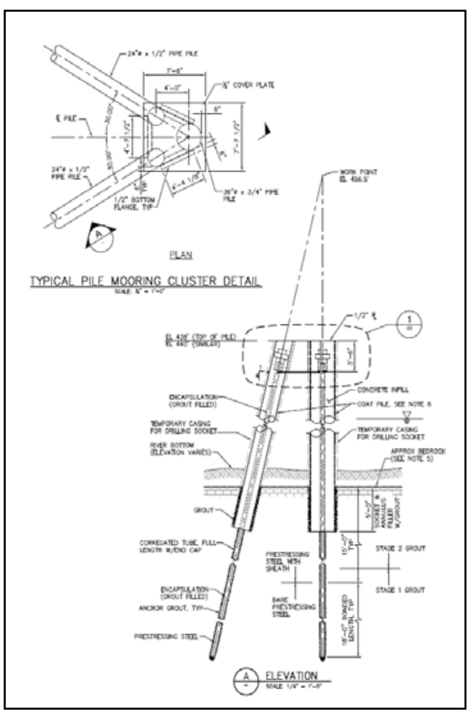


Figure 3 - Steel Pipe Pile Clusters

2) Mooring System: Twenty-two groups of 3-pile concrete-filled steel pipe clusters were selected to provide a reliable system for maintaining the wharf in position. The piles will be socketed into the underlying bedrock and rock anchors will be installed. A challenging aspect of the design was taking into account the seasonal fluctuations in the levels of the Mississippi River, which can be on the order of 50 feet. The pile clusters were located longitudinally along the moorings at specific locations to account for increased loadings represented by the larger sail areas of certain vessels. In effect, these vessels will have assigned "parking spaces". The barges that will make up the wharf will have collars attached to them that will allow the wharf to ride up and down the piles as river levels fluctuate.

3) Trestle Extension: The existing railroad trestle will be extended 45 feet to provide the fleet with more reliable, deeper water and to facilitate the wharf's alignment parallel to shore. A small crane may be permanently affixed on a trestle pile for use in supporting the fleet.

