T/S Golden Bear

Ballast Treatment Test Facility Concept Design Report

Prepared for
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University of Washington
Seattle, Washington

File No. 05111.02
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TS GOLDEN BEAR
BALLAST TREATMENT TEST FACILITY CONCEPT DESIGN REPORT

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1. OVERVIEW

Training Ship *Golden Bear*

The Training Ship *Golden Bear* was built in 1989 by Bethlehem Steel Corporation at Sparrows Point, Maryland, and originally named the *USNS Maury* (T-AGS 39). Designed as an oceanographic survey ship for the U.S. Navy, its original mission was to conduct ocean surveys and provide essential geophysical bathyrretric, gravity, and geomagnetic data. At the time of construction, the *Maury* was the largest and fastest oceanographic ship ever built, capable of maintaining speeds up to 20 knots.

The *USNS Maury* was transferred to the California Maritime Academy in September of 1994 and renamed the *Golden Bear*. Upon transfer the vessel underwent more than $6 million worth of repairs and modifications to adapt it to function in a training environment. The U.S. Maritime Administration is the vessel Owner and provides maintenance and operational assistance to support academy activities.

Now registered in Vallejo, California, the *Golden Bear* provides a comprehensive training platform to those interested in working in the marine industry. The California Maritime Academy operates two 2-month training cruises during the summer months of each year, during which time students from other universities such as California State University, California Polytechnic Institute or California State University, Monterey Bay join the academy to conduct biological and cultural research.

Figure 1 - *Golden Bear* at Dock in Vallejo, California

Ballast Treatment Test Facility: Testing Needs

The IMO adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Convention) in February 2004 with the stated objective to "prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments." Annex 3 of this Convention, *Guidelines for Approval of Ballast Water Management Systems (G8)*, details the "technical procedures for evaluation and the procedure for issuance of the Type Approval Certificate of the Ballast Water Management System." These guidelines supply detailed requirements for both land-based and shipboard testing efforts. Active substance use is detailed in Annex 4, *Procedure for Approval of Ballast Water Management Systems that Make Use of Active Substances (G9)*. This report will refer to each of these IMO documents as "*Guidelines*."

A November 2006 presentation by Jose Matheickal, Ph.D., IMO Globallast Program Director, listed three "Major Hurdles for Treatment Technology Development." The second of these was "lack of test facilities and physical infrastructure to test treatment systems." The following points were made by Dr. Matheickal regarding the status of current testing efforts and why ballast test facilities are needed.

- Current Status of Testing and Approvals
  - Significant variations associated with experimental designs, measurements made and reliability of analysis
  - Testing and evaluation, even at large scale, occurred before the groundwork had been established – is there a need to re-assess this in light of new guidelines?
  - Significant gaps in terms of information sharing
  - Problems often compounded by the extremely complex nature of the technical issue

- Need for Facilities
  - Increase standardization and quality control in experiments
  - Independence between treatment technology vendors and evaluators
  - Access to necessary physical infrastructure and to support R&D
  - Facilitate a regional, cost effective response to the needs of the industry

While Dr. Matheickal was likely addressing land-based facilities, the *Guidelines* give equal notice to shipboard testing. We submit that these challenges are even more significant with shipboard testing efforts. It is a significant challenge to "increase standardization and quality control" on commercial ships of opportunity where a science team must work through the realities of cargo operations and ship movements.

Ballast Treatment Test Facility: Proposed Capabilities for the *Golden Bear*

The modifications proposed herein will provide the *Golden Bear* the following capabilities that fulfill the immediate needs of a variety of treatment vendors. These modifications are **designed to meet the *Guidelines* for both shipboard ballast treatment system trials and land-based testing criteria.** In this way, the proposed modifications could provide investigators one evaluation location to gain the needed treatment system testing required for Type-Approval as detailed in the *Guidelines*. Type-Approval is a special status assigned by flag administrations to a particular product, indicating that it can be consistently manufactured to meet applicable standards. A comparison of the proposed modification capabilities with the *Guidelines* is provided in Table 1.

The proposed modification gives access to two ships ballast tanks (one treatment and one control), each with a capacity of 432 m^3 (114,100 gallons). The pumping system can vary the flow capacity of the system from 88 through 349 m^3 per hour (500 through 1500 gallons per minute) ranging between 4 and 12 feet per second of pipe velocity. This arrangement permits treatment on uptake and/or discharge with variable and control tanks filled simultaneously.

A quantity of nine sample tanks, each 1 m^3 (264 gallons), are fitted with ballast sample ports which permit testing ballast uptake before treatment, ballast uptake after treatment, control water intake, control discharge, ballast discharge before treatment and ballast discharge after treatment.

Ballast modifications include test equipment for in-line monitoring: flow rate, temperature and pressure. In addition, sampling ports and tank access permit portable equipment to measure: salinity, pH, total suspended solids, turbidity, particulate organic carbon, dissolved organic carbon and dissolved oxygen. The vessel's existing laboratory, while small, provides an appropriate working space for sample processing.

The proposed modifications eliminate the need for hard pipe, cabling or structural modifications to the vessel. This capability is termed "plug and play" and specifically addresses the challenge of outfitting a vessel of opportunity with suitable interfaces. The modifications include appropriate tie-downs for either a single 40 foot ISO container or two 20 foot ISO containers. The required interfaces of typical treatment systems (water, air and electrical power) are also provided.

Table 1 - Proposed Capability
Comparison with Shipboard and Land-based Guidelines

	IMO Criteria		Proposed Modifications		
			Vessel	IMO Comparison	
	Shipboard	Land-based	Capability	Shipboard	Land-based
Ballast Tanks					
Control capacity (m^3)	1:1 scale	200	432/441	☑	☑
Test capacity (m^3)	1:1 scale	200	432/441	☑	☑
Holding time	N/A	5 days	5 days	N/A	☑
Treatment Rate Capacity (TRC)					
Less than 200 m^3/hour	1:1 scale	1:1 scale	349	200	200
200 to 1000 m^3/hour	1:1 scale	1:5 scale	349	349	1,000
Greater than 1000 m^3/hour	1:1 scale	1:100 scale	349	N/A	34,900
Sampling Collection > 50 μm					
Influent test pre-treatment	Three x 1 m^3	Three x 1 m^3	Three x 1 m^3	☑	☑
Influent test post-treatment	N/A	Three x 1 m^3	Three x 1 m^3	Exceeds	☑
Influent control	N/A	Three x 1 m^3	Three x 1 m^3	Exceeds	☑
Discharge test pre-treatment	Three x 1 m^3	Three x 1 m^3	Three x 1 m^3	☑	☑
Discharge test post-treatment	N/A	N/A	Three x 1 m^3	Exceeds	Exceeds
Discharge control	Three x 1 m^3	Three x 1 m^3	Three x 1 m^3	☑	☑
In tank test	N/A	N/A	Three x 1 m^3	Exceeds	Exceeds
In tank control	N/A	N/A	Three x 1 m^3	Exceeds	Exceeds
Measurements, Physical					
Temperature	Required	Required	In-line	☑	☑
Ballast water flow rate	N/A	Required	In-line	Exceeds	☑
Ballast water pressure	N/A	N/A	In-line	Exceeds	Exceeds
Treatment power consumption	N/A	Required	Portable	Exceeds	☑
Salinity	Required	Required	Sample	☑	☑
pH	N/A	Required	Sample	Exceeds	☑
Total suspended solids	Required	Required	Sample	☑	☑
Turbidity (NTU)[3]	N/A	Required	Sample	Exceeds	☑
Particulate organic carbon	Required	Required	Sample	☑	☑
Dissolved organic carbon	N/A	Required	Sample	Exceeds	☑
Dissolved oxygen	N/A	Required	Sample	Exceeds	☑

Notes:
1. IMO criteria gathered from Annex 3, Resolution MEPC.125(53), Guidelines for Approval of Ballast Water Management Systems (G8).
2. IMO criteria does not appear to consider treatment upon discharge methods.
3. Sample collection below 50 μm will utilize portable containers: nine 20 liter containers and nine 1 liter containers.
4. Sample containers to be washed and reused between influent and discharge cycles.
5. Land-based performance is based on required organisms occurring naturally in the test water, no provisions to add cultured organisms have been considered at this time.

Golden Bear Open Source Approach

The *Golden Bear* ballast testing facility has been designed as an open-source facility. This means that the physical structure and support personnel are available for any investigator team to come and conduct testing. For example, a science team that has conducted testing at the Great Lakes facility can bring their treatment system and experience to the facility to continue their work.

This concept eliminates the overhead of maintaining a science staff, while maximizing the opportunity for projects that already have science and engineering teams integrated into the research and development. This however does not prevent "impartial" teams from using the facility to conduct certification testing when a system is ready.

Advantages of the Proposed *Golden Bear* Modifications

The *Golden Bear* ballast testing facility is specifically designed to minimize the cost, time and risk of conducting ballast treatment testing efforts while providing an environment which maximizes the reliability and repeatability of the scientific testing performed.

- Fiscal
  - An estimated complete certification testing cycle is $250,000. Detailed fiscal information is provided in Section 8 – Long Term Development Plan.
  - The capital modification costs (as proposed here) are significantly lower than the development of a new land-based facility. This lower cost is due to the existing vessel tanks, laboratory and support services (air compressors, electrical plant, potable water, etc.)
- Technical
  - The use of variable speed pumps allows an understanding of system effects (impact of sheer on organism mortality) at various flow rates. The system is designed with six feet per second pipe flow velocity as a speed which may minimize organism mortality while keeping organisms suspended in the flow stream. At the same time, the system has the ability to double this speed or half this speed as needed.
  - The use of multiple pipe size runs permits the system to achieve flow rates below the maximum design rate of 349 m^3 per hour, while maintaining a reasonable flow speed to keep organisms in suspension. Specifically, the six inch pipe runs allow a reduction to about 50% of the flow rate of the eight inch pipe at the same flow velocity.
  - The use of between bearings, double suction impeller on the test pump, which operates at a maximum of speed of 1200 rotations per minute, offers two advantages. The selected pump is typical for shipboard operations. This arrangement should minimize mortality to the ambient organisms from the waters of Vallejo, CA.
  - Ballast modification arrangement permits treatment application on ballast water uptake or ballast water discharge.
- Scientific
  - Testing and evaluation efforts are made simpler and more reliable through purpose designed piping interfaces and permanent science facilities.
  - The use of the same vessel through various treatment systems allows an understanding of the effects external to the treatment device.
  - Water in the San Francisco Bay area is heavily laden with non-indigenous species and is very turbid, offering a challenging location for treatment system trials, decreasing the likelihood that ballast water will need to be spiked with surrogate organisms.
  - The dock side location in Vallejo offers both fresh and brackish water opportunities following the diurnal cycle. The shipboard testing in the *Guidelines* recommends testing in at least two of three salinity levels.
  - The availability of a dedicated on board laboratory space offers significant advantage in comparison to the use of state rooms or spare rooms on a vessel of opportunity.

- Outreach
  - *Golden Bear* is an integrated part of a university educational environment, offering the mutual benefits of staff support and pedagogic opportunities.
  - *Golden Bear's* primary function is as a training vessel for future merchant ship officers who will be given a first-hand opportunity to learn ballast management issues as they enter their professional careers.
- Logistics
  - The *plug and play* concept eliminates the lead time required for shipboard modifications. Vessel modifications typically require four months to a year for engineering/design, regulatory review/approval, construction and commissioning. Today's marine industry is extremely busy and lead times for pumps and valves typically range from 8 to 16 weeks.
  - *Golden Bear* schedule includes annual dockside periods of about 8 months at Vallejo, CA. This will enable testing to take place during this period without the waiting and transit times inherent with underway vessel operations.

It is an advantage that the *Golden Bear* is strategically positioned for further modifications to improve testing efficiencies. It is also recognized that application of the Guidelines to the satisfaction of an Administration (U.S. Coast Guard for example) may differ than those envisioned here, perhaps requiring modifications not currently envisioned. It should be understood that the modifications proposed here are versatile, offering much flexibility as the science and regulations change over time. The following modifications are not proposed, but are presented to outline expansion capabilities of the *Golden Bear*.

- Future
  - The investigative team has reviewed additional services which would be natural extensions of a successful ballast testing operation. These include study of sediment and hull fouling on board ships, as well as research and development for more stringent ballast standard in the future.
  - The proposed modifications limit testing to dock-side operations. Underway testing is not required by the *Guidelines*, and also normal commercial ship ballasting operations typically take place dock-side. A future modification could reposition the container mounting location so as to not impair vessel operations, such that testing can be conducted with vessel underway.
  - The proposed modifications outfit a pair of ballast tanks with ease of access and simplicity of construction. However, several pairs of the vessels 28 ballast tanks present significant kinetic engineering (considerations of tank fluid dynamics) challenges to ballast treatment systems. It is likely that the complex structures of some of these tanks present opportunities for advanced ballast treatment testing in way of tank dead zones and trapped sediment. Like the tanks selected for the current modifications, there are more tank pairs that also meet the Guidelines for land-based testing. The additional tanks usually contain freshwater ballast and these tanks will need to be coated before seawater is routinely placed inside.
  - Advanced laboratory outfitting to increase the level of complexity of on board testing which can be performed. The existing facility will meet the *Guidelines* but can be improved to add value to an investigator team.
  - Advanced in-tank sampling outfitting. Although not required by the *Guidelines*, it is possible to access the control and variable ballast tanks – provided strict operational

procedures are followed. This outfitting would increase this accessibility by a larger hatch as well as internal hard piping for closed sampling as a value add to the investigator.

Ballast Treatment Test Facility: *Golden Bear* Modification Overview

A visual overview of the modifications proposed herein, extending from the 01 deck to shaft alley, is provided in Figure 2. These modifications would provide the *Golden Bear* with a *plug-and-play* capability to effectively perform successive shipboard trials with multiple treatment systems. The *Golden Bear* can accommodate one treatment system on board at a time ready for testing. Installation of each successive treatment system would not require further vessel modifications and may be very easily accomplished.

This is achieved by bringing the vessel's ballast water to an accessible location where the treatment systems to be tested are temporarily fastened to the ship's deck within the confines of standard ISO containers. A_service station would be located near the container fastening location, such that hoses and cables would provide ballast water and support services (power, air, fresh water) to one treatment system at a time. Following testing of each treatment system, another could take its place without the need for further modifications to the ship. The modifications are arranged such that treatment can be executed upon uptake, discharge or both. The *Modification Details* section provides a complete review of the proposed work shown in Figure 2.

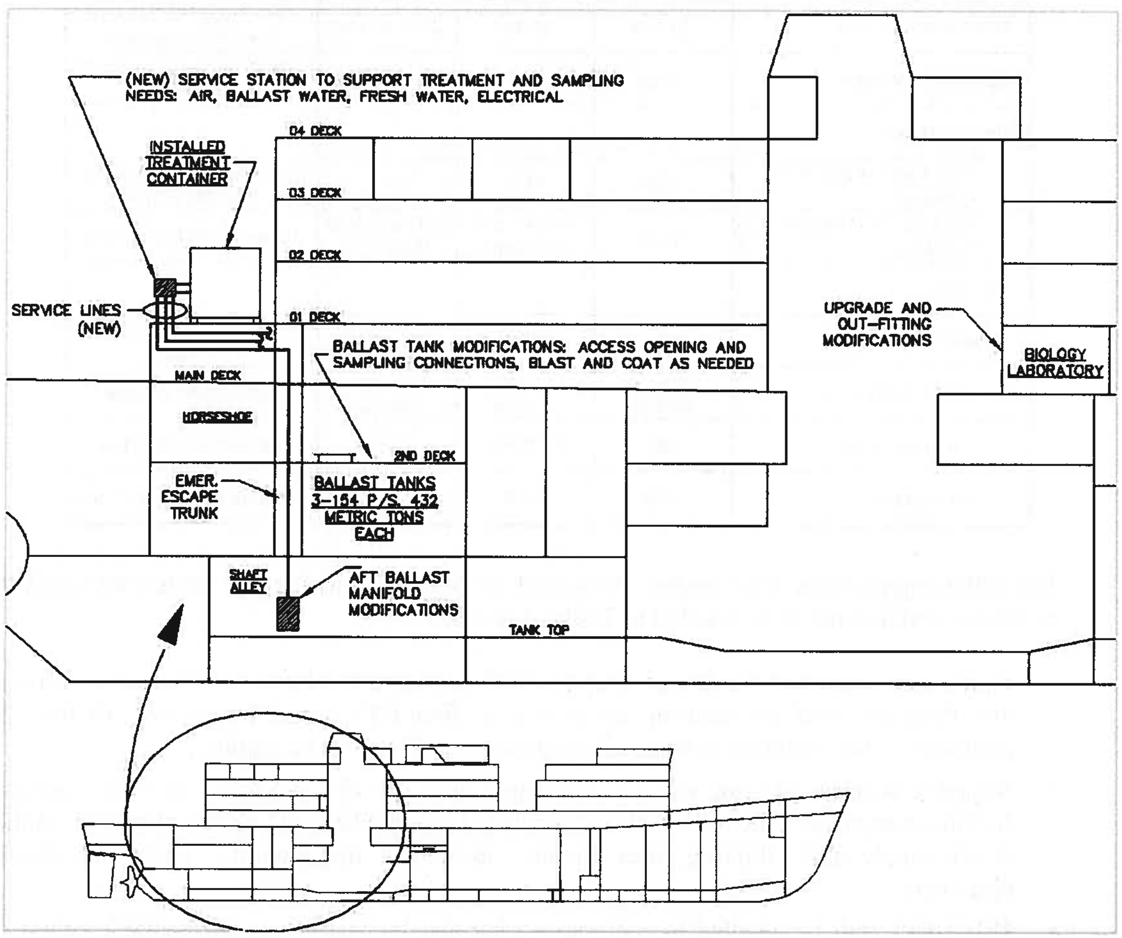


Figure 2 - Profile View Showing Modifications

2. MODIFICATION DETAILS

Summary

A visual overview of the modifications proposed herein, extending from the 01 deck to shaft alley, is provided in Figure 2. The description below provides an overview of the specific modifications, with the following sections providing concept level details based on pertinent feedback from the original concept design package.

Treatment system support modifications would provide the *Golden Bear* with a "Plug and Play" capability to effectively perform successive shipboard trials with multiple treatment systems. Table 2, below, provides a listing of treatment system types and interface particulars. These particulars, the requirements in Table 1 and classification rules of American Bureau of Shipping were used as the design basis in developing this modification concept.

Table 2 - Treatment System Interface Matrix

Treatment System Interface Matrix				Vessel Interface
Sample Treatment Technology	Chemical Injection	Electro chlorination	UV / Filtration	
ISO Container Size	20 foot	40 foot	20 or 40 foot	Tie-downs for 20 or 40 foot ISO container
Equipment Weight	~1 ton	~10 tons	~5 tons	Structure supports up to 20 tons
Ballast Water				
Flow Rates of 220 m^3/hr Acceptable ...	YES	YES	YES	Variable up to 349 m^3/hr, 8" ANSI flange
Treatment Application Upon Ballast ...	Uptake	Uptake and Discharge	Uptake and/or Discharge	Uptake and/or Discharge
Services				
440 VAC Electrical	10 Hp	50 kVA	50 kVA	Recepticles, 100 Amp & 50 Amp
120 VAC Electrical	30 amp service	30 amp service	30 amp service	Recepticle, 30 Amp
Compressed Air	NO	OPTIONAL	NO	Service air, 3/4" npt
Fresh Water	YES	YES	NO	Potable supply, 3/4" npt

The following sections describe the envisioned modifications to support the testing needs and treatment system interfaces detailed in Tables 1 and 2.

- **Container mounted treatment systems** will be supported by new below deck structure and fasteners used for securing up to two 20 foot ISO containers, or one 40 foot ISO container. The treatment system will be placed inside the ISO container.
- **Support services station** will be positioned near the ISO container mounts. Services include compressed air, fresh water and 120 VAC and 440 VAC electrical power. Ballast water supply and sampling lines are also located at this station. These are detailed elsewhere.
- **HAZMAT** will be handled in a storage locker and by drain lines into suitable drums for off-loading.

- **Ballast system modifications** will be performed in order to transport the ballast water to and from the container mounted treatment systems, on uptake and on discharge. Modifications will include new piping runs, manifold modifications and a new independent ballast water treatment pump in shaft alley.
- **Sampling and instrumentation** will be provided for to meet monitoring and testing requirements. This includes slip stream test ports in the ballast piping as well as sample lines and new access openings in the selected ballast tanks. This also includes the various storage tanks required. This section also details the various instrumentation efforts required in the electrical system and piping system.
- **Future**
    - **Ballast tank modifications** are described in the Sampling and Instrumentation section. In way of sampling modifications, the two selected ballast tanks will be spot coated as required.
    - **Marine biology laboratory** will be outfitted with laboratory equipment to provide the ability to analyze samples on board the *Golden Bear* in a timely manner.

Container Mounted Treatment Systems

The container mounting system will be designed and built to support at sea motions and subsequent loads. It is noted that the container location would interfere with operations when the vessel is underway, limiting ballast test operations to dock-side only. Relocation of the container mounting to remove this operational interference, allowing at sea testing efforts, is a future consideration.

- Container mounted treatment systems will be mounted on the 01 deck level extension behind the aft house. The containers will be positioned starboard of the centerline to avoid interference issues with the 30 ton crane immediately aft. This location may be seen in Photos 1 and 2. Containers will be supported by new below deck structure and fasteners used for securing up to two 20 foot ISO containers, or one 40 foot ISO container on the 01 deck of the aft house. The container position is shown in Figure 2.

- Twist-locks, bars, and/or turnbuckles are to be used to secure and lash down the containers to the deck. Deck mounting points are to be recessed to reduce tripping hazards.

- Preliminary evaluation of vessel stability of the vessel with containers mounted on the 01 deck level was found acceptable, as determined by the Chief Mate using the stability program on the vessel.


Photos 1 and 2 – Treatment Container Location

(looking to stbd shown left, looking to port with crane pedestal shown right)

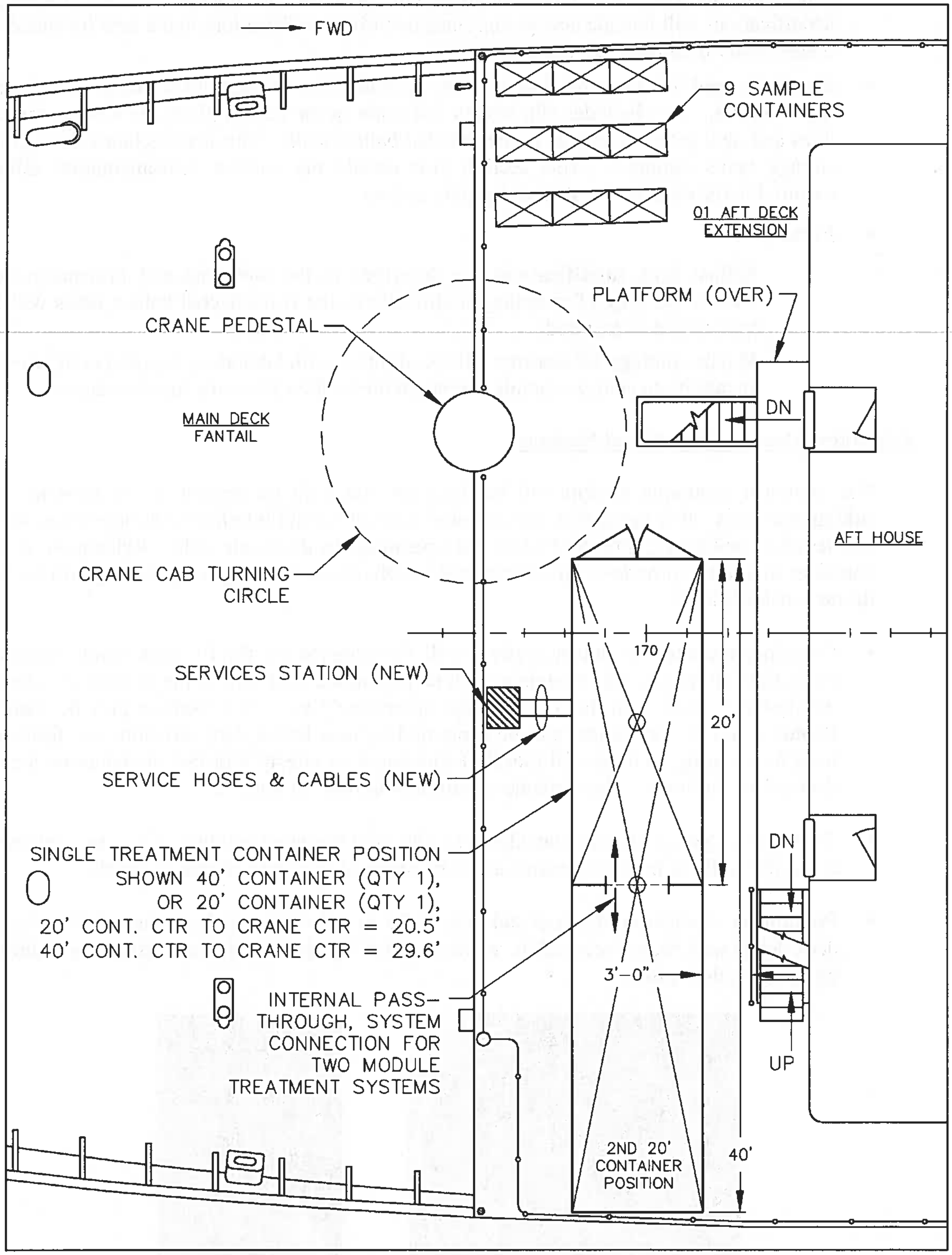


Figure 3 - Plan View Showing 01 Aft Deck Installations

Support Services

Support services station will be positioned near the ISO container mounts. Services include compressed air, fresh water and 120 VAC and 440 VAC electrical power. Ballast water supply and sampling lines are also located at this station, but are detailed elsewhere.

The piping and electrical equipment installed in the modification will interface with existing systems in such a way as to eliminate the possibility of interfering with normal ship operations. Added electrical equipment, potable water piping, and compressed air lines will all terminate at a single location on the 01 deck extension, just to the stern of the aft house and in line longitudinally with the aft emergency escape trunk. Isolation valves will be present at the termination points for the potable water and compressed air piping, and power receptacles will be installed for the 440 VAC and 120 VAC electric take-offs. This creates a "service station" from which treatment systems may be easily integrated into existing ship systems.

The service station on the deck of the 01 deck level will connect to treatment containers by means of hoses and cables. This provides a plug and play capability that will allow treatment systems to be exchanged quickly and easily. Since most ballast water treatment systems have similar support service requirements no further modifications will need to be made with each successive treatment installation.

Electrical Power

Electrical power aboard the *Golden Bear* is generated using three high speed diesel generators, two of which are running at any given time during normal operation. The electrical distribution consists of 440 VAC and 120 VAC, 3 phase systems. The aft steering space contains both a 440 VAC and 120 VAC power panel. These panels each have space to install additional breakers to support various treatment systems.

The ballast water treatment container will be provided with 440VAC and 120VAC power. The Contractor shall provide and install one 100 amp, 440V receptacle and one 120V, 30 amp receptacle, with integral circuit breakers, and break-before-make contact pins. The breakers will be installed in the power panels located in aft steering and shown in Photos 3 and 4. A new 100 amp, 480V, 3 phase circuit breaker and a new 50 amp, 480V, 3 phase circuit breaker, AQB-A101, or equal, shall be installed in blank spaces in the 440V steering gear power panel. Cable, LSTSGU-50, shall be installed from the 100 amp circuit breaker to the receptacle. The 120V, single-phase, 30 amp circuit breaker shall be an ALB-1, or equal, and shall be provided and installed in a blank space in a aft steering 120V load center panel. Cable, LSTSGU-9, shall be installed from the load center panel to the 120V receptacle.

The main 440V bus and 120V branch lie within the Engine Operation Station (EOS). At present there are no spare breakers available for either power option; however there are blank spaces in the main bus board where additional breakers and fuse units could be added to provide power for the lab spaces. Photo 5 shows available electrical locations within the EOS.

Photos 3 and 4 – Aft Steering Electrical Locations
(440V panel shown left, 120V panel shown right)

Photo 5 – EOS Electrical Location
(lighting panel for lab outfitting)

Compressed Air

Compressed air aboard the ship is used in three separate systems: Engine Start Air, Control Systems Air, and Ship Service Air. For the purpose of supplying compressed air to the treatment package Ship Service Air, maintained around 100 psi with a 120 psi maximum pressure, will be used. Ship Service Air may either be routed from Shaft Alley to the main deck through the aft emergency escape trunk, or it could be accessed directly from the main deck aft house through one of the existing compressed air fittings.

Fresh Water

Potable water is available in the engine room and may be piped to the 01 deck through the aft emergency escape trunk and out to the main deck behind the aft house. A potable water line will also be required in Shaft Alley to provide flushing water for ballast treatment pump lay-up.

HAZMAT Locker

A portable hazardous materials storage locker shall be installed in a suitable location on the vessel for temporary storage of chemicals and other materials which are required for the investigator team.

ISO Container and Sample Tank Drains

A flexible hose drain system shall be provided which can direct drains from various treatment system components (ISO Container and sample tanks) to either portable drums for off-site disposal or into the deck drains if discharge permit allows.

Ballast System Modifications

Ballast system modifications will be performed in order to transport the ballast water to and from the container mounted treatment systems, on uptake and on discharge. Modifications will include discharge manifold modifications, new piping runs and a new booster pump. These modifications are shown in the flow diagram below (Figure 4).

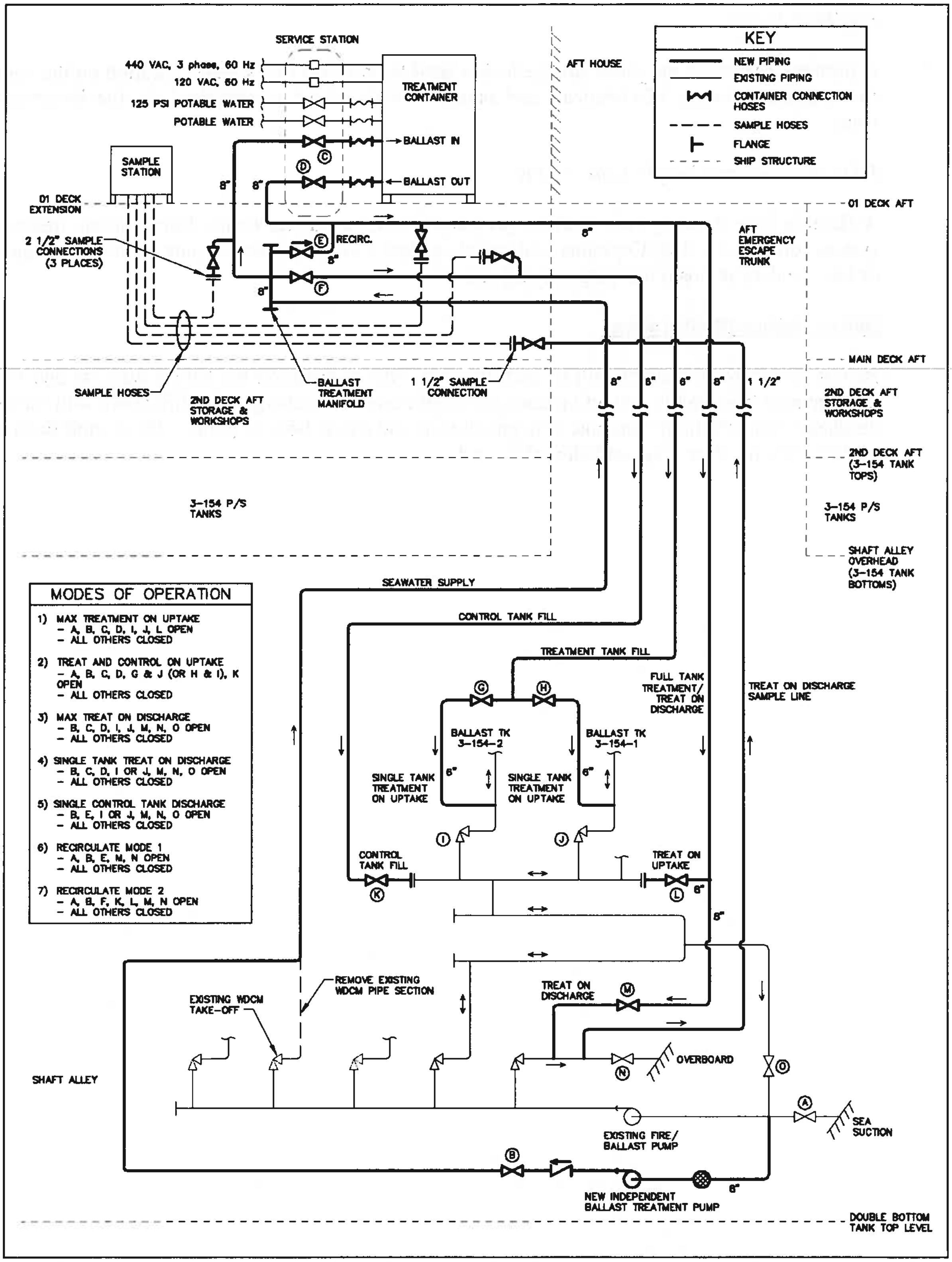


Figure 4 - SW Ballast / Treatment System Piping

Discharge Manifold Modifications

The existing aft ballast manifold is shown below in Photo 7 (discharge). The second ballast valve from the left side of the frame in Photo 7 leads to the fill/discharge header for ballast tanks 3-154 P/S. This ballast tank header is shown in Photo 8. In order to treat the ballast water it must first be taken from the discharge manifold. Photo 7 shows a 6 inch unused Wash-Down Counter Measure (WDCM) line that is currently connected to the aft ballast manifold. This line extends from the tank top level in shaft alley to the aft main deck via the aft emergency escape trunk. It will be removed from the escape trunk to increase available space for new piping runs as it is never used. The entrance into the escape trunk can also be seen in Photo 7 and is identified by a red ladder in the right side of the frame.

The Fire/Ballast Pump in Shaft Alley is too large to be used in this application. Even with the addition of a Variable Frequency Drive (VFD) the use of this pump would cause high flow rates that would lead to pipe erosion and high marine organism mortality rates prior to testing. The use of a smaller, independent ballast treatment pump will therefore be required. This pump will connect to the Fire/Ballast Pump manifold just downstream of the suction sea chest isolation valve by means of an 8 inch tee.

Photo 7 – Aft SW Ballast Discharge Manifold

Photo 8 – Ballast Tanks 3-154 P/S Header

In Photo 8 there are three vertical lines leading off of the discharge header. Of the three lines shown lines the two furthest left in the frame are fill/discharge lines for tanks 3-154 port and starboard. These pipes are both 5 inch nominal, supplied a 6 inch header also shown in the photo. The 6 inch header is flanged at both ends which will allow for the connection of return lines from the treatment systems.

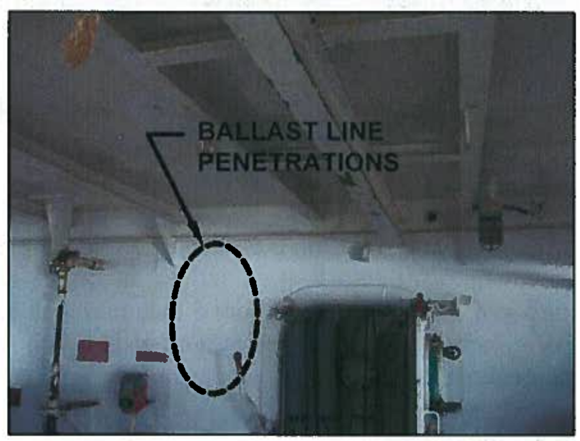
New Piping Runs

Figure 4 shows new pipe runs to be installed as bold lines. Existing pipes are shown in Figure 4 as light lines. Four new pipes will be installed through the length of the aft emergency escape trunk (1 seawater supply and 3 returns). The seawater supply will be an 8 inch nominal line leading from the new ballast treatment pump, and extended aft at the main deck level through the main deck overhead space. It will then terminate at the aft end of the 01 deck extension into an 8 inch manifold that will be located in the overhead of the main deck. From this manifold there will be a

6 inch control tank fill line that will pass back down the escape trunk and terminate at one of the flange connections of the 6 inch header shown in Photo 8. Another 8 inch line from the main deck manifold would provide ballast water to the ballast water treatment container on the 01 deck. This line will terminate at the treatment connection station on the 01 aft deck extension. An 8 inch line will carry the ballast treatment discharge back from the connection station through the aft escape trunk and connect to the second flanged connection on the 6 inch discharge shown in Photo 8. This arrangement will allow full flow in order to treat both tanks simultaneously. A separate 8 inch branch in Shaft Alley will connect to the simultaneous treatment line and allow treatment on discharge. Just before the 8 inch return takes its downward turn in the escape trunk a 6 inch line will be added to allow ballast treatment of individual tanks. A recirculation branch will also be added in the main deck overhead as shown in Figure 4 to permit the ballast treatment lines to be flushed.

Isolation valves will be installed on the discharge side of the treatment pump, at the service station on both the discharge and return, and at the other locations shown in Figure 4. New ballast pipe installed in this arrangement will be steel. Copper Nickel Alloy 90:10 was preferred and explored, but is cost prohibitive to this effort. As such fittings for fresh water flushing the pumps and lines shall be installed.

The aft emergency escape trunk may be seen in Photo 9. It is located on the stern side of the aft house and extends from the main deck to Shaft Alley. Figure 5 shows the layout for piping through the aft emergency escape trunk. The top image is a plan view of the current arrangement and the lower image shows the new arrangement. All four new lines are grouped together to simplify installation. The new lines must penetrate the aft outer bulkhead on the main deck to the inboard side of the escape trunk hatch. In all there will be three penetrations in this location (see Photo 10). The current 6 inch nominal section of WDCM line passing through the aft emergency escape trunk will be removed to increase usable space in the narrow trunk.



Photos 9 and 10 – Aft Emergency Escape Trunk
(Looking Down From Main Deck left, Future Penetration Locations right)

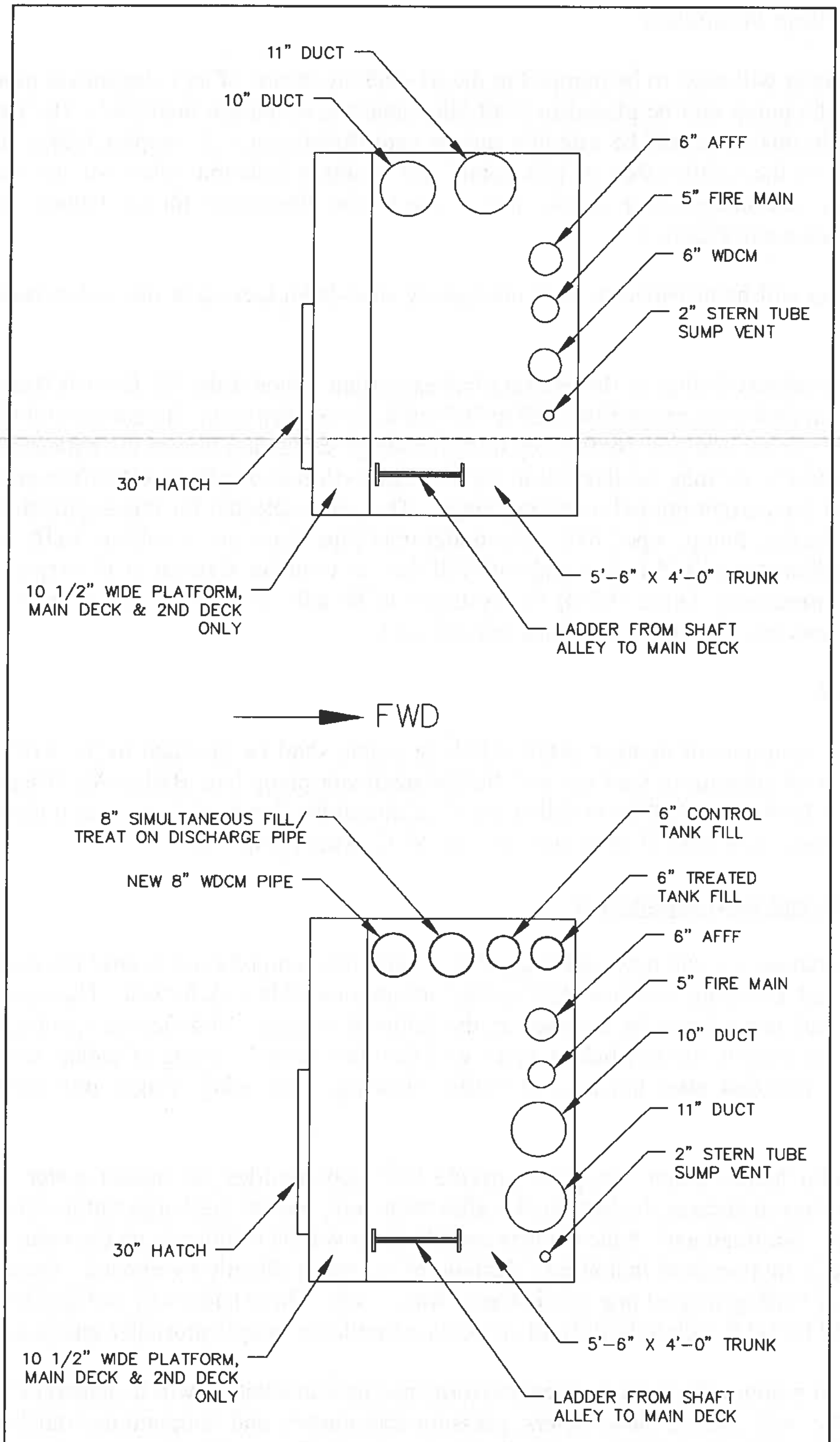


Figure 5 - Aft Emergency Escape Trunk Piping Arrangement (Current Arrangement top, New Arrangement bottom)

Booster Pump Installation

Ballast water will need to be pumped to the 01 deck by means of an independent treatment system pump. The pump will be placed in shaft alley near the aft ballast manifold. The treatment pump installed in this space will be a double suction centrifugal pump. A simplex basket strainer will be installed on the suction side of this pump, and a single isolation valve will be required on the discharge side along with a check valve. The system placement for the ballast water treatment pump is shown in Figure 2.

This pump will be provided with an emergency shut-down located at the ballast treatment service station.

From operational testing of the existing ballast system onboard the TS Golden Bear it was found that typical flow rates range from 120 to 205 cubic meters per hour. By connecting the suction of a treatment system pump in Shaft Alley to the existing sea suction line of the ballast system in Shaft Alley ballast water may be diverted to the 01 deck (~46 ft above the keel), while maintaining flow rates near the current normal operating range. The pump selected for this application is a Gould's Double Suction Pump, type 3410. The outlet/inlet pipe diameters would be 8x10 inches, with an impeller diameter of 9.75 inches and with full flow at a rotational speed of 1180 rpm. In utilizing a Variable Frequency Drive (VFD) the system will be able to control flow between 105 and 340 cubic meters per hour to meet various test protocol.

Electrical

A new 50 amp circuit breaker, AQB-A101, or equal, shall be installed in the 440V power panel located in aft steering to feed the new ballast treatment pump (see Ballast Modifications section). Cable, LSTSGU-23, shall be installed from the circuit breaker to the new pump supplier-provided variable frequency drive (VFD), and from the VFD to the pump motor.

Sampling and Instrumentation

Vessel arrangement and new outfitting will permit utilization of a 441 metric ton port side tank for control, and a virtually identical 432 metric ton starboard side tank for test. The vessel's numerous other ballast tanks could be accessed in the future if needed. New access opening and sampling lines in the control and test ballast tanks will facilitate in-tank testing of ballast water to evaluate treatment progress after uptake and before discharge, providing insight into treatment system process.

Slip stream ballast water test ports provide four opportunities for ballast water testing: ballast uptake before treatment, ballast uptake after treatment, ballast discharge before treatment, ballast discharge after treatment. Nine (9) new sample tanks will be positioned on the main deck as shown in Figure 2, in a position that allows flushing of sea water directly overboard. These tanks will be capable of holding at least one metric ton of water each. These tanks will be filled by hoses. These hoses will be 1-1/2 inch to limit fluid velocity, minimizing sample mortality due to transport.

In order to monitor the ballast system performance instrumentation will be added to the new piping runs. This will include flow meters, pressure transducers, and temperature transducers. One of each will be installed on the new ballast water supply line to the booster pump, the return line before the flow branches, and on the control fill line. The equipment will be installed on horizontal pipe sections under the 01 deck to ensure complete coverage of the sensors. Readings will be taken locally using a notebook computer with properly calibrated data acquisition software. The following instruments are preferable for this system:

- Flow Meters; Transit-Time flow meter model F-200-FLVS12; indicator, transmitter and associated model F-200-FLW41 transducer; mounting track kit; NEMA 6 enclosure, switch

- Pressure Transducer; Autoline Controls model ABB 2600T; suitable for seawater service; NPT connection; NEMA 4 enclosure; mounting kit

- Temperature Transducer; suitable for seawater service; NEMA 4 enclosure; mounting kit

- Local temperature and pressure gages

Additional taps will be added to the new ballast supply and return lines near the transducers for future instrumentation. These taps may be used to add sensing equipment for testing conductivity and turbidity.

Laboratory instrumentation is detailed in the *Marine Biology Laboratory* section.

Ballast tank sampling is detailed in the *Ballast Tank Modifications* section.

Ballast Tank Modifications (Future)

Tank Selection

The seawater ballast tanks selected for use in this project are tanks 3-154-1 and 3-154-2, with the option of extending use of other ballast tanks in future studies. Both tanks are similar in construction and mirrored about the ship's centerline, each with a capacity of at least 114,210 gallons. The tank tops reside on the 2nd deck, approximately 33 feet above the keel. Both tanks are easily accessible through their tank tops, which for tank 3-154-1 is located on the port side of the aft equipment storage/shop area, and on the starboard of this space for 3-154-2. Both tanks extend down to the overhead of Shaft Alley, approximately 16 feet off the keel, and aft to frame 174, the forward most frame in the 3-174 aft peak ballast tank pair.

The 3-154 tank pair is constructed with large transverse frames spaced at intervals of 10 feet and stiffeners. There are large spaces in between the frames that extend down to the tank bottoms. The current manhole covers are located along the forward tank bulkheads, which rule out the possibility of them acting as access from which to collect biological samples via plankton net casting.

Access Hatches

Biological sampling access through the 3-154-1 and 2 tank-tops may be made possible through the use of flush mounted, watertight hatches. It would be ideal to have at least a 24 x 24 inch clear opening for ease of plankton net casting. Safety guard arrangements are also considered to protect personnel from falling hazards. The transverse passageway of the aft storage/workshop area, approximately 6 feet starboard of centerline, would be the most suitable location for a sample access hatch to the starboard tank. This location is shown in Photo 11. There is room in the aft line locker for the installation of a port tank access hatch. Other locations within the aft space may also permit the installation of access hatches. If installed in a low traffic area the hatches should be raised above the deck on a coaming to minimize ballast water spilling through when open due to sloshing within the tank. The supporting members in the tank tops are spaced by roughly 30 inches.