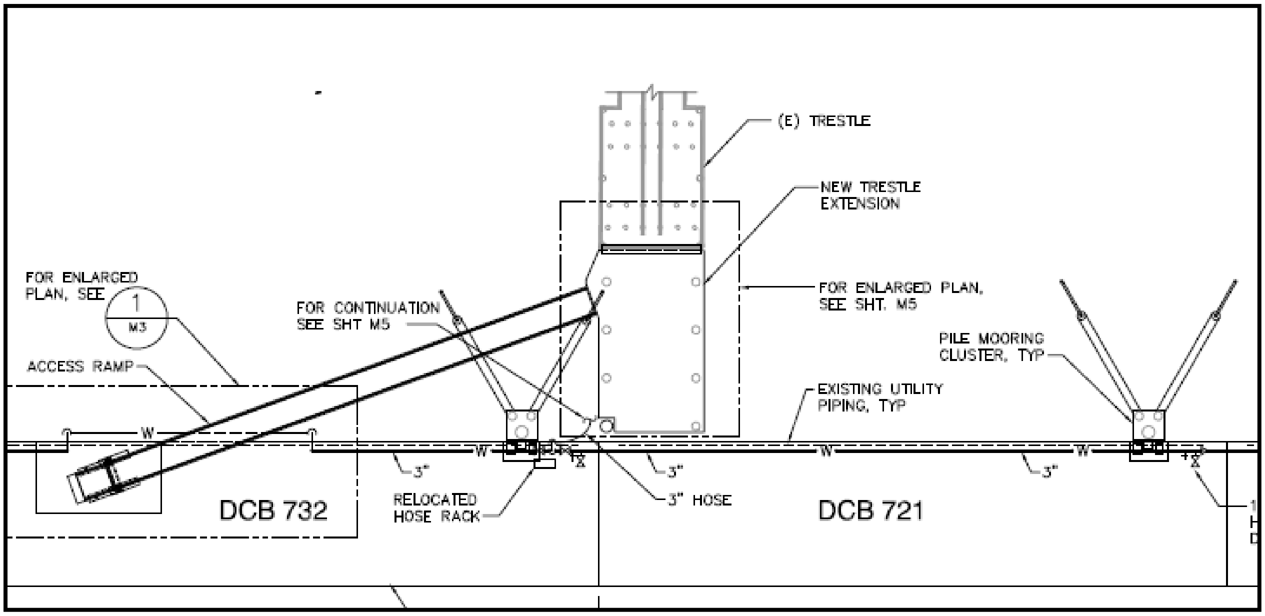


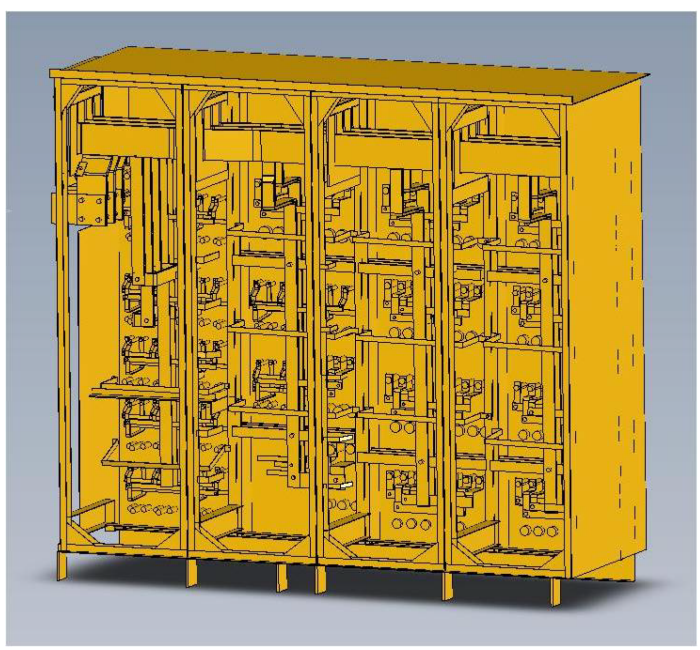
Figure 4 –Trestle Extension, Access Ramp, Pile Clusters and Wharf

4) Access Ramp: A ramp will be constructed to allow pedestrians and small motorized carts to access the fleet directly from the trestle. The inclination of the ramp will rise and fall with the river level.

5) Utilities: Electric and water will be supplied to the fleet.

The proposed project will meet the mooring needs of the St. Louis District and require less manpower to manage at all river levels. P.O.C. for this project is Brian Murtaugh at 215-656-6850.

Using 3D Laser Scan for Marine Retrofits –

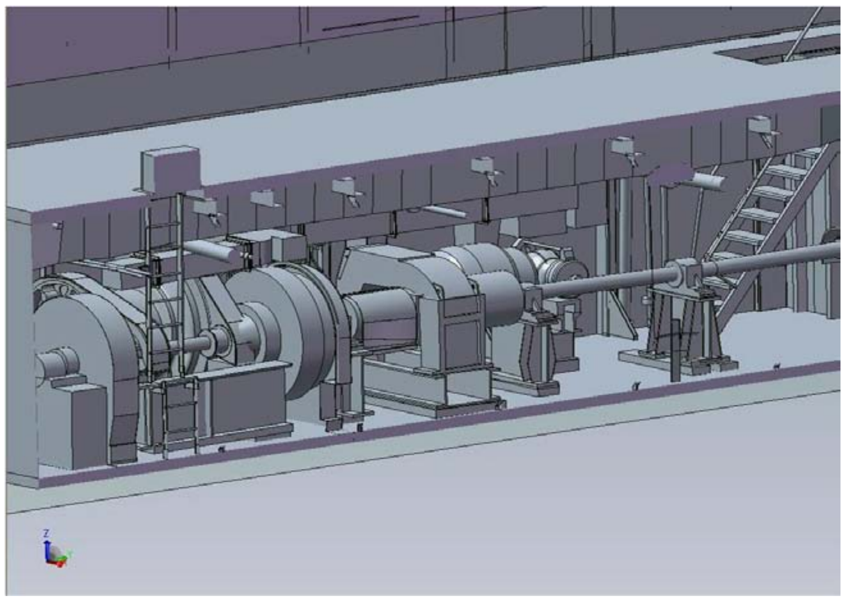


MDC is in the process of utilizing 3D Laser scanning for complex marine retrofits in congested areas. So far, we have acquired 3D scans for the dredges YAQUINA, McFARLAND, POTTER, and JADWIN. Example outputs of the scans are attached.

3D Laser scanning uses a high speed rotating laser scanner to paint an entire compartment with light. The resulting data is a 3D raster point cloud of everything in the space. It resembles a black and white photo except the data is 3D. This generic point cloud is then post-processed into distinct geometrical entities that can be displayed and manipulated via any 3D modeling software such as Solidworks.

The typical process of retrofitting new equipment into an existing congested space is to do a shipcheck, taking photos, measurements, and copious notes. Using the shipcheck data, the engineer then prepares plans and specifications for the upgrade. During the engineering, all interfaces and removals are identified to prepare ripout and installation plans. Usually a 2nd , 3rd , or sometimes a 4th shipcheck is required to confirm important data that was overlooked in previous checks. All of this data gathering was done with a tape measure referenced back to a "known" reference point.

With a 3D Laser Scan, geometrical data for the entire space is acquired at one time with very high accuracy (1-3 mm). All of the data taken can be referenced back to a known, surveyed point. The scanner can only get data that is line of sight. So the scanner is relocated and another scan is taken. Each 360 degree takes between 3 and 15 minutes per scan, depending on the density and accuracy specified. Obstacles may need to be removed, such as deck plates, walkways, etc…



The benefits are extraordinary. Dimensional accuracy is dead on. Bulkhead and deck penetrations are perfect in x, y, and z, planes. Orientation of important components is immediately apparent. Differences between original construction and existing condition today is easily discerned. We can see where structure has been modified or damaged, and how much permanent deformation occurred. We can see where piping has been removed or added.