Photo11 – Aft Storage Area Transverse Passageway

Sample Collection

Tank top penetrations of ¾ inch threaded, carbon steel pipes will be installed in the ballast tank for future sampling connections. A possible sample system may consist of tubes that will be dispersed throughout the 3-154-1 and 2 ballast tanks in order to draw seawater samples from various levels and locations within these two tanks. The sample tube system for each tank will consist of 3/8 inch or 1/2 inch plastic tubing connected to permanent fixtures, such as ladders and beams within the tanks, for support. The tubes will pass through the tank-top using the installed deck penetrations of ¾ inch threaded, carbon steel pipes. The pipes will join into a common manifold with individual isolation valves (most likely 90 degree ball valves). A single diaphragm pump for each of the two manifolds will be used to draw seawater from the tanks and return it through a final deck penetration back down to a remote part of the ballast tank. This will allow recirculation of the water through the sample system in order to flush the sample tubing. On the discharge of the sample pump, but before the final deck penetration, a bleed valve will allow collection of ballast water into clean five gallon buckets. The samples may then be carried to laboratory facilities for analysis. One model diaphragm pump suitable in this application would be a Wilden P.025 Metal Pump, with ¼ inch suction and discharge connections, which would be capable of flow rates up to 5 GPM.

Tank Features

In many spaces the deck of the tank tops is clear and unobstructed, which will permit relatively easy access for the addition of biological sampling hatches and future piping for water sample pumping systems. The deck space of each tank top is isolated from the main traffic areas of the ship, allowing for study of these tanks without interfering with routine vessel operations. Also, these spaces are protected from the weather, which will increase the reliability of gathered ballast samples. Their location on the ship also makes these tanks easy to access from the existing marine biology lab on the port side of the main deck. These tanks are only one deck below and aft of the marine biology lab.

Tank Coating

These tanks were not inspected for developing this proposal. It is anticipated the proposed tanks may require some minor spot coating during shipboard modifications to maximize integrity of the tests.

Marine Biology Laboratory (Existing, Advanced Outfitting Future)

Fixtures

Several modifications should be made to the existing marine biology laboratory in order for it to be more useful to scientists who will be conducting ballast water treatment research. A larger sink will need to be installed in place of the small twelve inch square sink already present. Ideally the new sink will have two deep basins, which should each be at least 15 x 15 inches (225 in^2 in area), and 12 inches deep. It would also be helpful to have additional counter space around the new sink at the same height. A drying rack would be installed above the sink. One of the desks that currently reside in that room may be kept to use as a sitting workstation, but higher countertops need also be added for standing workspace. Standing workspace may be added using either permanent or temporary fixtures (i.e. fastened counters with lower storage space, or tall detached desks). Bulkhead mounted storage cabinets would also make a helpful addition to the biology laboratory. The installation of a fume hood and chemical storage locker will be necessary as well.

Electrical Modifications

A new 120V power distribution panel, with eight single phase circuits, shall be provided and installed outside the marine biological laboratory. The panel will be equipped with (16) ALB-1, or equal, circuit breakers to serve the various loads described below.

- Three, single-phase, 50 amp circuit breakers, ALB-1, or equal, shall be provided and installed in a blank space in a local 120V load center panel. Cable, LSTSGU-23, shall be installed from the load center panel to the new 120V distribution panel described above.
- Six, single-phase, 20 amp circuit breakers, ALB-1, or equal, shall be provided to serve three new receptacle circuits.
- Two, single phase, 10 amp circuit breakers, ALB-1, or equal, shall be provided to serve one new fluorescent light circuit.
- Four, single-phase, 15 amp circuit breakers, ALB-1, or equal, shall be provided to serve two new refrigeration circuits (see section XX).
- Two, single phase, 10 amp circuit breakers, ALB-1, or equal, shall be provided to serve one new exhaust fan (hood) circuit (see section XX).
- Two, single phase, 15 amp circuit breakers, ALB-1, or equal, shall be provided to serve one new "spare" circuit.

Additional lighting will be installed in the biology lab space. Five new fluorescent lighting fixtures, Pauluhn, or equal, shall be provided and installed in the marine biological lab. The lights shall be fed from the new 120V distribution panel, described above, with LSDSGU-4 cable.

Three new 6-receptacle strips, Hubbell, or equal, shall be provided and installed in the marine biological lab. The strips shall be fed from the new 120V distribution panel, described above, with LSDSGU-4 cable.

Laboratory Equipment

In order to meet the testing requirements detailed in Table 1, specific laboratory equipment is required. New equipment will include, but not be limited to, a salinity meter, HACH spectrometer, Turner fluorometer, bacterial incubator, phytoplankton incubator, autoclave, computer, and water temperature data loggers.

Modification Cost Estimate

The following modification cost estimate is provided for planning purposes. This estimate does include other program associated costs including planning of various outreach efforts. Due to high volatility in the price of metals and a tight labor market, it is difficult to accurately predict bid costs for the project. This means that there are several alternative arrangements to the design which can be adjusted to suit higher or lower project costs. Any changes to the plan would be vetted by the stakeholders. These changes might include:

- Elimination of the six inch ballast piping runs. These runs are an advantage which would support the lower flow rate tests. Elimination does not affect the ability to make higher flow rate tests.
- Deferment of installation of the container tie-downs. As the proposed testing would occur dock-side (when ballasting typically occurs for commercial ships), the dock has adequate space and access to support testing efforts.

Section 2 Attachments

2-1 MARAD Comments

2-2 Cost Estimate

2-3 Pump Specification

U.S. Department of Transportation
Maritime Administration

Memorandum

Subject: INFORMATION – Comments on Ballast Water Treatment System Proposed for TS GOLDEN BEAR

Date: November 13, 2006

From: Paul Gilmour, Chief
Division of Maintenance and Repair

To: Michael Carter, Director
Office of Environment Activities

The Division of Ship Maintenance and Repair (MAR-611), MARAD Western Region, and Officers of the TS GOLDEN BEAR have conducted a joint review of the proposed TS GOLDEN BEAR Ballast Treatment Test Facility Concept Design, Rev. B, dated October 20, 2006. It is recognized that the authors of the proposed concept have incorporated several of the recommendations made to the initial concept. We believe this proposal has great potential and it is generally feasible for installation on the TS GOLDEN BEAR.

In the review of the proposal, we took the following questions/factors into consideration:

- Was the proposal generally feasible to support the goals of the scientific community *and* could it rationally be installed on the TS GOLDEN BEAR?
- Would the installation of the "plug and play" system incur an unacceptable burden on the TS GOLDEN BEAR from the perspective of supporting the mission of California Maritime Academy as a training ship, even while dockside?
- Would the necessary modifications and installation create an unacceptable maintenance burden on the TS GOLDEN BEAR and MARAD's Schoolship Maintenance Budget?
- **Most importantly**, will the installation *and* proposed operation result in any safety hazards to the personnel (crew and students) on board the ship or to the integrity of the ship, itself?

General Comments:

1. All modifications to and installations of electrical, piping, and structural systems shall be of good marine practice and in accordance with applicable regulatory body requirements (USCG, ABS, etc.). Any modification or installation warranting regulatory body review and approval shall be submitted to the regulatory body and approval gained prior to commencing work on the ship.

2. The proposal lacks clarity on the discharge of the ballast water especially where it pertains to treated water. In accordance with California Environmental Regulations in the San Francisco Bay Region, "zero effluent" may be discharged over the side. Exemptions or special considerations may need be granted to the TS GOLDEN BEAR given the nature of the study. *Legally, the the Master and crew of the TS GOLDEN BEAR, California Maritime Academy, and the U.S. Maritime Administration are ultimately responsible and liable for the operation of the vessel and what is discharged over the side.*
3. The proposal, from an operational and financial perspective, needs to clarify who will be responsible for disposal of any treated ballast water that is deemed unacceptable for discharge over the side.
4. Correct the second bullet on page 6 to read "Vessel is owned by MARAD and operated by California Maritime Academy…" The ship's crew is directly employed by CMA and not MARAD. While the vessel is primarily a training ship, MARAD can take custody of the vessel to support Department of Defense or National Emergency contingencies.
5. The proposal cites in several areas the potential for expanding the water treatment testing system onboard the TS GOLDEN BEAR. This may include utilization of additional ballast tanks and to also conduct testing during the planned training cruises. These future considerations, while noted, were not addressed in the review of this proposal. Further expansion of the system will require careful scrutiny to assess and mitigate any impacts to the primary mission of the ship.

Technical Comments:

1. The proposal lacks clarity on the handling and storage of the HAZMAT (treatment chemicals) associated with two of the three treatment protocols (see chart on page 7). The final proposal shall address: dangers associated with handling and storing these chemicals; special handling, storage and ventilation procedures; and air emissions considerations to crew and students aboard the ship or within the vicinity.
2. The proposal lacks clarity on the drainage requirements for the same two treatment protocols noted in Technical Comment #1 above. The final proposal shall address: how many drains will originate from these TEUs/FEU modules on the 01 Deck Aft; location of drain lines; and where drain lines will lead to.
3. The proposal needs to clarify the location of the nine (9) new sample tanks (see "Sampling and Instrumentation" on page 18) and whether these tanks are installed on the 01 Deck Aft or on the Main Deck. There appears to be a discrepancy between what is stated on page 18 and what is indicated in Figure 2 on page 10.
4. As noted in Technical Comment #2 above, it may not be appropriate for treated ballast water from the nine (9) sampling tanks to be "flushed directly overboard" as indicated in the proposal. The final proposal should include proper drainage and associated piping installations.
5. Use of the vessel's aft crane (see "Contaner Mounted Treatment System", second bullet, page 8) may be restricted below the capacities identified in Table 3. This crane is not part of the ship's Cargo Gear Survey record and, as such, not maintained to original operating parameters. Consideration should be given in the proposal to utilize two twenty foot containers vice a single forty foot container as it may be more viable to handle the smaller containers with the crane assuming they weigh less. Ultimately, crane use will be subject to the ship's crew discretion.
6. As detailed in "Operations" and "Container Fastening" and "reducing tripping hazards" (see page 23) the detailed design must include appropriate devices, means, and lighting to mitigate tripping hazards on 01 Deck Aft, both when the system is installed and during periods when the system has been removed.
7. As detailed in "Operations" (see page 23), the installation of an emergency remote shutdown for the ballast booster pump is required. The recommended location for this shut down is at the "service

station" (see Figure 2 on page 10), next to the TEUs/FEU module so that the operator(s) can quickly shut down the booster pump in emergency situations.
8. It is recommended that local thermometer and pressure gauges be installed in addition to the remote instrumentation discussed under "Sampling and Instrumentation" (see page 19, last two bullets).
9. As detailed under "Ballast Tank Modifications – Sample Collection", all ballast tank penetrations and piping external to the ballast tank shall be in accordance with regulatory body requirements and shall include isolation valves at the tanktop penetration. Utilization of flexible tubing should suffice within the ballast tank for the intended purpose but is unacceptable beyond the tanktop.
10. Clarify "Ballast Tank Modifications – Tank Coating" (see page 20) to read "These tanks were not inspected for developing this proposal. It is anticipated the proposed tanks may require some minor spot coating during shipboard modifications to maximize integrity of the tests." The tanks are inspected and maintained in accordance with regulatory body requirements.
11. An effective and reliable means of communications needs to be established between the 01 Deck Aft platform area and the Engineers Operating Station. This is required to coordinate and safely monitor ballasting operations and to prevent overfilling ballast tanks and other accidents.

While not directly related to the technical feasibility of the proposed modifications and installation, additional operational factors should be addressed in conjunction with establishing the ballast water treatment testing program. Open discussions among the stakeholders and understanding respective responsibilities will assure the long term success of this program aboard the TS GOLDEN BEAR. The following factors should be clarified to determine the lines of responsibility for the components that support the plug and play systems.

1. MAR-611 assumes the MARAD Schoolship Program will have <u>no</u> responsibility to the ballast water treatment equipment within the TEU/FEU modules as it pertains to: procurement and ownership; operation; maintenance; repairs; and installation and removal of modules on/off the ship including transport and storage costs involved. CMA may, at some time, assume greater involvement in the ballast water testing program, however, this would be independent of the Schoolship Program.
2. Based on the limited scope of the proposal, MAR-611 assumes the Schoolship Program will be responsible for routine maintenance of any modified or newly installed piping, valves, electrical conduits, structural installations, pumps, which provide support to the plug and play system. These will be factored into the ship's maintenance regime. This will <u>not</u> include any electronic sensors, computers, or other item which requires specialized or unique testing. Major repair or necessary replacement of any equipment (booster pumps, circuit breakers, electronic sensors, computers, etc.) will <u>not</u> be at the account of the Schoolship Maintenance budget.
3. Determination must be made on who will be responsible for contracting and executing the necessary modifications to support the plug and play system. All contractors who will be performing work on the TS GOLDEN BEAR must be qualified to perform shipboard work and meet minimum liability standards of the Maritime Administration.
4. MARAD reserves the right to inspect and accept or reject any and all installations to shipboard structure and systems. This is standard protocol for all MARAD owned vessels.
5. As the plug and play system operation will require the support of shipboard resources (electricity, compressed air, fresh water), it will be necessary to have qualified crew members on board during periods when equipment is being operated. Those organizations conducting the tests and CMA will have to coordinate how any testing outside normal business hours will be handled.
6. An operational protocol must be developed and documented prior to any entity or organization conducting ballast treatment tests on the TS GOLDEN BEAR. This document, which shall include

check-off lists, needs to address the chain of command, scheduling and conduct of testing, operation of ship's and plug and play support equipment, communications, etc. All parties will be required to review the protocol and ensure their understanding of the procedures.

We believe this concept has great potential and can achieve the goals of the scientific community in conducting the research in ballast water treatment. However, it is imperative that all stakeholders recognize the primary mission of the ship as a training platform for future merchant mariners and the safety of the crew and students is paramount to any modifications made to the ship. It is our intent to address operational and safety concerns during the November 28, 2006, stakeholders meeting onboard the TS GOLDEN BEAR. During this meeting, we will also discuss future applications of the "plug and play" system and what would be required for at sea operations during training cruises should the ballast treatment program continue to mature.

If you have any questions or comments on this memorandum, please do not hesitate to contact me at (202) 366-1882 or Tony Margan at (202) 366-0433.

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maradsvr3\users\611\611 e-Files\Schoolships\Ballast Water Treatment Comments.doc

cc: MAR-610, 610.4, 611(AM)
MAR-820 (C.Junneman)
MRG-4100, 4700 (H.Ryan, K.Dwyer, S.Mukherjee, B.Vogel, R.Carter)
California Maritime Academy (Captain John Keever)
Reading File

CONSTRUCTION MODIFICATIONS ESTIMATE - FUNDING TO MARAD

ITEM	DESCRIPTION	LABOR (HOURS)	MATERIALS ($)	SUB-TOTAL ($)	MATERIAL MARKUP	CONTINGENCY	TOTAL ($)	PERCENT
1	CONTAINER MOUNTED TREATMENT SYSTEMS	340	9,000	27,700	1,400	2,800	31,900	10.7%
2	SUPPORT SERVICES PIPING AND STATION	356	10,200	29,800	1,500	3,000	34,300	11.5%
3	BALLAST PIPING	1,661	54,700	146,100	8,200	14,600	168,900	56.4%
4	SAMPLE, MONITOR, MISC.	280	34,300	48,800	5,100	4,900	58,800	18.8%
5	REGULATORY REVIEW	0	6,500	6,500	0	700	7,200	2.5%
	SUB-TOTAL	2,637	$114,700	$258,900				
	LABOR RATE	$55	PER HOUR	*REFERENCE MARAD PRE-CRUISE SPRING 2007 CONTRACT RATE				
	MATERIAL MARKUP	15%		16,200				
	ESTIMATE CONTINGENCY	10%		25,900				
	TOTAL ESTIMATED COST						$301,100	

SUPPORT ACTIVITIES ESTIMATE - FUNDING TO PRINCIPAL INVESTIGATOR

ITEM	DESCRIPTION	SUB-CONT ($)	GLOSTEN ($)	SUB-CONT MARKUP	TOTAL ($)	PERCENT
6	PROJECT MANAGEMENT - GLOSTEN		14,740		14,740	14.8%
7	NAVAL ARCH/MARINE ENG - GLOSTEN		29,010		29,010	29.0%
8	VESSEL CREW SUPPORT - CMA	17,008		1,700	18,708	18.7%
9	CMA ADMINISTRATION - CMA	9,240		900	10,140	10.1%
10	SCIENCE TEAM INTERFACE - UW	24,834		2,500	27,334	27.4%
	SUB-CONTRACTOR MARK-UP 10%					
	TOTAL ESTIMATED COST				$99,932	

PROPOSAL TOTAL

ITEM	DESCRIPTION		PERCENT
1 - 5	Construction Modifications - Transfer Funds Directly to MARAD	301,100	75.1%
6 - 10	Support Activities - Principal Investigator Funding	99,932	24.9%

TOTAL ESTIMATED COST	$401,032	

COST ESTIMATE SUMMARY - LAB OUTFITTING (FUTURE)

ITEM	DESCRIPTION	LABOR (HOURS)	MATERIALS ($)	SUB-TOTAL ($)	MATERIAL MARKUP	CONTINGENCY	TOTAL ($)	PERCENT
11	MARINE BIOLOGY LABORATORY	244	18,600	32,000	2,800	4,800	39,600	40.2%
12	LABORATORY EQUIPMENT	0	46,100	46,100	6,900	6,900	59,900	57.9%
13	SAMPLE BOTTLES	0	1,500	1,500	200	200	1,900	1.9%
	SUB-TOTAL	244	$66,200	$79,600				
	LABOR RATE	$55	PER HOUR					
	MATERIAL MARKUP	15%		9,900				
	ESTIMATE CONTINGENCY	15%		11,900				
	TOTAL ESTIMATED COST						$101,400	

COST ESTIMATE SUMMARY - TANK SAMPLING (FUTURE)

ITEM	DESCRIPTION	LABOR (HOURS)	MATERIALS ($)	SUB-TOTAL ($)	MATERIAL MARKUP	CONTINGENCY	TOTAL ($)	PERCENT
14	BALLAST TANK SAMPLING MODIFICATIONS	660	15,000	51,300	2,300	7,700	61,300	100.0%
	SUB-TOTAL	660	$15,000	$51,300				
	LABOR RATE	$55	PER HOUR					
	MATERIAL MARKUP	15%		2,300				
	ESTIMATE CONTINGENCY	15%		7,700				
	TOTAL ESTIMATED COST						$61,300	

ITEMIZED COST ESTIMATE DETAILS - BASE MODS

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT LABOR (HOURS)	UNIT MATERIAL ($)	TOTAL LABOR (HOURS)	TOTAL MATERIAL ($)	TOTAL COST ($)	REMARKS
1	CONTAINER MOUNTED TREATMENT SYSTEMS								
1.01	Underdeck Structure and Deck Fittings	1	lot	200	8,000	200	8,000	19,000	
1.02	Railing Repairs, Drain Lines	1	lot	60	200	60	200	3,500	Removable Railing
1.03	Painting Piping, Railings, Deck Structures	1	lot	80	800	80	800	5,200	No tank coating repairs
	Sub-Total					340	9,000	27,700	
2	SUPPORT SERVICES PIPING AND STATION								
2.01	Deck Station Outfitting	1	lot	120	4,000	120	4,000	10,600	Fittings, hoses, enclosure
2.02	Electrical								
2.03	Receptacle, 450V, 100 Amp	1	ea	8	800	8	800	1,240	Container 450V
2.05	Receptacle, 120V, 30 Amp	1	ea	8	425	8	425	865	Container 120V
2.06	Power Center	1	ea	60	4,000	60	4,000	7,300	Treatment Container Power Feed
2.12	Compressed Air	60	ft	1	6	60	360	3,660	Compressed Air Pipe
2.13	Potable Water	100	ft	1	6	100	600	6,100	Includes Fittings/Valves
	Sub-Total					356	10,185	29,765	
3	BALLAST PIPING								
3.01	Steel Pipe, 8 inch nom	1	lot			882	18,289	66,799	See Pipe Detail Sheet
3.02	Steel Pipe, 6 inch nom	1	lot			390	4,840	26,290	See Pipe Detail Sheet
3.02	Steel Pipe, 2-1/2 inch nom	1	lot			9	276	771	See Pipe Detail Sheet
3.02	Escape Hatch Pipe and Duct Rework	120	feet	2	10	240	1,200	14,400	
3.03	Pump, Goulds model # 3410, 8x10-12	1	ea	80	25,000	80	25,000	29,400	Ballast Pump
3.04	Pumpsmart VFD, model # PS75	1	ea	40	5,000	40	5,000	7,200	Variable Frequency Drive
3.06	Cable, LSTSGU-9, 50'	1	lot	20	47	20	47	1,147	
	Sub-Total					1,661	54,651	146,006	

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT LABOR (HOURS)	UNIT MATERIAL ($)	TOTAL LABOR (HOURS)	TOTAL MATERIAL ($)	TOTAL COST ($)	REMARKS
4	SAMPLE, MONITOR, MISC.								
4.01	Sample Tanks (Racks of Three)	9	ea	16	2,500	144	22,500	29,700	~300 gallons each
4.02	Sampling Hoses and Fittings	9	ea	4	200	36	1,800	3,600	Includes Fittings/Valves
4.03	HAZMAT Locker	1	ea	40	6,000	40	6,000	8,200	Portable
4.04	Instrumentation	1	ea	60	4,000	60	4,000	7,300	Temp, Press, Valve Position
	Sub-Total					280	34,300	48,800	
5	REGULATORY REVIEW								
5.01	American Bureau of Shipping Plan Review and Site Inspection	1	lot		6,500	0	6,500	6,500	
5.02	Long lead procurement and contracting	1	lot			0	0	0	MARAD/CMA
5.03	Construction Management	1	lot			0	0	0	MARAD/CMA
	Sub-Total					0	6,500	6,500	

ITEMIZED COST ESTIMATE DETAILS - SUPPORT ACTIVITIES

ITEM	DESCRIPTION	UNIT LABOR (HOURS)	LABOR RATE ($/HR)	TOTAL LABOR ($)	EXPENSE ($)	TOTAL COST ($)	REMARKS
6	PROJECT MANAGEMENT - GLOSTEN						Travel Includes
6.01	Project Coordination, Meeting	80	112	8,960	500	9,460	1 Person, Vallejo, 2 Days
6.02	System Commissioning	40	112	4,480	800	5,280	1 Person, Vallejo, 4 Days
	Sub-Total	120		13,440	1,300	14,740	
7	NAVAL ARCH/MARINE ENG - GLOSTEN						
7.01	Contract Design						As-Builts by MARAD
7.02	Electrical One-line Diagram	40	96	3,840		3,840	
7.03	Structure Modification Drawing	60	106	6,360		6,360	
7.04	Piping Drawing	100	88	8,800		8,800	
7.05	Work Item Description	40	112	4,480	200	4,680	
7.06	Weight Estimate	60	88	5,280	50	5,330	Stability Analysis by MARAD
	Sub-Total	300		28,760	250	29,010	
8	VESSEL CREW SUPPORT - CMA						
8.01	Contract Design Package Review	24	92	2,208		2,208	
8.02	Modification On-site Supervision	110	92	10,120	600	10,720	Misc Materials
8.03	System Commissioning	40	92	3,680	400	4,080	Misc Materials
	Sub-Total	174		16,008	1,000	17,008	
9	CMA ADMINISTRATION - CMA						
9.01	Oversight of Vessel Crew	24	100	2,400		2,400	
9.02	Coordination with Vessel Crew	24	85	2,040		2,040	
9.03	Central Administration	24	100	2,400	2,400	4,800	
	Sub-Total	72		6,840	2,400	9,240	
10	SCIENCE TEAM INTERFACE - UW	SALARY & BENEFITS ($)	INDIRECT LABOR (%)	INDIRECT LABOR ($)	EXPENSE ($)	TOTAL COST ($)	
10.01	Russel Herwig, Research Professor - 1 month @100%	8,846	26%	2,300		11,146	
10.02	Jeffery Cordell, Prin Research Sci - 0.75 month @100%	6,258	26%	1,627		7,885	

ITEM	DESCRIPTION	UNIT LABOR (HOURS)	LABOR RATE ($/HR)	TOTAL LABOR ($)	EXPENSE ($)	TOTAL COST ($)	REMARKS
10.03	Review of Contract Design Package						
10.04	Support of CMA Curriculum Development						
10.05	Zooplankton Calibration - 0.25 month, Various persons	2,939	26%	764	2,100	5,803	
	Sub-Total			4,691	2,100	24,834	

ITEMIZED COST ESTIMATE DETAILS - ASTM A53B PIPING

Piping Run Description	Branch Name	8" Pipe (ft)	8" Flanges (#)	8" Valves (#)	8" Tees (#)	8" Elbows (#)	8" Strainer (#)	8" Check Valve (#)	6" Pipe (ft)	6" Flanges (#)	6" Valves (#)	6" Tees (#)	6" Elbows (#)	2-1/2" Pipe (ft)	2-1/2" Valves (#)
Seawater Supply		97		1	1	4	1	1							
Control Tank Fill*									61	1	1		4		
Treatment Tank Fill	Treatment Tank Fill				1				83			1	2		
	Single Tank Treatment on Uptake, Port								5		1		1		
	Single Tank Treatment on Uptake, Stbd								5		1		1		
Full Tank Treatment / Treat on Discharge	Full Tank Treatment	95			1	2									
	Treat on Uptake	20	1	1	1	1									
	Treat on Discharge	10		1	1										
Sample Lines	Treat on Discharge Sample Line														1
	Main Deck Sample Lines													6	
Recirc.		6		1	1	1									
Ballast Into Treatment Container		12	1	1	1	2									
Ballast Out of Treatment Container		12	1	1	1	2									
Ballast Treatment Manifold			2		4				2						
Subtotal Units		**252**	**5**	**6**	**12**	**12**	**1**	**1**	**156**	**1**	**3**	**1**	**8**	**6**	**1**
Material Unit Cost		$39	$101	$195	$105	$97	$666	$3,782	$25	$63	$131	$66	$53	$35	$67
Subtotal Material ($)		$9,744	$506	$1,173	$1,260	$1,159	$666	$3,782	$3,898	$63	$392	$66	$421	$209	$67
Pipe Size Total Material ($)		**$18,289**							**$4,840**					**$276**	
Labor Hours/Unit		3.5							2.5					1.5	
Pipe Size Total (Hours)		**882**							**390**					**9**	

ITEMIZED COST ESTIMATE DETAILS - LAB OUTFITTING

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT LABOR (HOURS)	UNIT MATERIAL ($)	TOTAL LABOR (HOURS)	TOTAL MATERIAL ($)	TOTAL COST ($)	REMARKS
11	MARINE BIOLOGY LABORATORY								
11.01	Fixture Outfitting								
11.02	Bulkhead Mounted Cabinets	1	ea		2,200	0	2,200	2,200	Cabinets / Shelves
11.03	Drying Rack	1	ea		500	0	500	500	Wall mount rack
11.04	Stainless Steel Counter Tops w/ Sink	2	ea		2,250	0	4,500	4,500	Two basin sink in one counter
11.05	Ductless Fume Hood	1	ea		6,000	0	6,000	6,000	
11.06	Plumbing Materials	1	lot		300	0	300	300	Sink faucet and new piping
11.07	Chemical Safety Shower / Eye Wash	1	ea		1,000	0	1,000	1,000	
11.08	Installation Labor	1	lot	100		100	0	5,000	
11.09	Electrical Outfitting								
11.10	Distribution Panel, ALB-1, 8-1Ø Ckt	1	ea	12	2,565	12	2,565	3,165	Panel for Marine Biological Lab
11.11	Lighting Fixture, Fluorescent	5	ea	4	175	20	875	1,875	For Marine Biological Lab
11.12	Receptacle Strips	3	ea	4	125	12	375	975	For Marine Biological Lab
11.13	Cable, LSTSGU-23, 100'	1	lot	40	238	40	238	2,238	
11.14	Cable, LSDSGU-4, 200'	1	lot	60	86	60	86	3,086	
	Sub-Total					244	18,639	30,839	
12	LABORATORY EQUIPMENT								
12.01	HACH spectrometer	1	ea		600	0	600	600	Estimate from Jake Perrins
12.02	pH/ORP meter w/ Salinity Meter	1	ea		1,000	0	1,000	1,000	Estimate from Jake Perrins
12.03	Turner fluorometer (analysis)	1	ea		8,000	0	8,000	8,000	Estimate from Jake Perrins
12.04	Fluorometer probe	1	ea		4,500	0	4,500	4,500	Estimate from Jake Perrins
12.05	Bacterial incubator	1	ea		2,300	0	2,300	2,300	Estimate from Jake Perrins
12.06	Phytoplankton incubator	1	ea		5,000	0	5,000	5,000	Estimate from Jake Perrins
12.07	Refrigerator	1	ea		400	0	400	400	Estimate from Jake Perrins
12.08	water temp data loggers	5	ea		100	0	500	500	Estimate from Jake Perrins
12.09	DI Water System	1	ea		3,500	0	3,500	3,500	Estimate from Jake Perrins
12.10	Autoclave	1	ea		8,000	0	8,000	8,000	Estimate from Jake Perrins
12.11	Chemical Safety Cabinets	2	ea		800	0	1,600	1,600	Estimate from Jake Perrins
12.12	Niskin Bottle set up	1	ea		500	0	500	500	Estimate from Jake Perrins
12.13	pneumatic pump set up	1	ea		500	0	500	500	Estimate from Jake Perrins
12.14	Weigh Scale	1	ea		500	0	500	500	Estimate from Jake Perrins
12.15	Hot Plates	2	ea		140	0	280	280	Estimate from Jake Perrins
12.16	Metal spatulas	8	ea		9	0	74	74	Estimate from Jake Perrins
12.17	Volumetric Glassware	1	ea		200	0	200	200	Estimate from Jake Perrins
12.18	P1000 Pipettor	2	ea		250	0	500	500	Estimate from Jake Perrins

12.19	P200 Pipettor	2	ea		250	0	500	500	Estimate from Jake Perrins
12.20	P5000 Pipettor	1	ea		250	0	250	250	Estimate from Jake Perrins
12.21	Rinse Bottles	3	ea		12	0	36	36	Estimate from Jake Perrins
12.22	Hockey sticks	3	ea		10	0	30	30	Estimate from Jake Perrins
12.23	Spread Plate Turn Tables	2	ea		50	0	100	100	Estimate from Jake Perrins
12.24	Forceps	3	ea		20	0	60	60	Estimate from Jake Perrins
12.25	Vortex	1	ea		250	0	250	250	Estimate from Jake Perrins
12.26	Alcohol Lamps	3	ea		15	0	45	45	Estimate from Jake Perrins
12.27	Vaccum Pump	2	ea		550	0	1,100	1,100	Estimate from Jake Perrins
12.28	Membrane manifolds	2	ea		20	0	40	40	Estimate from Jake Perrins
12.29	Chlorophyll fractionation manifold	1	ea		1,500	0	1,500	1,500	Estimate from Jake Perrins
12.30	Chlorophyll Filter Funnels	4	ea		110	0	440	440	Estimate from Jake Perrins
12.31	Microbial Filter Funnels	4	ea		175	0	700	700	Estimate from Jake Perrins
12.32	rubber corks	1	ea		5	0	5	5	Estimate from Jake Perrins
12.33	rubber hose	1	ea		15	0	15	15	Estimate from Jake Perrins
12.34	5L Erlynmeyer Filter Flask	2	ea		150	0	300	300	Estimate from Jake Perrins
12.35	Zooplankton Nets	2	ea		200	0	400	400	Estimate from Jake Perrins
12.36	Zooplankton sprayer	2	ea		30	0	60	60	Estimate from Jake Perrins
12.37	Zooplankton Scope	1	ea		1,400	0	1,400	1,400	Estimate from Jake Perrins
12.38	Zooplankton Counting Device	1	ea		300	0	300	300	Estimate from Jake Perrins
12.39	Zooplankton Raceway plates	2	ea		50	0	100	100	Estimate from Jake Perrins
12.40	Hard Hats	4	ea		10	0	40	40	Estimate from Jake Perrins
12.41	Safety goggles	6	ea		5	0	30	30	Estimate from Jake Perrins
12.42	Flashlights	4	ea		40	0	160	160	Estimate from Jake Perrins
12.43	Jump suits	4	ea		25	0	100	100	Estimate from Jake Perrins
12.44	Gloves	4	ea		15	0	60	60	Estimate from Jake Perrins
12.45	Depth Guage	1	ea		30	0	30	30	Estimate from Jake Perrins
12.46	Mixing Apparatus	1	ea		50	0	50	50	Estimate from Jake Perrins
	Sub-Total					0	46,055	46,055	
13	SAMPLE BOTTLES								
13.01	Phytoplankton bottles	73	ea		8	0	584	584	Estimate from Jake Perrins
13.02	1L Nalgene bottles	60	ea		8	0	480	480	Estimate from Jake Perrins
13.03	Zooplankton bottles	100	ea		1	0	100	100	Estimate from Jake Perrins
13.04	10L sampling carboys	4	ea		60	0	240	240	Estimate from Jake Perrins
13.05	2.5 Gal Cube containers	10	ea		5	0	50	50	Estimate from Jake Perrins
	Sub-Total					0	1,454	1,454	

ITEMIZED COST ESTIMATE DETAILS - TANK SAMPLING

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT LABOR (HOURS)	UNIT MATERIAL ($)	TOTAL LABOR (HOURS)	TOTAL MATERIAL ($)	TOTAL COST ($)	REMARKS
14	BALLAST TANK SAMPLING MODIFICATIONS								
14.01	Tank hatch installation	2	ea	80	2,400	160	4,800	12,800	
14.02	Sampling pump and piping manifold	2	ea	60	1,400	120	2,800	8,800	Diaphragm Pump
14.03	In tank sample tubing and deck penetration	2	ea	80	600	160	1,200	9,200	
14.04	Spot repair of ballast tank coating (paint)	2	ea	80	1,200	160	2,400	10,400	
14.05	Existing equipment reorganization, stbd only	1	lot	60	600	60	600	3,600	
14.06	Engineering/Design	1	lot		3,200	0	3,200	3,200	
	Sub-Total					660	15,000	48,000	

GOULDS PUMPS BECKWITH & KUFFEL INC

Neal Johnson
Beckwith & Kuffel, Inc.
5930 1st Ave. S.
Seattle, WA 98108
Phone: 1-800-767-6700
Fax: (206) 767-6230

Glosten & Associates

Proposal No: 06-02085-10U

Item No: ITEM 001

October 11, 2006

Attn: Dan Clopton

MODEL:3410-V M SIZE: 8x10-12 QTY: 1

Operating conditions

SERVICE	
LIQUID	Water Temp. 70.0 deg F, SP.GR 1.000, Viscosity 1.000 cp
CAPACITY Rated	1,500.0 gpm
HEAD	50.0 (ft)

Performance at 1180 RPM

PUBLISHED EFFY	86.0% (CDS)
RATED EFFY	84.5% with contract seal
RATED POWER	22.4 hp (incl. Mech. seal drag 0.34). (Run out 26.1 hp)
NPSHR	4.9 ft
DISCH PRESSURE(R)	22.1 psi g (27.4 psi g @ Shut off)
PERF. CURVE	3849-2 (Rotation CW viewed from coupling end)
SHUT OFF HEAD	63.2 ft
MIN. FLOW	Continuous Stable: 463.8 gpm Hydraulic: 463.8 gpm Thermal: N/A

Materials

CONSTRUCTION	Bronze fitted
CASING	Cast iron (max.casing.pres. @ rated temperature 175.0 psi g)
CASING WEAR RING	Bronze
IMPELLER	Bronze - Enclosed (11.5000 in rated, max mean=12.0000 in, min mean=9.0000 in)
CASING GASKETS	Non asbestos
SHAFT MATERIAL	SAE 4140
SHAFT SLEEVE	Bronze
LUBRICATION	Regreasable bearings
SEAL CHAMBER	Stuffing box bore
GLAND	316SS Flush vent and drain
BEARINGS	SKF 6207 (Inboard) SKF 5306 A/C3 (Outboard)
SUPPORT PLATE	Fabricated steel
COUPLING	T.B. Wood`s - Standard-Sure Flex 9S-S.F. 1.00
COUPLING GUARD	Steel

Sealing Method

MECHANICAL SEAL	John Crane 1 X(1)F(50)1XO(58)1 (Carbon vs Silicon Carbide) - (Conventional - Single)

Casing connections

Tapped suction and discharge gauge (4 taps)

Flanges

125# flat face

Frame features

Labyrinth oil seals - Inpro VBX
Single extended shaft

Testing

Non witnessed casing hydrostatic-test

Miscellaneous

Piping Plan 7331 316SS tubing with cyclone separators

Painting

Goulds Blue standard painting

Driver : Electric motor Manufacturer : Pump mfg`s Choice

FURNISHED BY	Pump mfg	MOUNTED BY	Pump mfg
RATING	25.0 hp (18.6 KW)	ENCLOSURE	Severe Duty/Mill and Chemical Premium Efficiency
PHASE/FREQ/VOLTS	3/60 Hz/230/460	SPEED	1200 RPM
INSULATION/SF	F/1.15	FRAME	324TSC

Weights and Measurements

TOTAL NET UNIT WEIGHT / VOLUME	2,402.0 lb / 30.3 ft^3
TOTAL GROSS UNIT WEIGHT / GROSS VOLUME	2,773.0 lb / 74.2 ft^3

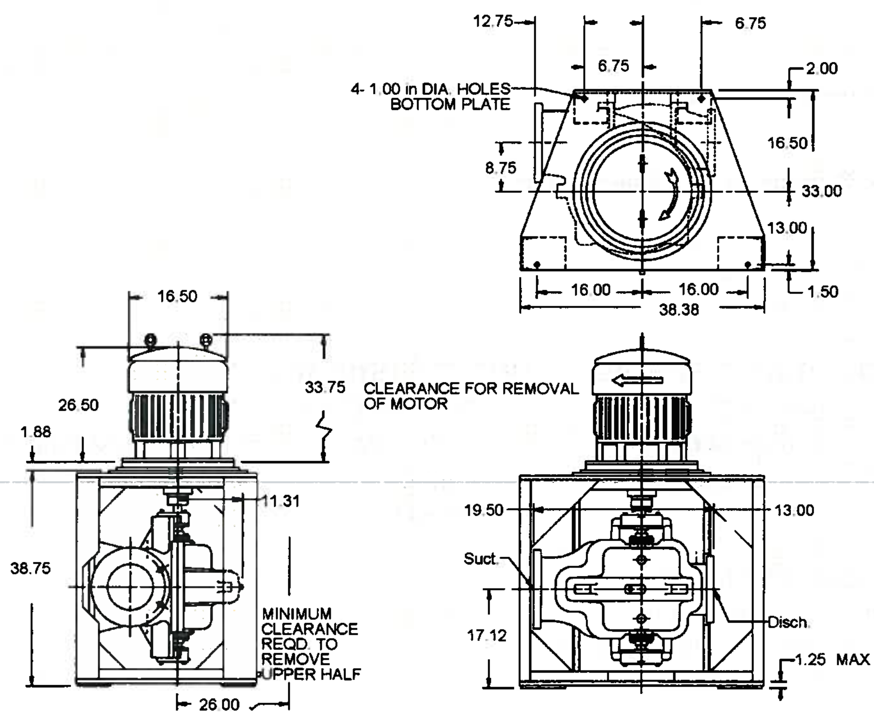
Program Version 1.18.0.1

Our offer does not include specific review and incorporation of any Statutory or Regulatory Requirements and the offer is limited to the requirements of the design specifications. Should any Statutory or Regulatory requirements need to be reviewed and incorporated then the Customer is responsible to identify those and provide copies for review and revision of our offer.

Our quotation is offered in accordance with our comments and exceptions identified in our proposal.

OUTLINE DRAWING

Model 3410-V M
Size 8x10-12



Pump specification

SUCT.FLANGE SIZE *10"*	DRILLING *ANSI 125 #*	FACING *FF*	FINISH *SMOOTH*
DISCH.FLANGE SIZE *8"*	DRILLING *ANSI 125 #*	FACING *FF*	FINISH *SMOOTH*
PUMP ROTATION (LOOKING AT PUMP FROM MOTOR) *CW*			
TYPE OF LUBRICATION *REGREASABLE BEARINGS*			COOLED *NO*
TYPE OF STUFFING BOX *STUFFING BOX BORE*			COOLED *NO*
TYPE OF SEALING *MECHANICAL SEAL*			

Weights and Measurements

PUMP	858.0 lb
MOTOR/CPLG	540.0/14.0 lb
PUMP SUPPORT	990.0 lb
TOTAL	2,402.0 lb
GR.VOLUME w/BOX	74.2 ft³
GR.WEIGHT w/BOX	2,773.0 lb

Motor specification

MOTOR BY *PUMP MFG*	MOUNT BY *PUMP MFG*	MFG. *PUMP MFG'S CHOICE*
FRAME *324TSC*	POWER *25.0 hp*	RPM *1200*
PHASE *3*	FREQUENCY *60 HZ*	VOLTS *230/460*
INSULATION *F*	S.F. *1.15*	
ENCLOSURE *SEVERE DUTY/MILL AND CHEMICAL PREMIUM EFFICIENCY*		

Notes and References

- MTR DIMENSIONS ARE APPROXIMATE
- INSTALL FOUNDATION BOLTS IN PIPE SLEEVES
- ALLOW FROM 0.75 to 1.50in. FOR GROUTING. SEE INSTRUCTION BOOK FOR DETAILS.

FOR PUMP TAPPED OPENINGS REFER TO DWG.:
T06-02085-10U / ITEM 001

Auxiliary specification

COUPLING BY *PUMP MFG*	CPLG TYPE *T.B. WOOD'S STANDARD-SURE FLEX 9S*
CPL GUARD BY *PUMP MFG.*	CPLG GUARD MATL *STEEL*
PUMP SUPPORT *FABRICATED STEEL*	
MECH.SEAL *JOHN CRANE 1 X(1)F(50)1XO(58)1 (CARBON VS SILICON CARBIDE)*	

DRAWING IS FOR REFERENCE ONLY.
NOT CERTIFIED FOR CONSTRUCTION UNLESS SIGNED.

Customer: Glosten & Associates
Serial No:
Customer P.O. No:
Item No: ITEM 001
End User: Marine
Service:

DRAWING NO 06-02085-10U/ITEM 001

FORM # ED0190 Program Version 1.18.0.1

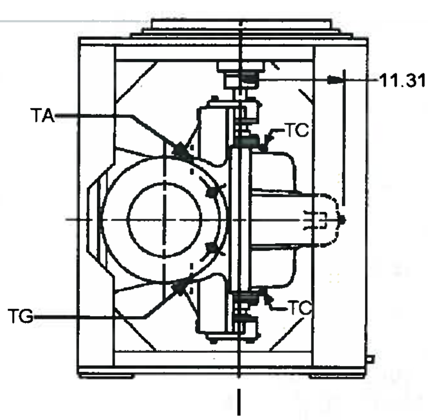
GOULDS PUMPS TAPPED OPENINGS Model 3410-V M Size 8x10-12

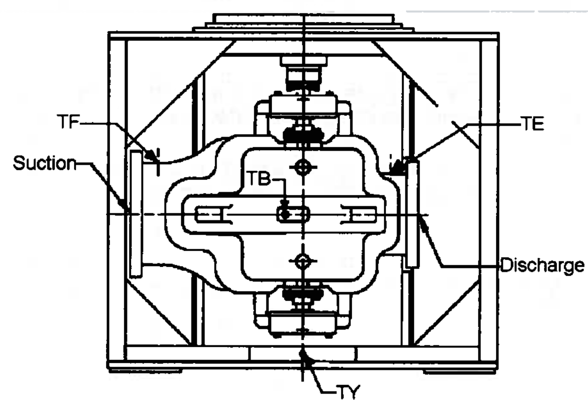
ITT

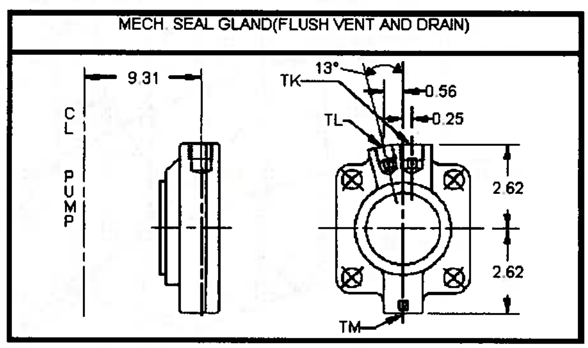
TAPPED OPENINGS MODEL 3410-V M 8x10-12

NO.	SIZE	QTY.	PURPOSE	FURNISHED YES/NO
TA	3/8	1	CASING VENT	YES
TB	3/4	1	CASING PRIME CONN	YES
TC	3/8	2	STUFF. BOX SEAL RING CONN	YES
TE	3/8	2	DISCH. GAUGE CONNECTION	YES
TY	3/4	1	BASEPLATE DRAIN (HALF CPLG)	NO
TF	3/8	2	SUCTION GAUGE CONNECTION	YES

NO.	SIZE	QTY.	PURPOSE	FURNISHED YES/NO
TG	3/4	1	CASING DRAIN CONN	YES
TK	3/8	2	GLAND FLUSH CONN	YES
TL	1/4	2	GLAND VENT CONN	NO
TM	3/8	2	GLAND DRAIN CONN	NO
TN	1/4	4	GLAND QUENCH CONN	NO







DRAWING IS FOR REFERENCE ONLY.
NOT CERTIFIED FOR CONSTRUCTION UNLESS SIGNED.