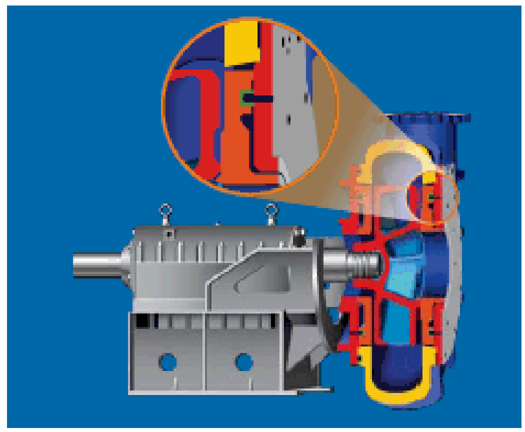
Other uses are:

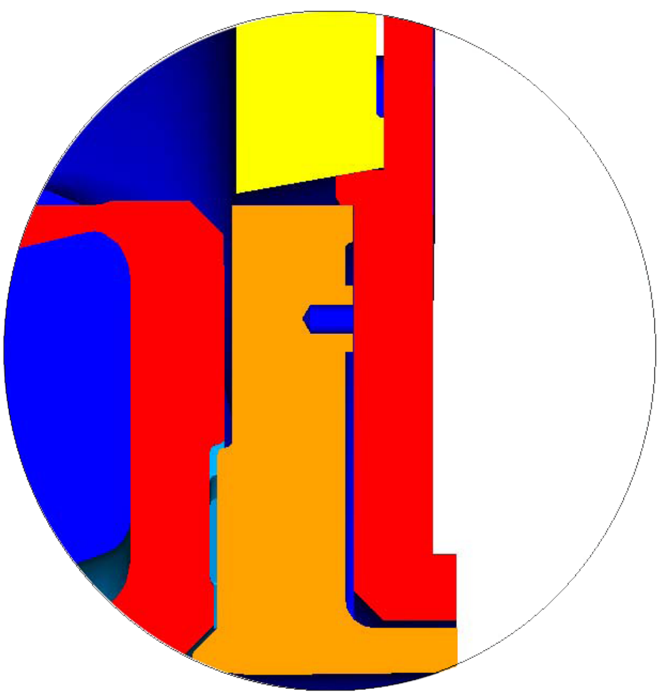
- Wear – castings, pump parts, propellers, etc… can be scanned when new and rescanned each year. Scans can be overlayed and the wear rate can be calculated and predicted very accurately.
- Damage Surveys – 3D Laser scans are used extensively for forensic engineering after an accident to help with future prevention of similar problems or to very accurately design and estimate the repair. Law enforcement uses scanners to take 3D photos of crime scenes.
- Simulations – 3D scans can quickly create walk-thru scenes of plant or consoles for training new operators or simply informing the public with realistic visual displays of what it is like in the engine room of a dredge or in the bowels of a dam.

- Hull Surveys – 3D scans can be used to quickly create accurate models of a vessel's hull form. This information is essential in performing stability calculations on existing vessels. This is especially useful where there are no original drawings or the hull has been changed.

Dredge Pump Casting Development – GIW Industries (Georgia Iron Works) in Augusta, Georgia is the premier dredge pump manufacturer in the world. GIW pumps are going into practically every new large dredge build worldwide. The most cost conscious Dutch and Belgian dredging firms regularly specify GIW pumps. Why is that? GIW has a tremendous staff of the best pump design and metallurgy brains in the industry. On their facilities in Augusta adjacent to their foundry they have a pump lab and test facility, and a materials test facility for performing research and development. Their investment in R & D, along with their commitment to develop their products into the highest quality, most efficient, longest life pump components in the world makes them a true model for American business.

One development that deserves recognition is GIW's patented Diverter technology. The Diverter is an ingeniously simple change to the impeller and the suction liner castings. The Diverter has no moving parts, no extra piping – does not require feeding. The Diverter consists of matched shoulders or steps cast into the pump's impeller and liner that drastically reduce the amount of dredged solid particles from migrating from the impeller periphery back down the front liner wall into the suction eye of the impeller. The shoulder on the liner forces the particles into higher velocity flow fields moving away from the eye.





Since many less particles actually recirculate back to the impeller suction, the Diverter decreases the wear in the suction throat (nose gap) area. This decreased wear results in longer life of the impeller and liner, less frequency of required nose gap adjustments (2-10 mm impeller-to-liner clearance), better NPSH and better efficiency over a longer time period. This results in less cost per cubic yard of dredged material pumped. http://www.giwindustries.com/GIW_Pumps_Finish_1st_in_Canada.shtml