Customer: Glosten & Associates
Serial No:
Customer P.O. No:
Item No: ITEM 001
End User: Marine
Service:

All dimensions are in inches.
Drawing is not to scale

DRAWING NO 06-02085-10U/ITEM 001

FORM # ED0190 +849 Program Version 1.18.0.1

Model: 3410-V	Size: 8x10-12	Group: M	60Hz	RPM: 1180	Stages: 1

Job/Inq.No. :			
Purchaser :	Glosten & Associates		
End User :	Marine	Issued by :	Neal Johnson
Item/Equip.No. :	ITEM 001	Quotation No. :	06-02085-10U
Service :			
Order No. :		Certified By :	

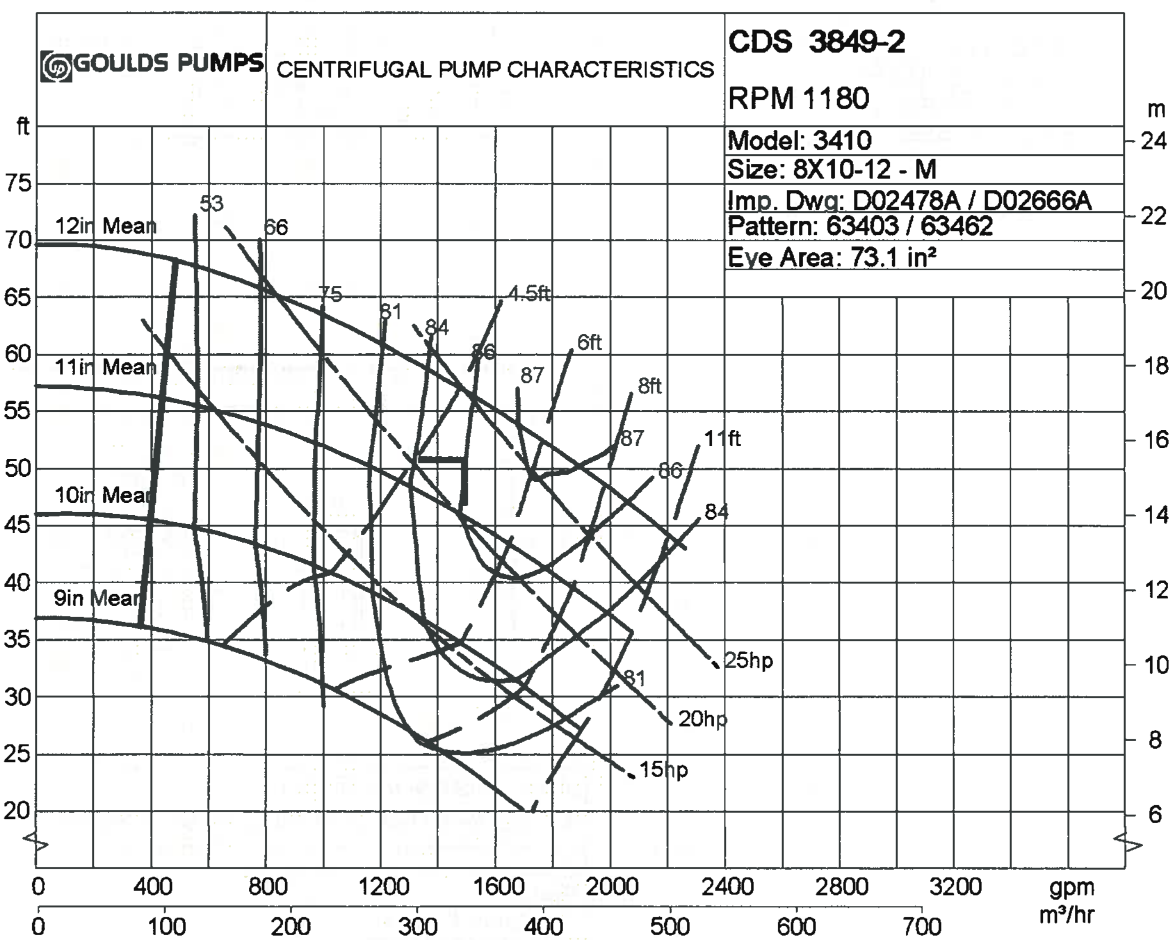
Date : 10/11/2006

Operating Conditions / **Pump Performance**

Liquid:	Water	Actual Pump Eff.:	84.5 %	Suction Specific Speed:	9,234 gpm(US) ft
Temp.:	70.0 deg F	Actual Pump Power:	22.4 hp	Min. Hydraulic Flow:	463.8 gpm
S.G./Visc.:	1.000/1.000 cp	Total Power Loss:	0.34 hp	Min. Thermal Flow:	N/A
Flow:	1,500.0 gpm	Rated Total Power:	22.4 hp		
TDH:	50.0 ft	Imp. Dia. First 1 Stg(s):	11.5000 in		
NPSHa:		NPSHr:	4.9 ft	Non-Overloading Power:	26.1 hp
Solid size:		Shut off Head:	63.2 ft		
% Solids:		Vapor Press:			
Max. Solids Size:	1.1000 in				

Notes: 1. Power and efficiency Losses are not reflected on the curve below.
2. Elevated temperature effects on performance are not included.

- Some impeller diameters of this selection will require a taper cut trim. They are indicated in the performance curve below as MAJOR DIAMETER x MINOR DIAMETER.



BECKWITH & KUFFEL INC

Neal Johnson
Beckwith & Kuffel, Inc.
5930 1st Ave. S.
Seattle, WA 98108
Phone: 1-800-767-6700
Fax: (206) 767-6230

Glosten & Associates

Proposal No : 06-02085-10U

Item No : ITEM 001

October 11, 2006

Attn: Dan Clopton

PUMPSMART VARIABLE SPEED DRIVE SYSTEMS: PS75

Operating conditions

INSTALLATION SITE ALTITUDE	
MAX AMBIENT TEMPERATURE	104.0 deg F

Controller

SUPPLY VOLTAGE	380/460 VAC
POWER	25.0 hp
MOUNTED STYLE	Wall Mounted
CONTROLLER OUTPUT CAPACITY	0.0 (Amps) (No Correction due to Altitude or Ambient Temp.)

Optional Features:

Controller Enclosure

NEMA 1 - IP21

Pressure Transmitter

Direct Mount - ifm effector PA series (4-20mA OutputVoltage 10.8-30 VDC), (0-145psig) - 5m cable

See pricing section for applicable adders.

The PS75 is an integrated pump controller that can increase the efficiency and reliability of your pump and system. Use the PS75 to replace a traditional motor starter to take advantage of the adjustable soft starter and add the flexibility to dial in the pump speed to match the process demand. The PS75 protects the pump from upset conditions with patented pump protection algorithms and the motor from overload conditions by limiting current. The PS75 is the complete pump controller package and can be applied to any centrifugal or positive displacement pump.

Right Size - *Use the PS75 to electronically trim the pump and right size the pump to the application requirements.*

Pump Protection - *Use the patented Torque Based Pump Protection to protect the pump from upset conditions such as dry-run, low-flow, dead-head and run-out at any operating speed.*

Soft Start & Stop - *Use the PS75 to replace a traditional across-the-line motor starter for an adjustable soft starter that can limit the in-rush current and eliminate water hammer.*

Simplicity - *The PS75 can be configured in minutes with the automated Start Up Assistants. Power the PS75 up, follow the on screen instructions, dial in the desired pump speed and you are ready to operate the pump.*

Energy Savings - *Pump power is proportional to speed3 which means even a small decrease in speed such as 20% can yield a 50% energy reduction.*

Process Control - *Use the PS75 to automatically control the pump speed to meet the process demands. Add a pressure transmitter to the PS75 and make your pump a constant pressure system to eliminate high and low pressure surges.*

Pump Knowledge - *With over 150 years of pump expertise be confident your pump has been optimally selected and is properly protected by the people who know pumps. If you have a pump that can benefit from any of these features let the pump experts evaluate your system and recommend the best PumpSmart solution.*

Our offer does not include specific review and incorporation of any Statutory or Regulatory Requirements and the offer is limited to the requirements of the design specifications. Should any Statutory or Regulatory requirements need to be reviewed and incorporated then the Customer is responsible to identify those and provide copies for review and revision of our offer.

****** Our quotation is offered in accordance with our comments and exceptions identified in our proposal.**

3. BIOLOGICAL CALIBRATION AND BETA TESTING

BIOLOGICAL CALIBRATION

While the primary purpose of this proposal is to provide for capital improvements to make the Golden Bear a viable ballast water technology test platform, we acknowledge that biological calibration will be necessary before the system is put into service. This is because any within-system mortality to organisms being tested must be measured in order to accurately evaluate mortality that is caused by the treatments. We briefly describe calibration that will be needed for each of the major organism groups that are usually measured during technology testing and evaluation:

Bacteria

Background

Bacteria are known to be sensitive to turbulence and shear. In particular, bacterial reductions after passing through a dynamic fluid channel have been studied in relation to biofilms and bacterial adhesion. While less work has been done with free floating or motile bacteria, physical properties and forces are assumed to affect these bacteria similarly. Mascari et al. (2002), found that bacteria remain more rigid than eukaryotic and mammalian cells when subjected to shear forces, suggesting that bacteria deform substantially less. However, prolonged periods of shear forces with *Re* values of 500 – 1500 after 30s exposure show greater effect than those with a 10s exposure, and higher temperatures along with smaller shear forces have also been shown to increase bacteria mortality (Bayoudh et al., 2005; Bulut et al., 1999). While it is unlikely that measurable bacteria mortality would be detected at the scale of the Golden Bear ballast treatment system, we recommend at least an initial test for system mortality. Calibration testing to determine bacteria mortality produced from the operation of the ballast testing system can be performed with the environmental bacteria community or with the use of a surrogate species.

Calibration test method-environmental bacteria community

Environmental bacteria analysis would be performed using heterotrophic plate counts of the community before and after a source water has been through the ballast testing system. A sample would be taken from the source water nearest the point where the water is pumped through the system, and a second sample would be taken from holding tanks once discharged from the ballast treatment system. Heterotrophic plate counts would be performed for each sample in triplicate (e.g., see Perrins et al. 2006). Any significant difference between the two sets of plate counts can be considered due to the processing of the water through the ballast testing system.

A previous study investigating the effect of shear forces and bacteria determined that any resulting mortality appeared to happen while bacteria are were in the log phase of growth and did not appear until 12h after the shear force was administered (Sahoo et al., 2006). With the bacteria being held in two tanks (one as a source water for treatment, and one as an analysis tank after treatment), bacteria sampling could also be performed 12-24h after the calibration test to determine any delayed effects.

Due to the size, cellular structure, and abundance of bacteria found in natural water, calibration testing to determine bacteria mortality produced from the operation of the ballast testing system should only have to be performed at the highest flow rate achieved by the ballast testing system.

Calibration test method-surrogate testing using Bacillus subtilis

Calibration testing to determine bacteria mortality produced from the operation of the ballast testing system using a surrogate species would be designed similarly to the environmental bacteria testing. Prior to the performance of the calibration testing, a sufficient concentration of the surrogate species would need to be produced, such that a final concentration of 10^5 cells/ml was achieved. Previous research involving shear forces has used *Bacillus subtilis* to determine bacteria mortality where a shear force of 1482/s showed a decrease in viable cell concentration. *Bacillus subtilis* is a gram-positive bacterium capable of sporulation under stress, but has shown to not sporulate under shear stress (Sahoo et al., 2006). It is easy to propagate under laboratory conditions and can be forced to sporulate prior to harvesting and storage. Calibration testing would conducted as described above, where a known concentration of *B. subtilis* would be amended to the water and samples taken before and after passing through the ballast testing system. *Bacillus subtilis* could be amended to the water either as a viable cell or as a spore.

Phytoplankton

Background

Shear forces are known to negatively impact phytoplankton, either by inhibiting growth or causing direct mortality. The degree of shear-related inhibition depends on the group of phytoplankton examined, where sensitivity ranges from least sensitive to most sensitive is: green algae, blue-green algae, diatoms, dinoflagellates (Thomas & Gibson 1990).

The majority of studies examining the impact of shear on phytoplankton focus on dinoflagellates, since their numbers tend to be reduced in turbulent water regimes (Sullivan & Swift 2003). Several studies have documented reduced growth and increased mortality of cultured dinoflagellates exposed to increasing shear forces (Juhl et al. 2000, Juhl & Latz 2002).

Few studies have examined the effect of shear forces on pelagic diatoms. Low shear forces benefit some diatom species by enhancing the nutrient flux at the surface of a diatom cell (Karp-Boss et al. 1996). Diatoms are believed to be less susceptible to shear-related growth inhibition, since they tend to dominate phytoplankton communities in well-mixed, turbulent waters (Sullivan & Swift 2003). However, stronger shear forces may cause breakage in diatom chains, especially in rigid cell types (Karp-Boss & Jumars 1998).

Overall, the effect of shear on phytoplankton is determined by: 1) the species and group of phytoplankton being considered (e.g., diatoms vs dinoflagellates), 2) the cell type (rigid vs flexible), 3) the growth phase of the organisms exposed to shear (early vs late phase exponential growth), 4) the intensity of the shear force, and 5) the duration of exposure to shear. Mortality is most likely to occur when rigid cells in late exponential phase growth are exposed to high shear forces for an extended duration (Juhl & Latz 2002). Cells in the early exponential phase of growth may experience inhibition of growth, but not direct mortality.

Most experiments conducted to examine the effect of shear on phytoplankton attempt to replicate those forces experienced in nature, for example, in surface waters during a high energy wind event. No studies have been conducted to determine the impact of short-term, high intensity, shear force exposure to phytoplankton cells, such as that experienced by cells moving through a ship's ballast water system.

Previously conducted pilot study – the effect of shear force on phytoplankton

Several of the investigators on this proposal (Cordell, Herwig) conducted three pilot tests at the Marrowstone Island Marine Field Station to determine if pump and pipe-related shear forces reduced phytoplankton biomass when moving water between a 5700 L supply tank and a 285 L mesocosm tank. A 32 GPM pump was used to move the water, via a 1 inch diameter pipe. Chlorophyll *a* concentration, a proxy for phytoplankton biomass, was measured in the supply tank prior to pumping, and again in the receiving mesocosm tank, 5 h post-pumping.

In all three tests, there was no significant difference in chlorophyll *a* concentration between the supply and receiving tanks (Table 3), indicating that, under these conditions, shear forces did not negatively impact phytoplankton. The shear forces experienced by phytoplankton during these tests would be small relative to that generated by a much higher capacity pump, and a longer, more complex piping route. Thus, an experimental test of the *Golden Bear* ballast treatment system is recommended, and described below, to examine shear-generated mortality of phytoplankton in a more realistic scale.

Table 3 - Chlorophyll *a* concentration (± standard deviation) in the 5700 L filling tank, and the receiving 285 L mesocosm tank, 5 h post-delivery (n=4).

Date	chlorophyll a concentration (µg/L) 5700 L filling tank	285 L mesocosm @ 5 h
Apr-05	38.36 ± 3.36	37.51 ± 0.33
Jul-05	10.61 ± 1.23	11.59 ± 0.39
Feb-06	0.43 ± 0.01	0.45 ± 0.04

Calibration test method - phytoplankton

This test would measure the mortality of phytoplankton cells resulting from shear forces as they move through the pump and piping of the *Golden Bear* ballast water testing system. This test would 'calibrate' the treatment testing system, so that the losses of phytoplankton related to movement through the system could be quantified separately from the effect of the ballast water treatment technology being tested.

Water containing natural assemblages of phytoplankton would be pumped into a large supply tank. This supply tank water would then be pumped through the testing system, and its associated plumbing, to ultimately be deposited into smaller receiving tanks. The test system-associated phytoplankton mortality would be determined by comparing the phytoplankton population in the supply tank to the receiving tank. This test would be conducted with the highest flow rate achievable by the test system, because higher rates would impart stronger shear forces on the phytoplankton.

Two methods would be used to quantify the phytoplankton population in these tanks. First, the chlorophyll *a* concentration, a proxy for phytoplankton biomass, would be determined. Chlorophyll *a* is a pigment naturally found in aquatic and terrestrial plants and photosynthetic protists. Second, the number of viable phytoplankton cells would be quantified using a modified version of the Most Probable Number method (Anderson & Throndsen 2003). This technique determines the number of viable phytoplankton cells in a water sample by serially diluting that sample into tubes containing medium that supports phytoplankton growth. Based on the pattern of growth in these tubes, number of viable cells in the original sample can be determined, and are reported as cells ml^{-1}.

As with bacteria, test-system associated mortality may be delayed for phytoplankton, so the supply tank and receiving tank water would be held and resampled 12-24 hr after the initial test.

Zooplankton

Background

Mechanical disturbances experienced in large volume water movement systems are known to cause mortality in zooplankton. For example, Evans et al. (1986) found that zooplankton mortalities resulting from passage through a nuclear plant, while small, were significantly greater in discharge than intake waters. Calanoid copepods were most sensitive to plant passage, cyclopoid copepods least sensitive, while cladocerans were intermediate in sensitivity. There was no relationship between zooplankton mortalities and temperature, and mechanical stresses appeared to be the major source of mortality. Higher zooplankton mortalities (>80%) were also observed in water passing through hydroelectric turbines, especially for rotifers and small Cladocera (Sorokin 1990). Sublethal affects of mechanical disturbance inside power plant cooling systems has also been observed, such as those reported by Standke and Monroe (1981), who found that more than 70% of mature *Daphnia* species had broken spines at the effluent compared to 37% at the intake, and that a species of calanoid copepod experienced a decrease by a factor of 7 in eggs being carried in the outfall area of the effluent channel. Recently, in a ballast water test bed facility located in Key West Florida, in-system mortality of a surrogate species (*Artemia salina*) has been a problem (T. Lemieux, personal communication). Therefore, we recommend that calibration tests for zooplankton mortality be conducted on the Golden Bear treatment system. Because there have been varying mortalities reported for different taxa and life-history stages of zooplankton in large piping/pumping systems (see references above), we further recommend that zooplankton calibration experiments be conducted at several time of the year when different assemblages of zooplankton will be present in ambient waters, and also using surrogate taxa (e.g., *Artemia*) of multiple life-history stages. We outline a pilot-scale zooplankton test that will be conducted as part of this proposal, below.

Calibration test method - zooplankton

This test would measure the mortality of different zooplankton taxa resulting from mechanical disturbance after passing through the Golden Bear ballast water testing system. This calibration would allow separation of mortality of zooplankton related to movement through the system from that caused by the effect of the ballast water treatment technology being tested.

Water containing natural assemblages of zooplankton would be pumped into a large supply tank. This supply tank water would then be pumped through the testing system, and its associated plumbing into smaller receiving tanks. The test system-associated zooplankton mortality would be determined by comparing mortality patterns in the supply tank to the receiving tank. This test would be conducted with the highest flow rate achievable by the test system, and then at lower flow rates if significant mortality was observed.

Mesozooplankton would be collected from the holding tanks in sample bottles, and filtered through a 35 µm sieve (50 µm mesh in diagonal), placed in a counting tray, and observed under a stereo microscope. They would then be classified into taxonomic groups. In each group, individuals would be classified as live, moribund, or dead, and counts of each category recorded. Animals would be designated as "live" if they were actively moving or exhibited an escape response when probed with a fine needle, "moribund" if external or internal movement was detected but no motility resulted when the individual was probed, and "dead" if no activity or movement of any kind was observed.

Pilot Study – The Effect Of Golden Bear Ballast Treatment System On Zooplankton

At the conclusion of the Golden Bear modifications, we will conduct a single pilot calibration study for zooplankton. Because this project is primarily intended to provide funding for the capital improvements to the Golden Bear, we will not conduct calibration studies for the other bacteria or phytoplankton, which require relatively expensive laboratory culturing (growout) of the test samples. The zooplankton calibration study will be conducted during the spring/summer when zooplankton densities and diversity are high. The experiment will be conducted as indicated above.

BETA TESTING

We have initiated beta-testing discussions with Maritime Solutions, Inc. regarding a filtration and UV system. This system is attractive for beta testing as the system is already containerized and does not utilize active substances. This will limit the planning as the system container is ready to ship and lead time of gaining permits for active substance discharges. This effort will be coordinated with the bilogical calibration of the test facility.

Figure 6 - Maritime Solutions containerized system ready for testing.

Figure 7

4. PROJECT STAKEHOLDERS

On 28 November 2006, Stakeholders gathered for a one-day working meeting at CMA. This group of 15 persons included senior and working personnel for CMA, MARAD, UW and Glosten. Staff from the California State Lands Commission attended to observe. As per the published summary of the meeting:

- Viability of project. The operations profile for the project indicated adequate ability to attract ballast research and testing efforts, while enhancing the ship's primary mission of training ship's officers. The group supported moving forward with capital modification efforts.
- Management of capital improvement effort. It was determined that the planning and development efforts to date are adequate to proceed with completing the SeaGrant proposal effort (deadline 10 January 2007). A plan for handling the capital improvement funds was developed which minimized overhead to the project. It was noted that funds are tight for the envisioned effort.
- Management of operations following capital improvement. A concept to receive, evaluate and execute ballast research and testing efforts on an operational basis was developed and agreed upon. It is recognized that development of an approved plan will take significant additional effort, but the concept is sound enough to move ahead with the capital improvement effort.

Further documenting and supporting this effort are subsequently letters from the Master of the Golden Bear as well as the MARAD Administrator (Appendix A). These letters show the commitment which MARAD and CMA are putting into this effort.

Subsequent to this Stakeholder meeting, the potential investigator teams were queried to determine their level of interest and support. This resulted in a very positive response, especially when cost, schedule and interface details were discussed. Support letters from both treatment system vendors and prominent ballast water scientific investigators are provided in Appendix A.

Beyond Ballast 1.0

It is important to the Golden Bear Stakeholders that the development efforts for addressing the round of full-scale testing of ballast water provide a venue for further opportunities in the future. Figure 8 provides an assessment of those future opportunities. It shows that a cycle for technology development which begins with identification of the problem and ends with certification of the technology. It identifies areas which, assuming modification completion in 2008, the Golden Bear can serve during this round of ballast water technology development (Ballast 1.0). It considers that the modifications and program development for the Golden Bear will well position CMA to pursue opportunities with sediment management and hull fouling. It also considers that the Convention expects to revisit the ballast standards in 2012, with a possible additional round of technology development at that time. These modifications should well position the Golden Bear to enrich its education program and serve the maritime industry as a test platform well into the future.

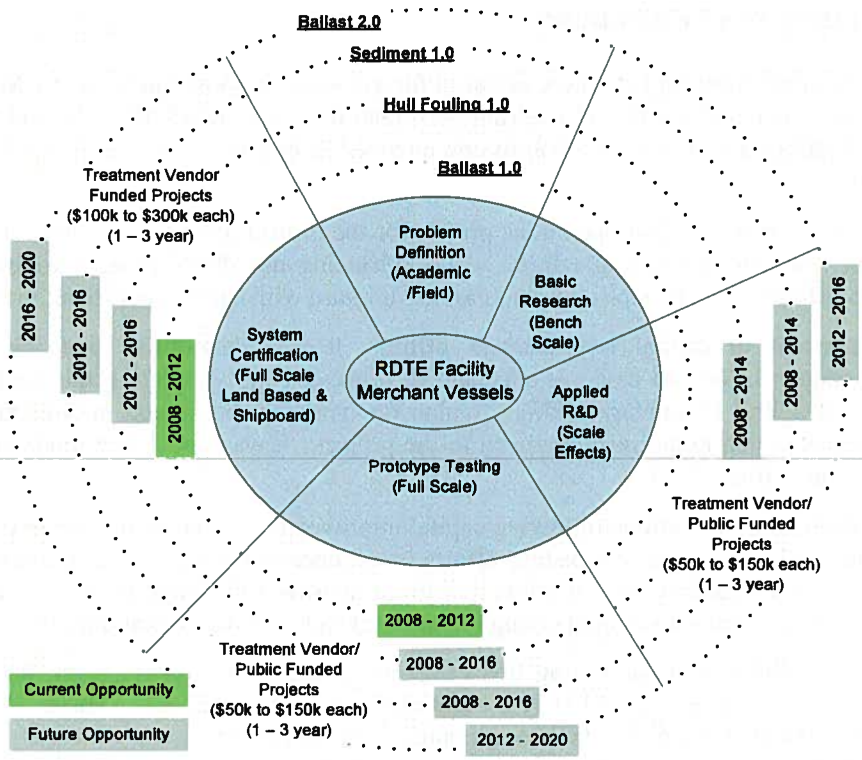


Figure 8 - Technology Development Cycle with *Golden Bear* Opportunities

Section 4 Attachments

4-1 Stakeholder Summary

4-2 Stakeholder Presentation

4-3 Support Letters

Owners
Investigator
Vendors
Faculty

PROJECT MEMORANDUM

TS Golden Bear - Ballast Test Platform
Stakeholders Working Meeting – Meeting Summary

TO: Golden Bear Ballast Stakeholders
DATE: 28November 2006
FILE No.: 05111.02
FROM: Kevin J. Reynolds

References:
1. *TS Golden Bear* Ballast Treatment Test Facility, Concept Design, Rev B – Draft, The Glosten Associates, 20 October 2006
2. T.S. Golden Bear Ballast Treatment Facility, Project Operational Co-ordination Diagram, Draft 2, Glosten, 7 November 2006
3. Memorandum, Comments on Ballast Water Treatment System, MARAD, 13 November 2006
4. *TS Golden Bear* Ballast Treatment Test Facility, Stakeholders Meeting Agenda, The Glosten Associates, 28 November 2006

LOGISTICS

- 28 November 2006, Tuesday, 10 am to 3 pm
- SPEC Complex, California Maritime Academy, Vallejo, CA
- Attendees
    - MARAD: Paul Gilmour, Carolyn Juneman, Hank Ryan, Sujit Mukherjee, Kevin Dwyer, Byran Vogel, Frank Johnston, Al Lipski
    - California Maritime Academy: Captain John Keever, Captain Dan Weinstock, Chief Engineer Bill Davidson, Michael Bittner
    - California State Lands Commission: Suzanne Gilmore
    - University of Washington: Jeff Cordell
    - The Glosten Associates: Kevin Reynolds, Dan Clopton

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OVERVIEW

A working stakeholders meeting was held to review the proposed ballast system modifications to the *TS Golden Bear*. This effort reached the following conclusions:

- Viability of project. The operations profile for the project indicated adequate ability to attract ballast research and testing efforts, while enhancing the ship's primary mission of training ship's officers. The group supports moving forward with capital modification efforts.
- Management of capital improvement effort. It was determined that the planning and development efforts to date are adequate to proceed with completing the SeaGrant proposal effort (deadline 10 January 2007). A plan for handling the capital improvement funds was developed which minimized overhead to the project. It was noted that funds are very tight for the envisioned effort.
- Management of operations following capital improvement. A concept to receive, evaluate and execute ballast research and testing efforts on an operational basis was developed and agreed upon. It is recognized that development of an approved plan will take significant additional effort, but the concept is sound enough to move ahead with the capital improvement effort.

SUMMARY

The agenda proposed for the meeting (Reference 4) was closely followed, with the meeting adjournment at 4:30 pm. A PowerPoint presentation was provided, but will not be distributed as the information is draft, proprietary and competition sensitive. Following completion of the proposal draft, which will contain significant portions of the presentation, a closely controlled copy of the proposal draft will be circulated to stakeholders for review.

10:00 am Meeting Objectives and Meeting Plan

10:15 am Introductions, Team Expectations and Concerns

- Commodore Keever: Maintain Primary Training Mission, Permission from MARAD for Alternate Use, Enhance Environmental Stewardship – CA State Benefit, Meet Classification Society Requirements – Maintain Class, Vessel Safety, Controls Over Program (Liability, Use of System), System Maintenance Plan/Responsibility, Contract Management and Funding, Project Demobilization Requirements, Further Concerns in Underway Efforts, Review of Costing
- Admiral Johnston: Highest Interest in Success of Proposed Project, Adherence with Primary Mission, Positive Impact on Environmental Issues, What do we Do After Testing

- Bill Davidson: Impact on Permanent Crew – Mitigation, Safe Clean Viable Installation, Equipment Removal
- Paul Gilmour: Support of Environmental Initiatives, Concern with Impact on Safety of Operations – Midshipmen on Board, Protection of Environment with Project, Refer to Memo, Life Cycle Costs
- Hank Ryan: Cost Management of Installation and Maintenance, Liability and Safety Issues, Adherence with Regulatory Requirements
- Sujit Mukherjee: Cost of Implementation, Meeting Concerns – Safety, Hazards, Environmental, Support of Program Funding, Who is Responsible Person, Liability Insurance, Contractor Requirements
- Al Lipski: Observing
- Carolyn Juneman: Drafting of MOA with Terms and Conditions, Documentation of Financial Concerns, Utmost Concern with Aquatic Invasive Species
- Suzanne Gilmour: Observing, Contacts for Permitting Discharges – Water Board
- Dan Clopton: Design Perspective, Vessel Operational Impacts
- Jeff Cordell: ANS Research: Transport and Technology Testing, Educational Outreach

11:00 am Project Overview

- Research, Development, Test and Evaluation Facilities
  - Need for Testing Facilities
    - UW Overview
    - IMO Overview
  - Pacific Ships RDTE Scheme
  - Golden Bear Advantages
- Project Specifics
  - Golden Bear Commercial Requirements
  - Project Viability
  - Capital Improvements
  - Operations/Maintenance Plan
- Logistics/Administration
  - Stakeholder Letters
  - Discharge Permits
  - Capital Improvement Financing

- Proposal Finalization

11:30 am Operations and Maintenance

- Organization Chart and Project Approval Process
  - Vessel Ownership, Liability, Responsibility
  - Treatment System/Vendor and Principal Investigator Roles and Responsibilities
- Project Based Maintenance, Operations and Lay-up Concept
- Discharge Permit Requirements
- Group Discussion and Issues
  - MARAD Review (Limit of Program Responsibility, Routine Maintenance, Contractor Qualifications, System Review, Crew Oversight Requirements, Operational Protocol

1:00 pm Capital Improvements Phased Approach

- Phase I – meets IMO criteria, but limits operations to dock side and limits on-site scientific outfitting to only IMO requirements
- Phase II/III – based on success and lessons learned from Phase I, includes laboratory outfitting, in-tank sampling and sea-going system
- Group Discussion and Issues
  - MARAD Review (Drains and Slops Handling, Storage of HAZMAT, Sample Tank Locations, Aft Crane Usage, Instrumentation, Tripping Hazards, Emergency Shut-downs, Tank Modifications, Communications
  - Contract Design, ABS Submittal and Plan Approval

2:00 Project Viability

- Benefits to California Maritime Academy/MARAD
- Integration with the Pacific Ships Initiative
- Demand for Facilities and Sources of Support
- Operational Costs and Handling
  - Draft Two Week Testing Effort (First Two of Three Required IMO G8 Tests) ~$100k (Not Including Admin Overhead)
  - One Week Testing Effort ~$70k (Last of Three Required IMO G8 Tests) (Not Including Admin Overhead)
  - Certification Effort is One Week plus Two Week Testing Effort ~$170k

- Overhead, Admin and Contingencies ~$250k for Testing Effort Meeting BOTH Land-based and Shipboard Requirements

- Group Discussion and Issues

3:00 pm Logistics and Administration

- SeaGrant Proposal
  - Completion and Submission of Proposal by 10 January 2007
  - Handling of Capital Funding
    - Estimate $300k for Capital Improvement Materials and Installation (To Be Updated)
    - Estimate $50k for Modification Plan Review and Approval, Construction Management
    - Estimate $35,000 for Contract Package (Specifications and Plans) Development and Engineering
    - Estimate $12,000 for Science Support to ensure installation meets potential Principal Investigator needs and requirements
    - Estimate for Required for CMA Direct Costs for Capital Improvement Effort (Vessel Crew Plan Review and Comment, SPEL Office Draft Proposal Review and Comment, SPEL Office Planning Efforts for Operations/Maintenance Program – TBD)
  - MARAD/CMA/Principal Investigator Terms of Use Agreement
- Further Development of Operations and Maintenance Plan
- Group Discussion and Issues

4:00 pm Meeting Objectives Review/Document Action Items

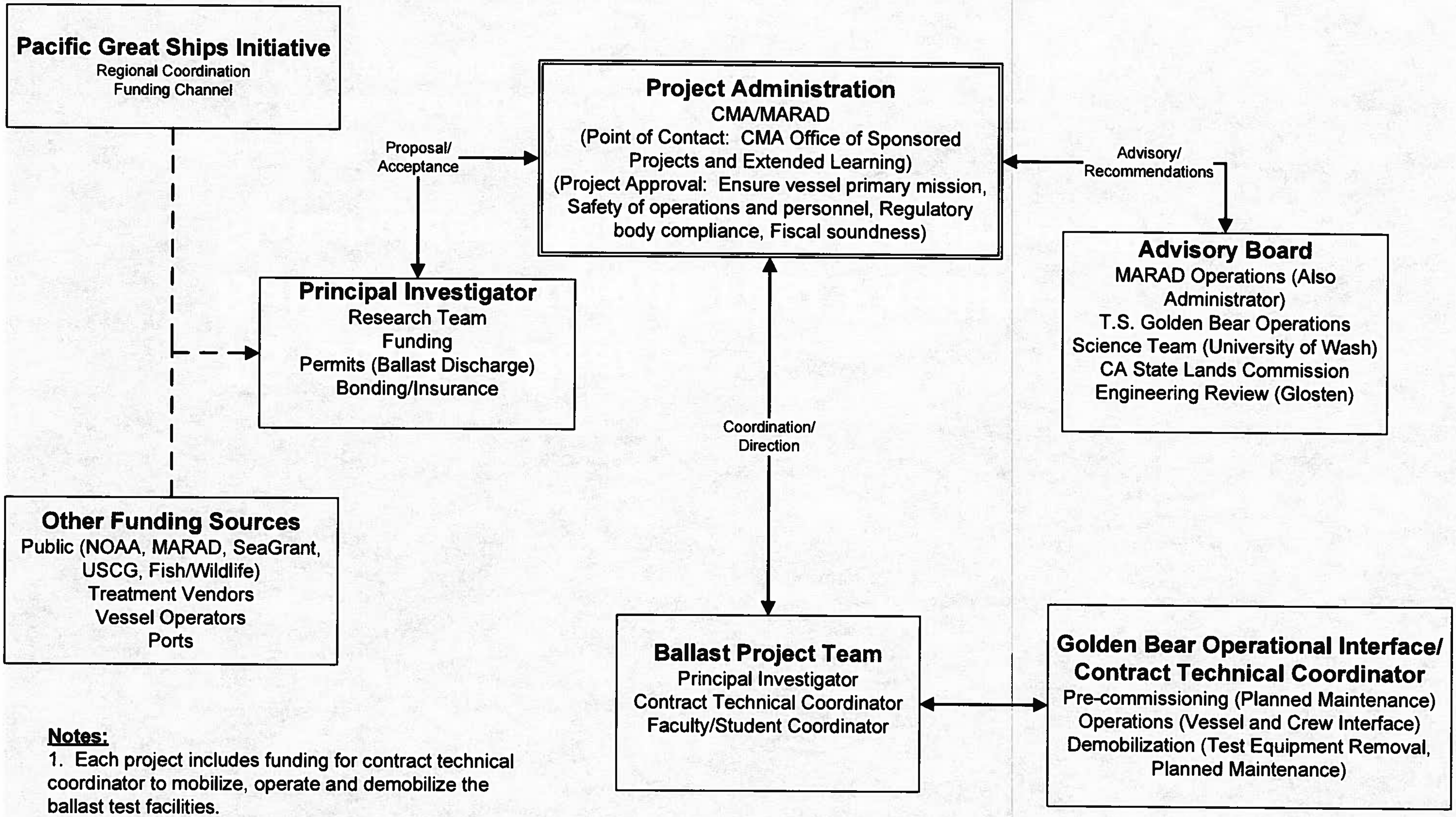
4:30 pm Adjourn

(Action Items Next Page)

ACTION ITEMS

ACTION ITEMS	PRIME	SUPPORT	DUE
Review Capital Improvements Scope and Budget			
Review Dock-side Location for Treatment System	Reynolds	Davidson	12-Dec
Consider Vessel Crane Use vs. Shore Crane Use	Reynolds	Davidson	12-Dec
Estimate Engineering Cost for Electrical and Ballast Systems As-Built Drawings	Reynolds		15-Dec
Incorporate Valve Monitoring into Concept Package	Reynolds		15-Dec
Incorporate MARAD Memo Comments	Reynolds		15-Dec
Draft Operations Check Lists for Proposal Inclusion			
Proposal Checklist/Format	Reynolds	Bittner	12-Dec
Precommissioning Checklist	Davidson	Reynolds	12-Dec
Operational Checklist	Davidson	Reynolds	12-Dec
Demobilization Checklist	Davidson	Reynolds	12-Dec
Vessel Accessibility Terms and Conditions			
MARAD Administrator Use of Vessel Letter - Signed	Juneman		7-Dec
CMA Use of Vessel Letter - Signed	Keever		7-Dec
Principal Use of Vessel MOA Between Prospective Principal Investigator and MARAD/CMA	Juneman	Gilmour	12-Dec
Proposal Logistics			
Determine Requirements for Direct Transfer of Capital Improvement Funds from NOAA to MARAD	Reynolds		7-Dec
Update Construction Cost Estimates Based on MARAD Comments and Meeting Review	Reynolds		15-Dec
Estimate UW Direct Costs for Capital Project Efforts	Cordell	Reynolds	
Estimate CMA Direct Costs for Capital Project Efforts			
Add CMA (Bittner) to Proposal as co-Principal Investigator	Reynolds	Bittner	15-Dec
Review Logistics and Project Costs of CMA Submittal of Proposal to SeaGrant	Bittner	Reynolds	15-Dec
Prepare Proposal Draft for Stakeholder Review and Comment	Reynolds	Cordell	15-Dec
Finalize Proposal and Submit to SeaGrant	Reynolds	Cordell	5-Jan

T.S. GOLDEN BEAR BALLAST TREATMENT FACILITY
PROJECT OPERATIONAL COORDINATION DIAGRAM - DRAFT



Notes:
1. Each project includes funding for contract technical coordinator to mobilize, operate and demobilize the ballast test facilities.
2. No operations can be conducted without the approval of the vessel Master.

7 November 2006
University of Washington

The Glosten Associates, Inc.
File No. 05111

TS Golden Bear –
Ballast Treatment Test Facility
Stakeholders Meeting – 28 November 2006

Presentation for:
***TS Golden Bear* Stakeholders**
28 November 2006, California Maritime Academy, Vallejo, CA

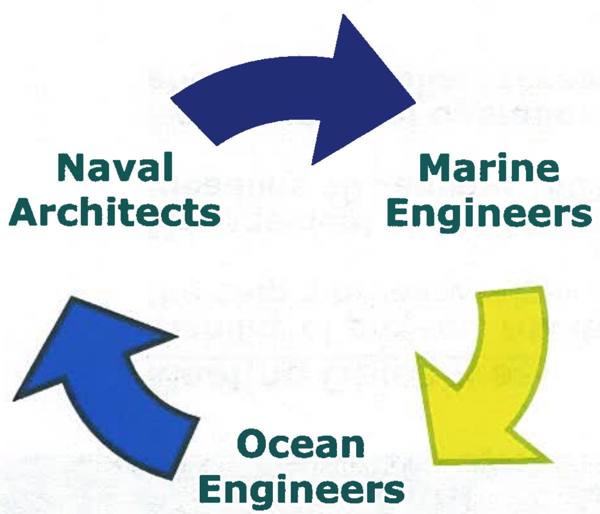
Presented by: Kevin J. Reynolds, PE, The Glosten Associates, Inc.

Glosten Overview

THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Marine Community

Engineering excellence and high quality service to commercial vessel owners and operators since 1958

Practical application of engineering & analysis to technical problems



Ballast Projects (1999 – 2006)

NEMW, Technology Demonstration Project, Full-Scale Design Study

Port of Seattle, Ballast Transfer Study, Vessel Modification Costs to Support Shore Processing Transfers

SBIR/USCG, Ballast Water Management System, Automated Tracking, Record keeping and Advisory

WDFW, Full Scale Ballast Exchange Trials, Volumetric Efficiency Analysis

Vitamar, Full Scale Ballast Discharge Dispersion Study, Deployment Plan

Severn Trent, Vessel Interface Study

Severn Trent, Prototype Installation Contract Design

SeaGrant, T/V Golden Bear Ballast Treatment Test Facility Contract Design

Pacific Ships Land-based Test Facility Design

Puget Sound Action Team (WA State Governor's Office), Ballast Treatment Technology Review

Member of Washington State Ballast Water Work Group

Meeting Objectives and Meeting Plan

Meeting Objectives

Viability of project. Ability to attract ballast research and testing efforts, while enhancing the ship's primary mission of training ship's officers.

Management of capital improvement effort. Ability to complete SeaGrant proposal (deadline 10 January 2007) and details of managing efforts and funds if successful.

Management of operations following capital improvement. Ability to receive, evaluate and execute ballast research and testing efforts.

Meeting Plan

10:00 am	Meeting Objectives and Meeting Plan
10:15 am	Introductions, Team Expectations and Concerns
11:00 am	Project Overview
11:30 am	Operations and Maintenance (Working Lunch)
1:00 pm	Capital Improvements Phased Approach
2:00 pm	Project Viability
3:00 pm	Logistics and Administration
3:30 pm	Meeting Objectives Review/Document Action Items
4:00 pm	Adjourn

Introductions, Team Expectations/Concerns

Team Expectations/Concerns

- MARAD 13 November Review
- Commodore Keever: Maintain Primary Training Mission, Permission from MARAD for Alternate Use, Enhance Environmental Stewardship – CA State Benefit, Meet Classification Society Requirements – Maintain Class, Vessel Safety, Controls Over Program (Liability, Use of System), System Maintenance Plan/Responsibility, Contract Management and Funding, Project Demobilization Requirements, Further Concerns in Underway Efforts, Review of Costing
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- Dan Clopton: Design Perspective, Vessel Operational Impacts
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Project Overview

Research, Development, Test and Evaluation Facilities

- Need for Testing Facilities
  - UW Overview
  - IMO Overview
- Pacific Ships RDTE Scheme
- Golden Bear Advantages

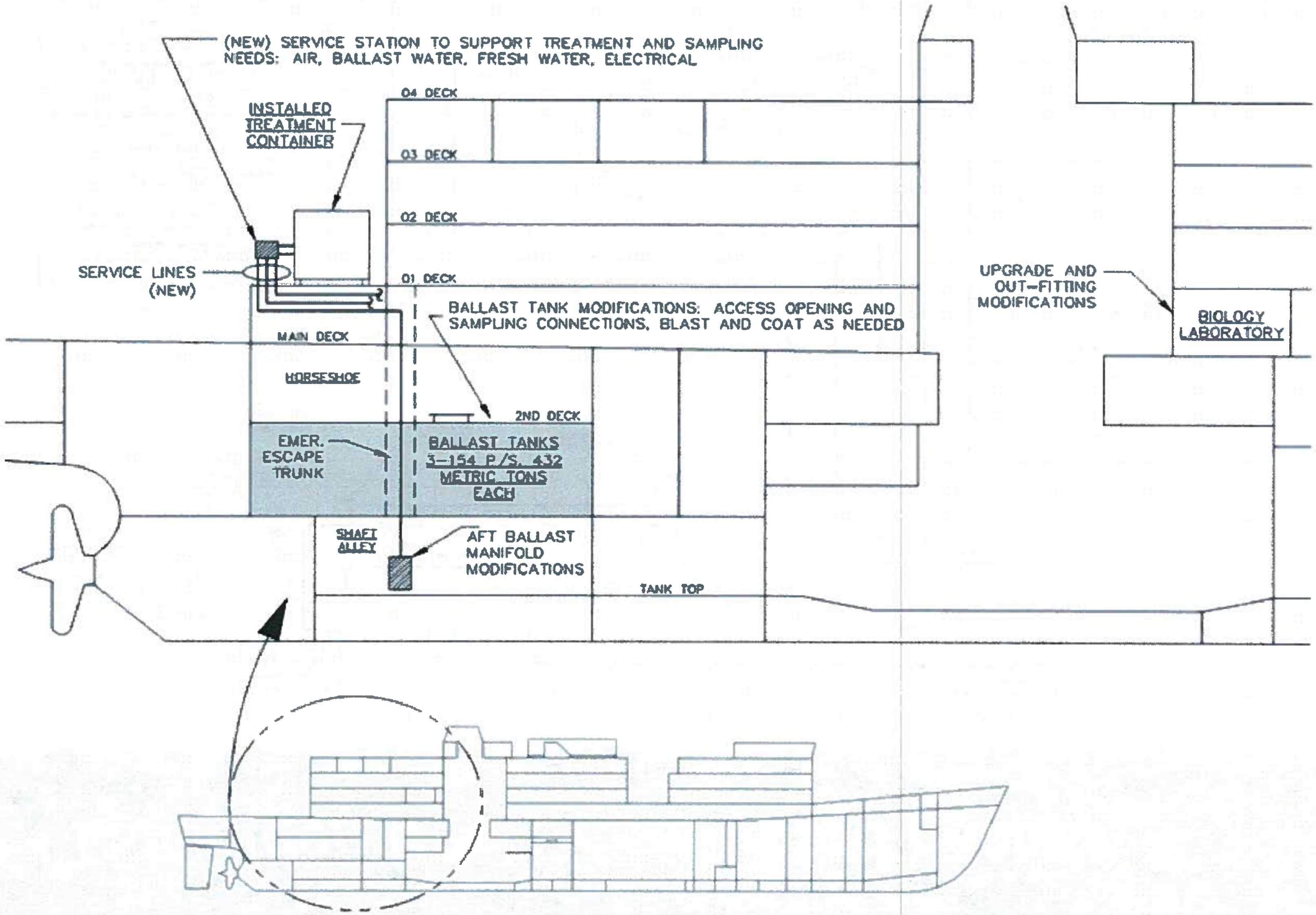
Project Specifics

- Golden Bear Commercial Requirements
- Project Viability
- Capital Improvements
- Operations/Maintenance Plan

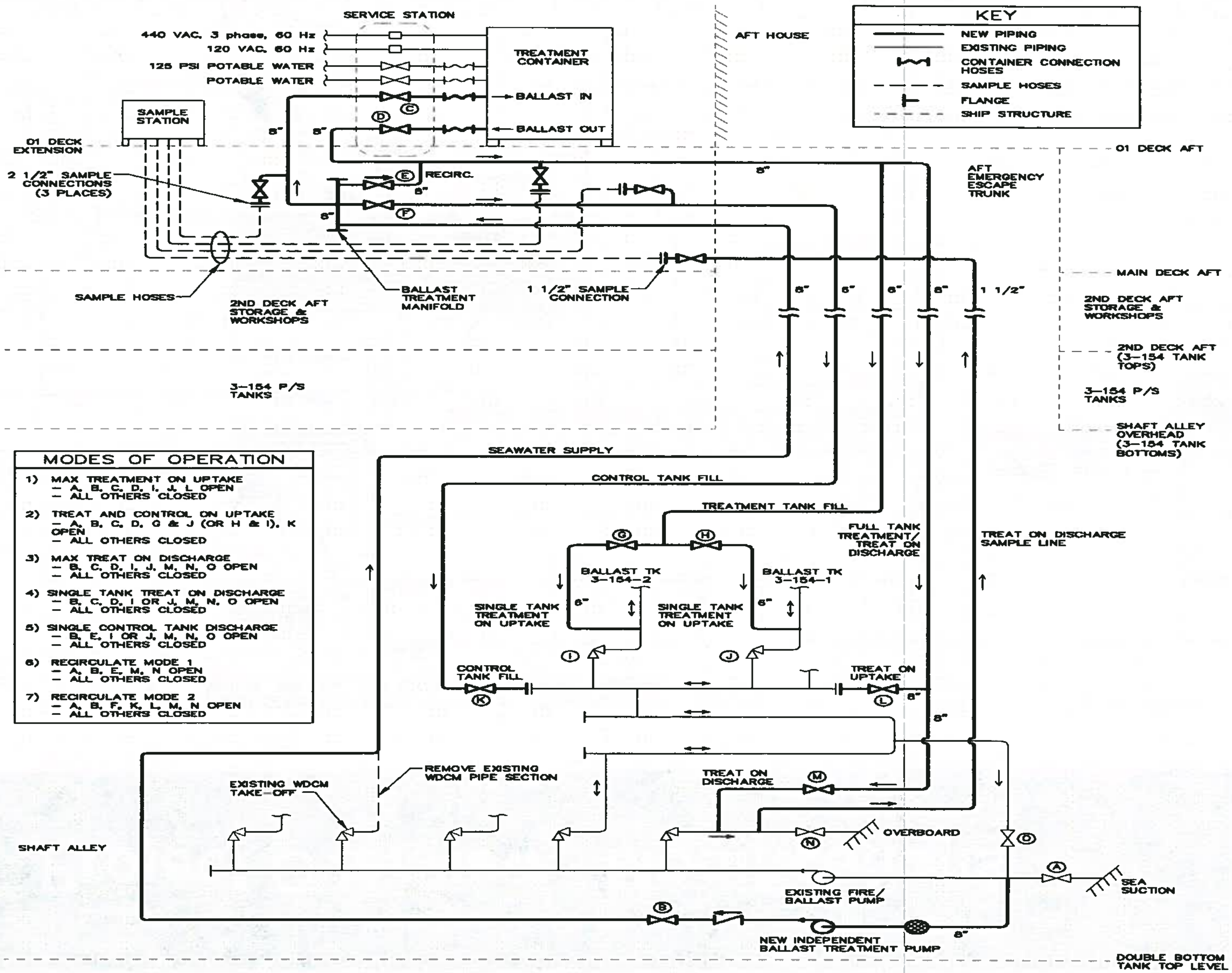
Logistics/Administration

- Stakeholder Letters
- Discharge Permits
- Capital Improvement Financing
- Proposal Finalization

Project Overview - Modifications



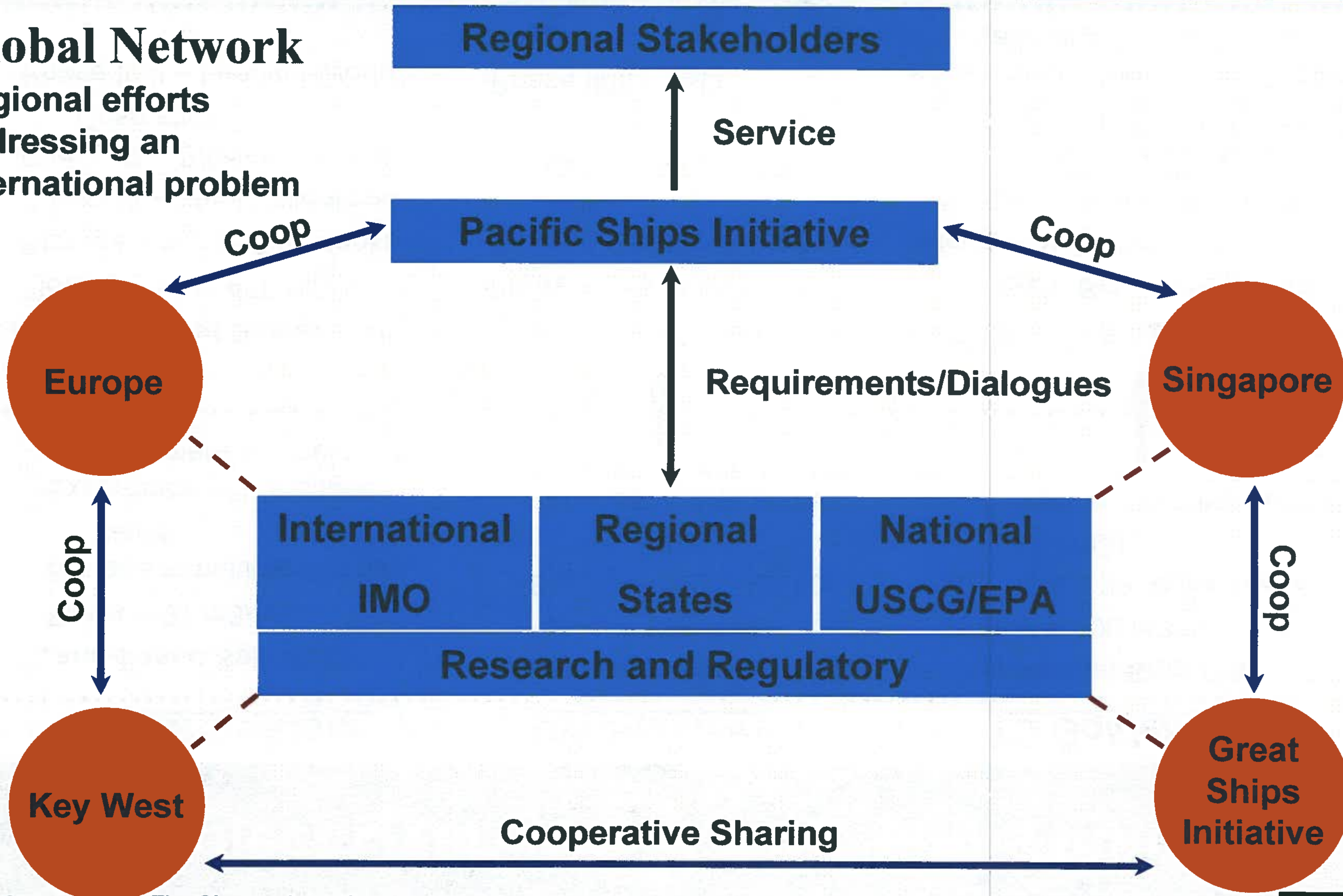
TS Golden Bear – Shipboard Facility



Project Overview: Pacific Ships Initiative

Global Network

Regional efforts addressing an international problem



Project Overview: Pacific Ships Initiative

	Marrowstone	UW Hatchery	TS Golden Bear
Existing	**Land-based Salt Water** -Flows = 91 m3/hr -Storage = multiple 280 liter tanks -Experience with multiple treatment technologies	**Land-based Fresh Water** -Flows = 148 m3/hr -Storage > Hundred 600 liter tanks -Experience with some treatment technologies	**Operational Ship (Salt & Fresh)** -Flows = 400 m3/hr -Storage = 28 Ships Tanks (200 to 450 m3) -No treatment system outfitted
Proposed	**IMO G8 – Land Based (Salt)** -Flows = 150 to 450 m3/hr -Storage = two 200 m3 tanks -Phase IA – Meet Guidelines -Phase IB – Efficiencies and Cosmetics -Phase II/III – Leading World	**Land Based (Fresh)** -Flows = 148 m3/hr -Storage = multiple 1 m3 tanks -Phase I – Dedicated Ballast Facility -Phase II/III - TBD	**IMO G8 Ship & Land Based (Salt, Brackish, Fresh)** -Flows = 350 m3/hr -Storage = two 430 m3 tanks -Phase I – Plug and Play Ballast Treatment Systems, Dock Side -Phase II/III – Sea Going, Expanded Laboratories
More	**Great Ships Initiative (Great Lakes)** **Teaming/Cooperation**	**Vessels of Opportunity**	**UW & USGS** **Laboratory Expertise**

Project Overview: *Golden Bear* Advantages

	IMO Criteria		Proposed Modifications		
			Vessel	IMO Comparison	
	Shipboard	Land-based	Capability	Shipboard	Land-based
Ballast Tanks					
Control capacity (m^3)	1:1 scale	200	**432/441**	☑	☑
Test capacity (m^3)	1:1 scale	200	**432/441**	☑	☑
Holding time	N/A	5 days	**5 days**	N/A	☑
Treatment Rate Capacity (TRC)					
Less than 200 m^3/hour	1:1 scale	1:1 scale	**349**	200	200
200 to 1000 m^3/hour	1:1 scale	1:5 scale	**349**	349	1,000
Greater than 1000 m^3/hour	1:1 scale	1:100 scale	**349**	N/A	34,900
Sampling Collection > 50 µm					
Influent test pre-treatment	Three x 1 m^3	Three x 1 m^3	**Three x 1 m^3**	☑	☑
Influent test post-treatment	N/A	Three x 1 m^3	**Three x 1 m^3**	Exceeds	☑
Influent control	N/A	Three x 1 m^3	**Three x 1 m^3**	Exceeds	☑
Discharge test pre-treatment	Three x 1 m^3	Three x 1 m^3	**Three x 1 m^3**	☑	☑
Discharge test post-treatment	N/A	N/A	**Three x 1 m^3**	Exceeds	Exceeds
Discharge control	Three x 1 m^3	Three x 1 m^3	**Three x 1 m^3**	☑	☑
In tank test	N/A	N/A	**Three x 1 m^3**	Exceeds	Exceeds
In tank control	N/A	N/A	**Three x 1 m^3**	Exceeds	Exceeds
Measurements, Physical					
Temperature	Required	Required	**In-line**	☑	☑
Ballast water flow rate	N/A	Required	**In-line**	Exceeds	☑
Ballast water pressure	N/A	N/A	**In-line**	Exceeds	Exceeds
Treatment power consumption	N/A	Required	**Portable**	Exceeds	☑
Salinity	Required	Required	**Sample**	☑	☑
pH	N/A	Required	**Sample**	Exceeds	☑
Total suspended solids	Required	Required	**Sample**	☑	☑
Turbidity (NTU)[3]	N/A	Required	**Sample**	Exceeds	☑
Particulate organic carbon	Required	Required	**Sample**	☑	☑
Dissolved organic carbon	N/A	Required	**Sample**	Exceeds	☑
Dissolved oxygen	N/A	Required	**Sample**	Exceeds	☑

Project Overview: *Golden Bear* Advantages

Vessel schedule includes annual dockside periods of about 8 months. This will enable testing to take place during this period without the waiting and transit times inherent with underway vessel operations.

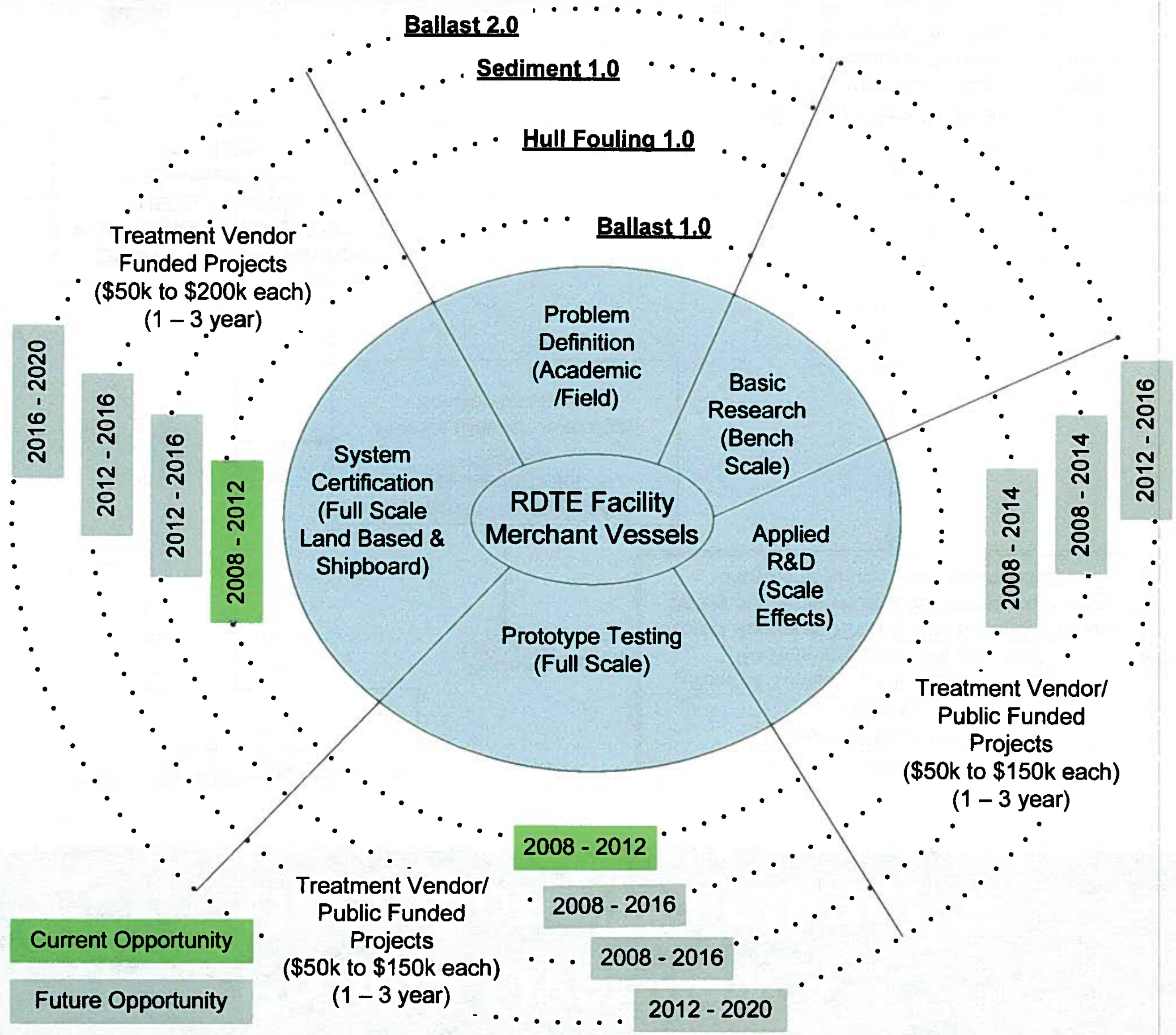
Vessel location in San Francisco Bay area is heavily laden with non-indigenous species, offering challenging water for treatment system trials, decreasing the likelihood that ballast water will need to be spiked with surrogate organisms.

Vessel is owned by MARAD, is a training vessel for ships' officers and is staffed with some of the best officers in the United States merchant fleet. The support structure offered by this stable and capable team will yield intangible benefits.

Vessel is an integrated part of a university educational environment, offering the mutual benefits of staff support and pedagogic opportunities.

Vessel primary function is as a training vessel for future merchant ship officers who will be given a first-hand opportunity to learn ballast management issues as they enter their professional careers.

Project Overview - Viability



Certification Example

Competitive market for treatment RDTE

Existing Facilities:

Land-based Example: NRL Key West – Verification: ~$200k

Shipboard Example: R&D Trial (Three Tests) (Not Including System Installation Costs) ~$200k

Total Cost: ~$400k for Certification

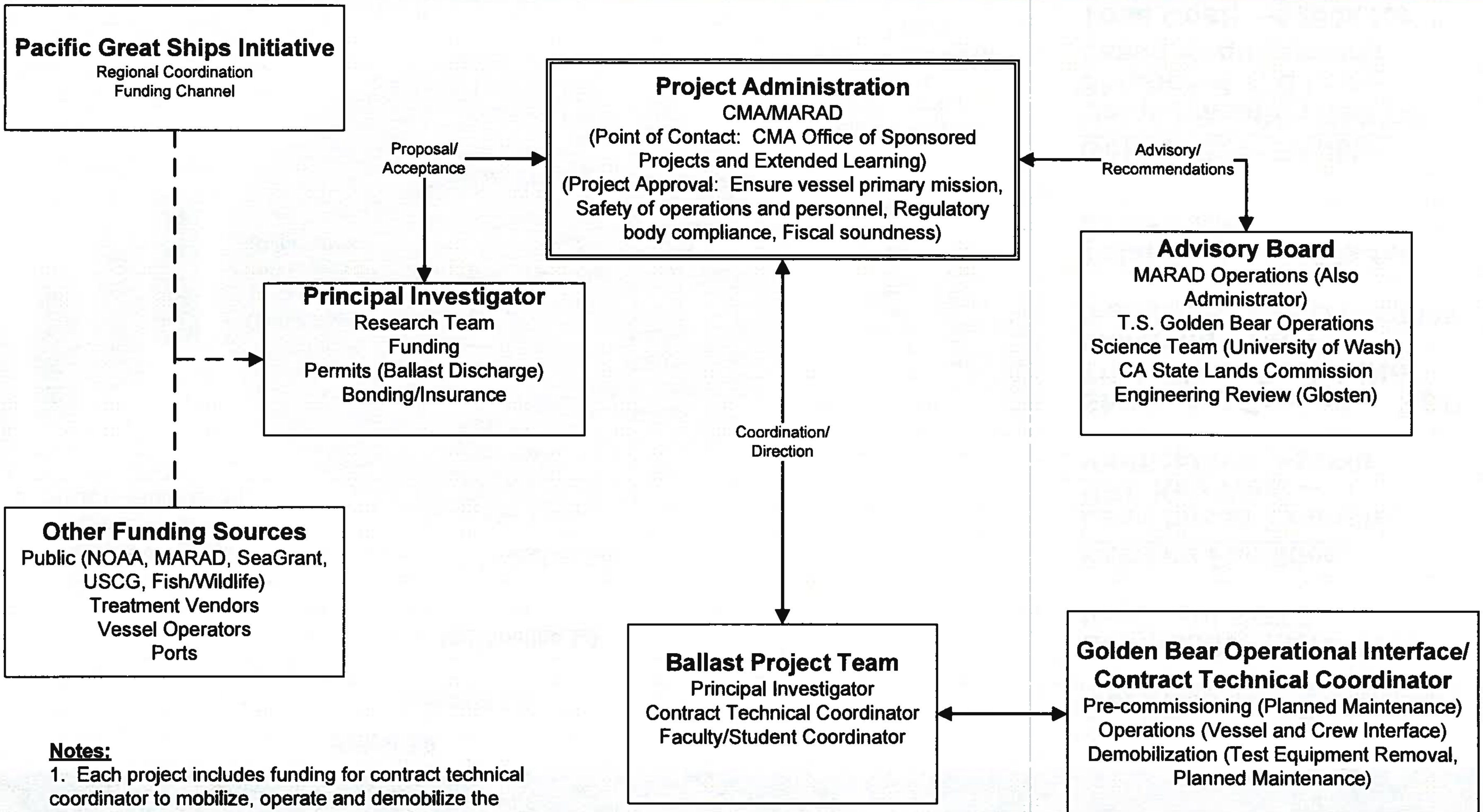
Golden Bear Facility:

Unique Meeting IMO G8 Shipboard and Land-based Requirements

Total Cost: ~$250k for Certification (Assumes similar level of effort as NRL Facility)

Competitive Advantage Factor of 2

Project Overview – Operations/Maintenance



Notes:

1. Each project includes funding for contract technical coordinator to mobilize, operate and demobilize the ballast test facilities.
2. No operations can be conducted without the approval of the vessel Master.

Project Overview

Research, Development, Test and Evaluation Facilities

- Need for Testing Facilities
- Pacific Ships RDTE Scheme
- Golden Bear Advantages

Project Specifics

- Golden Bear Commercial Requirements
- Project Viability
- Capital Improvements
- Operations/Maintenance Plan

Logistics/Administration

- Stakeholder Letters
- Discharge Permits
- Capital Improvement Financing
- Proposal Finalization

Meeting Plan

10:00 am Meeting Objectives and Meeting Plan
10:15 am Introductions, Team Expectations and Concerns
11:00 am Project Overview
11:30 am Operations and Maintenance (Working Lunch)
1:00 pm Capital Improvements Phased Approach
2:00 pm Project Viability
3:00 pm Logistics and Administration
3:30 pm Meeting Objectives Review/Document Action Items
4:00 pm Adjourn

Operations/Maintenance

Organization Chart and Project Approval Process

- Vessel Ownership, Liability, Responsibility
- Treatment System/Vendor and Principal Investigator Roles and Responsibilities

Project Based Maintenance, Operations and Lay-up Concept

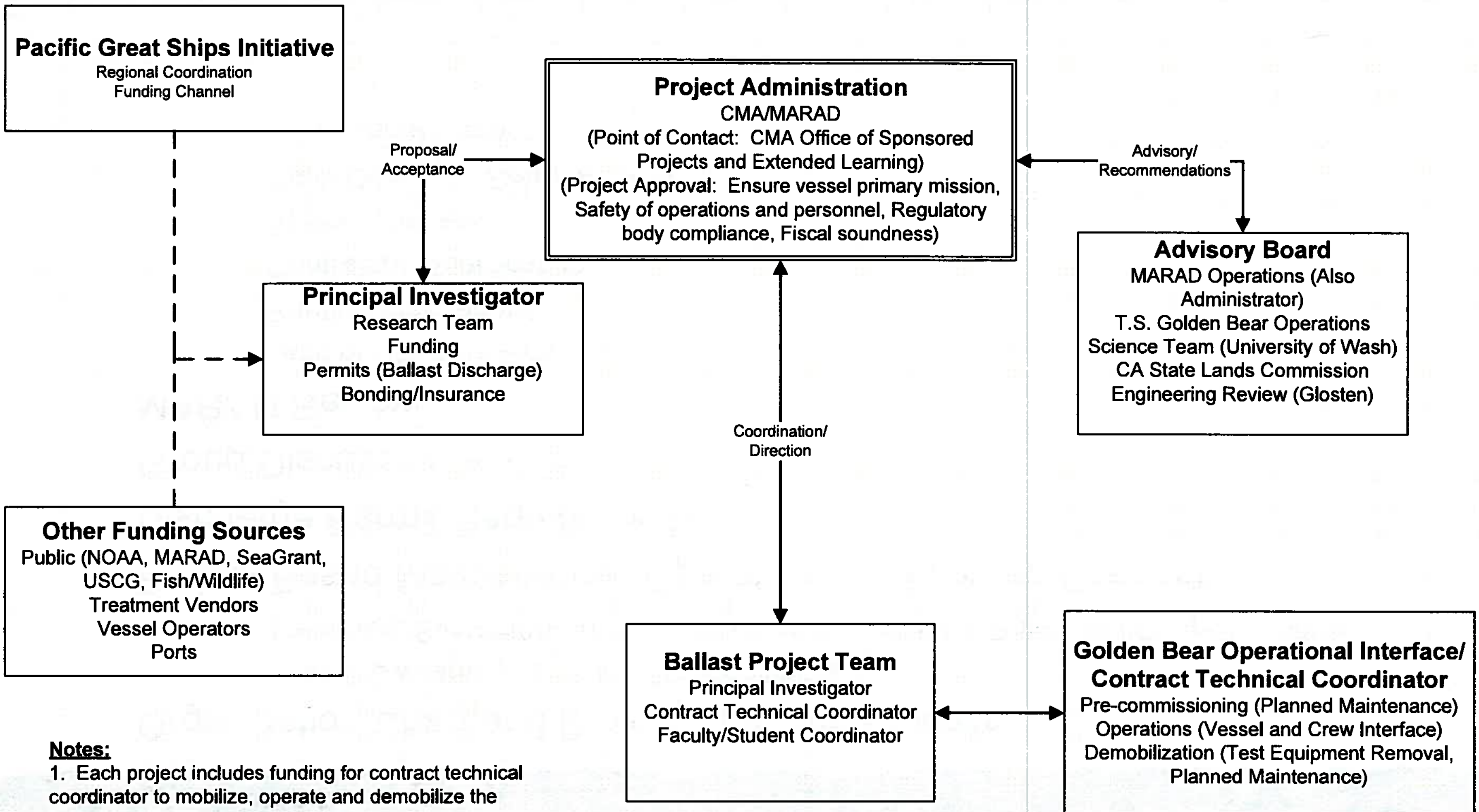
Discharge Permit Requirements

Group Discussion and Issues

MARAD Review

- Limit of Program Responsibility
- Routine Maintenance
- Contractor Qualifications
- System Review
- Crew Oversight Requirements
- Operational Protocol

Operations/Maintenance



Notes:

1. Each project includes funding for contract technical coordinator to mobilize, operate and demobilize the ballast test facilities.
2. No operations can be conducted without the approval of the vessel Master.

Capital Improvements/Phased Approach

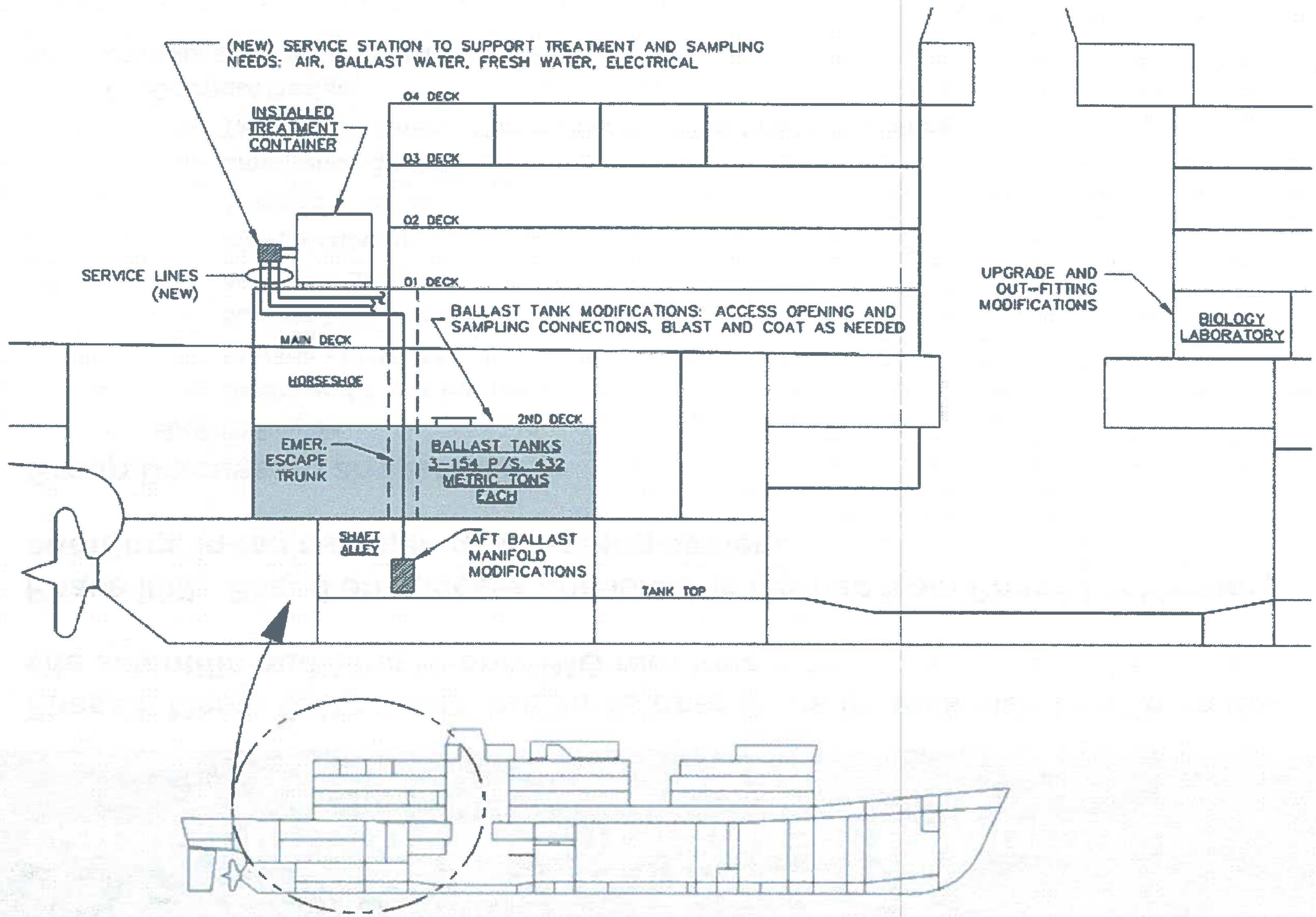
Phase I: Meets IMO criteria, but limits operations to dock side and limits on-site scientific outfitting to only IMO requirements

Phase II/III: Based on success and lessons learned from Phase I, laboratory outfitting, in-tank sampling, sea-going system

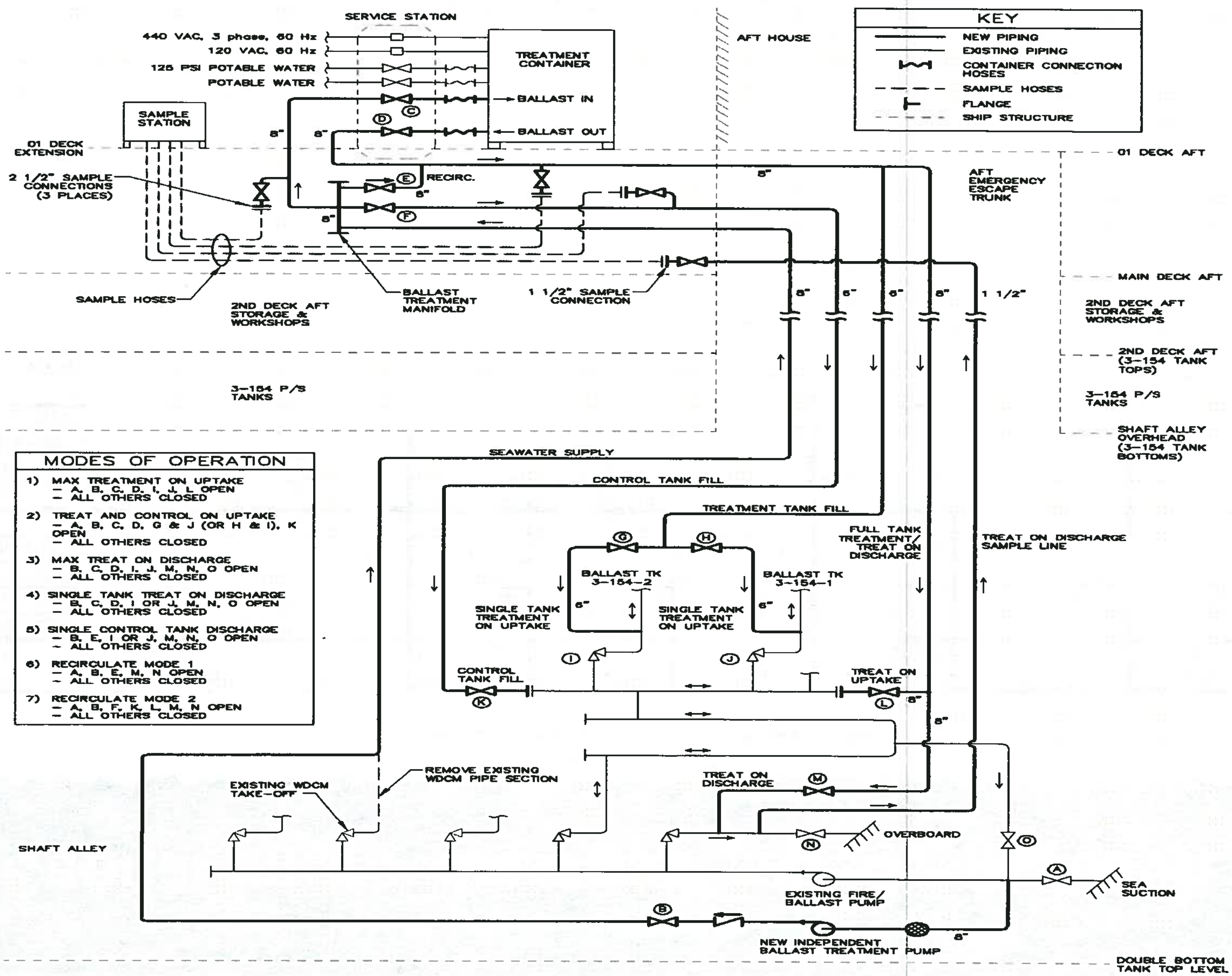
Group Discussion and Issues

- MARAD Review
  - Drains and Slops Handling
  - Storage of HAZMAT
  - Sample Tank Locations
  - Aft Crane Usage
  - Instrumentation
  - Tripping Hazards
  - Emergency Shut-downs
  - Tank Modifications, Communications Routine Maintenance
- Contract Design
- ABS Submittal and Plan Approval

Capital Improvements/Phased Approach



Capital Improvements/Phased Approach



Capital Improvements/Phased Approach

COST ESTIMATE SUMMARY - BASE MODS

ITEM	DESCRIPTION	LABOR (HOURS)	MATERIALS ($)	SUB-TOTAL ($)	MATERIAL MARKUP	CONTINGENCY	TOTAL ($)	PERCENT
1	CONTAINER MOUNTED TREATMENT SYSTEMS	180	5,100	14,100	800	2,100	17,000	5.1%
2	SUPPORT SERVICES STATION	681	34,500	68,600	5,200	10,300	84,100	24.6%
3	BALLAST MODIFICATIONS	1,872	62,600	156,200	9,400	23,400	189,000	56.0%
4	SUPPORT SERVICES	280	12,100	40,100	1,800	6,000	47,900	14.4%
	SUB-TOTAL	3,013	$114,300	$279,000				
	LABOR RATE	$50	PER HOUR					
	MATERIAL MARKUP	15%		17,100				
	ESTIMATE CONTINGENCY	15%		41,900				
	TOTAL ESTIMATED COST			$338,000			$338,000	

Capital Improvements/Phased Approach

ITEMIZED COST ESTIMATE DETAILS - BASE MODS

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT LABOR (HOURS)	UNIT MATERIAL ($)	TOTAL LABOR (HOURS)	TOTAL MATERIAL ($)	TOTAL COST ($)	REMARKS
1	CONTAINER MOUNTED TREATMENT SYSTEMS								
1.01	Prepare Structural Tubing, 6 in x 6 in	1	lot	40	4,000	40	4,000	6,000	
1.02	Removals in way of Paint Overhead	1	lot	20	200	20	200	1,200	
1.03	Weld Structure to Underside of Deck	1	lot	60	500	60	500	3,500	
1.04	Paint Repairs	1	lot	60	400	60	400	3,400	
	Sub-Total					180	5,100	14,100	
2	SUPPORT SERVICES STATION								
2.01	Deck Station								
2.02	Outfitting	1	lot	80	6,000	80	6,000	10,000	Fittings, painting, hoses
2.03	Painting	1	lot	60	600	60	600	3,600	
2.04	Electrical								
2.05	Receptacle, 450V, 100 Amp	1	ea	8	800	8	800	1,200	Container 450V
2.06	Receptacle, 450V, 50 Amp	1	ea	8	750	8	750	1,150	Container 450V
2.07	Receptacle, 120V, 30 Amp	1	ea	8	425	8	425	825	Container 120V
2.08	Circuit Breaker, AQB-A101, 100 Amp Trip	1	ea	2	12,000	2	12,000	12,100	Treatment Container Power Feed
2.09	Circuit Breaker, AQB-A101, 50 Amp Trip	1	ea	2	11,000	2	11,000	11,100	Treatment Container Power Feed
2.10	Circuit Breaker, ALB-1, 30 Amp Trip	3	ea	1	115	3	345	495	Treatment Container Power Feed
2.11	Cable, LSTSGU-50, 175'	1	lot	120	1,100	120	1,100	7,100	
2.12	Cable, LSTSGU-23, 175'	1	lot	120	800	120	800	6,800	
2.13	Cable, LSTSGU-9, 175'	1	lot	60	186	60	186	3,186	
2.14	Compressed Air	60	ft	1	3	60	180	3,180	Compressed Air Pipe
2.15	Potable Water	100	ft	1.5	3	150	300	7,800	Includes Fittings/Valves
	Sub-Total					681	34,486	68,536	
3	BALLAST MODIFICATIONS								
3.01	Cu-Ni Pipe, 8 inch nom	250	feet	4	50	1,000	12,500	62,500	Includes Fittings/Valves
3.02	Cu-Ni Pipe, 6 inch nom	250	feet	3	40	750	10,000	47,500	Includes Fittings/Valves
3.03	Pump, Goulds model # 3410, 8x10-12	1	ea	60	25,000	60	25,000	28,000	Ballast Booster Pump
3.04	Pumpsmart VFD, model # PS75	1	ea	40	4,000	40	4,000	6,000	Variable Frequency Drive
3.05	Circuit Breaker, AQB-A101	1	ea	2	11,040	2	11,040	11,140	Ballast Booster Pmp
3.06	Cable, LSTSGU-9, 50'	1	lot	20	47	20	47	1,047	
	Sub-Total					1,872	62,587	156,187	
4	SUPPORT SERVICES								
4.01	American Bureau of Shipping Plan Review and Site Inspection	1	lot		6,000	0	6,000	6,000	
4.02	Long lead procurement and contracting	1	lot	80	100	80	100	8,100	Use $100/hr
4.03	Construction Management	1	lot	200	6,000	200	6,000	26,000	Use $100/hr
	Sub-Total					280	12,100	40,100	

Capital Improvements/Phased Approach

COST ESTIMATE SUMMARY - LAB OUTFITTING

ITEM	DESCRIPTION	LABOR (HOURS)	MATERIALS ($)	SUB-TOTAL ($)	MATERIAL MARKUP	CONTINGENCY	TOTAL ($)	PERCENT
4	MARINE BIOLOGY LABORATORY	244	18,600	30,800	2,800	4,600	38,200	39.3%
5	LABORATORY EQUIPMENT	0	46,100	46,100	6,900	6,900	59,900	58.8%
6	SAMPLE BOTTLES	0	1,500	1,500	200	200	1,900	1.9%
	SUB-TOTAL	244	$66,200	$78,400				
	LABOR RATE	$50	PER HOUR					
	MATERIAL MARKUP	15%		9,900				
	ESTIMATE CONTINGENCY	15%		11,800				
	TOTAL ESTIMATED COST			$100,100			$100,000	

COST ESTIMATE SUMMARY - TANK SAMPLING

ITEM	DESCRIPTION	LABOR (HOURS)	MATERIALS ($)	SUB-TOTAL ($)	MATERIAL MARKUP	CONTINGENCY	TOTAL ($)	PERCENT
7	SAMPLING AND INSTRUMENTATION	176	32,700	41,500	4,900	6,200	52,600	52.0%
8	BALLAST TANK SAMPLING MODIFICATIONS	328	21,900	38,300	3,300	5,700	47,300	48.0%
	SUB-TOTAL	504	$54,600	$79,800				
	LABOR RATE	$50	PER HOUR					
	MATERIAL MARKUP	15%		8,200				
	ESTIMATE CONTINGENCY	15%		12,000				
	TOTAL ESTIMATED COST			$100,000			$99,900	

Meeting Plan

10:00 am	*Meeting Objectives and Meeting Plan*
10:15 am	*Introductions, Team Expectations and Concerns*
11:00 am	*Project Overview*
11:30 am	*Operations and Maintenance (Working Lunch)*
1:00 pm	*Capital Improvements Phased Approach*
2:00 pm	**Project Viability**
3:00 pm	**Logistics and Administration**
3:30 pm	**Meeting Objectives Review/Document Action Items**
4:00 pm	**Adjourn**

Project Viability

Benefits to California Maritime Academy/MARAD

Integration with the Pacific Ships Initiative

Demand for Facilities and Sources of Support

Operational Costs and Handling

Group Discussion and Issues

- x

Project Viability

Benefits to California Maritime Academy/MARAD

- x

Integration with the Pacific Ships Initiative

Demand for Facilities and Sources of Support

Operational Costs and Handling

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Project Viability

Vessel schedule includes annual dockside periods of about 8 months. This will enable testing to take place during this period without the waiting and transit times inherent with underway vessel operations.

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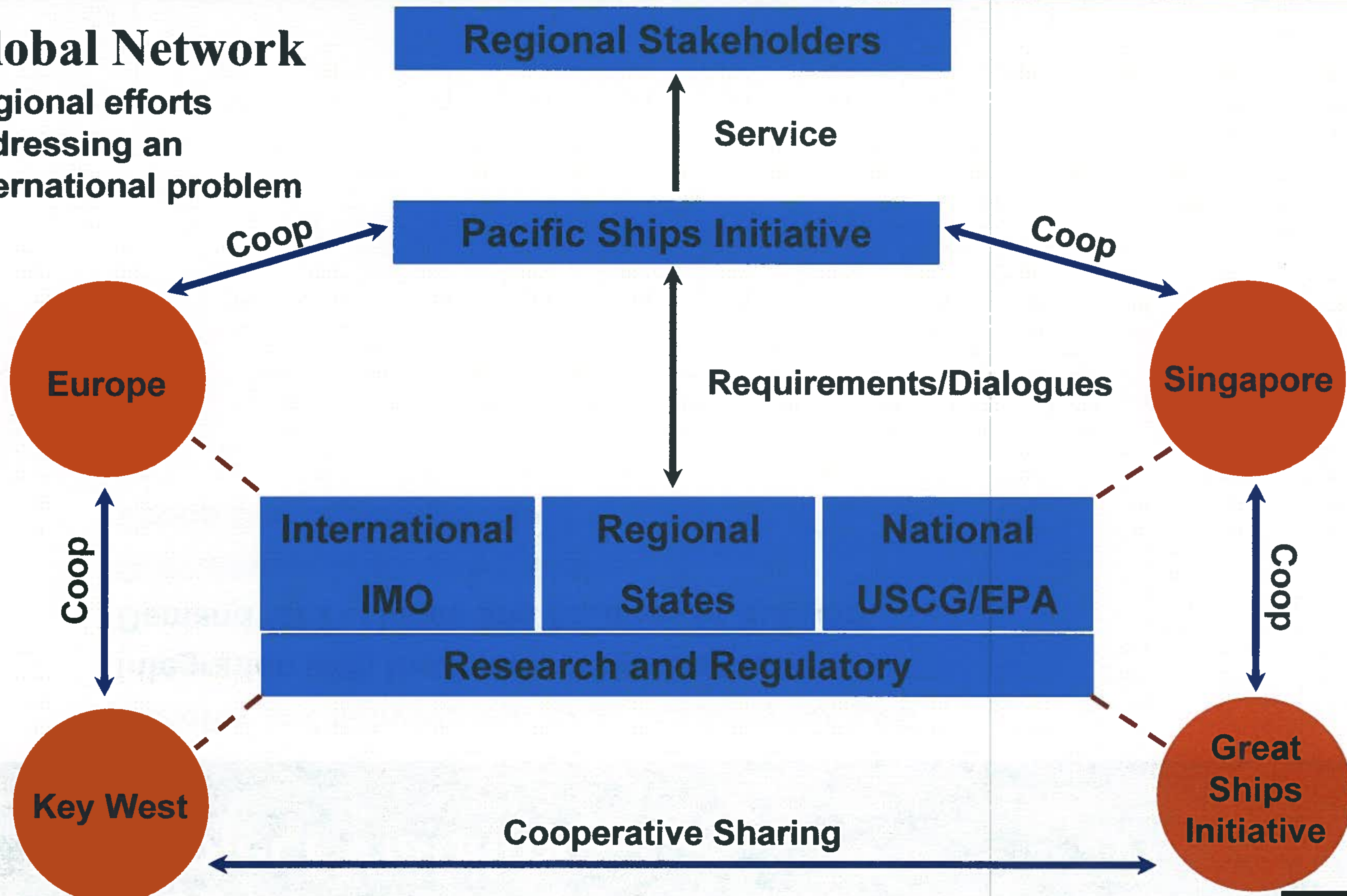
- x

Project Viability

Global Network

Regional efforts addressing an international problem



Project Viability

	Marrowstone	UW Hatchery	TS Golden Bear
Existing	**Land-based Salt Water** -Flows = 91 m3/hr -Storage = multiple 280 liter tanks -Experience with multiple treatment technologies	**Land-based Fresh Water** -Flows = 148 m3/hr -Storage > Hundred 600 liter tanks -Experience with some treatment technologies	**Operational Ship (Salt & Fresh)** -Flows = 400 m3/hr -Storage = 28 Ships Tanks (200 to 450 m3) -No treatment system outfitted
Proposed	**IMO G8 – Land Based (Salt)** -Flows = 150 to 450 m3/hr -Storage = two 200 m3 tanks -Phase IA – Meet Guidelines -Phase IB – Efficiencies and Cosmetics -Phase II/III – Leading World	**Land Based (Fresh)** -Flows = 148 m3/hr -Storage = multiple 1 m3 tanks -Phase I – Dedicated Ballast Facility -Phase II/III - TBD	**IMO G8 Ship & Land Based (Salt, Brackish, Fresh)** -Flows = 350 m3/hr -Storage = two 430 m3 tanks -Phase I – Plug and Play Ballast Treatment Systems, Dock Side -Phase II/III – Sea Going, Expanded Laboratories
More	**Great Ships Initiative (Great Lakes) Teaming/Cooperation**	**Vessels of Opportunity**	**UW & USGS Laboratory Expertise**

Project Viability

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			Vessel	IMO Comparison	
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Ballast Tanks					
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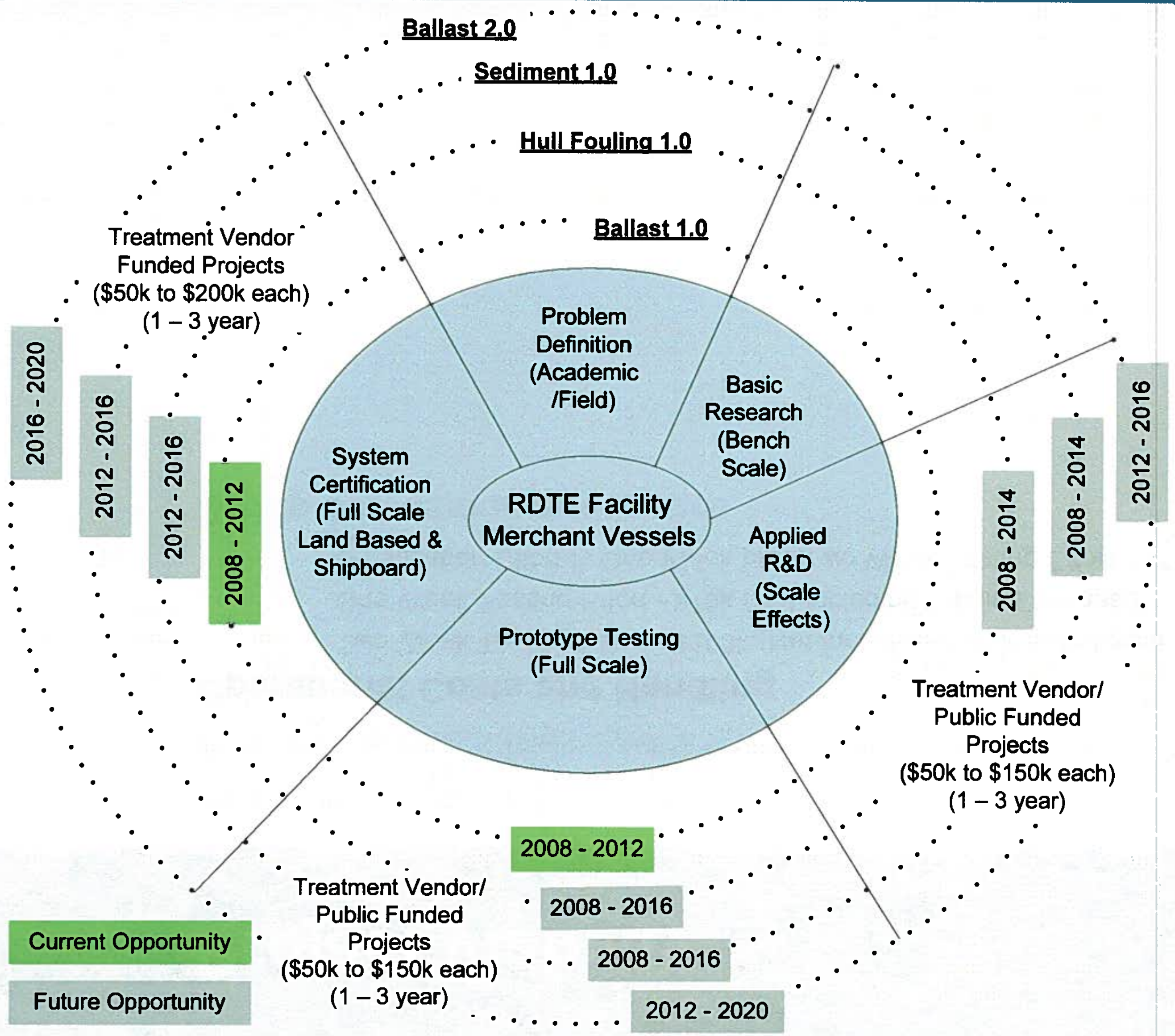
Test capacity (m^3)	1:1 scale	200	**432/441**	☑	☑
Holding time	N/A	5 days	**5 days**	N/A	☑
Treatment Rate Capacity (TRC)					
Less than 200 m^3/hour	1:1 scale	1:1 scale	**349**	200	200
200 to 1000 m^3/hour	1:1 scale	1:5 scale	**349**	349	1,000
Greater than 1000 m^3/hour	1:1 scale	1:100 scale	**349**	N/A	34,900
Sampling Collection > 50 µm					
Influent test pre-treatment	Three x 1 m^3	Three x 1 m^3	**Three x 1 m^3**	☑	☑
Influent test post-treatment	N/A	Three x 1 m^3	**Three x 1 m^3**	Exceeds	☑
Influent control	N/A	Three x 1 m^3	**Three x 1 m^3**	Exceeds	☑
Discharge test pre-treatment	Three x 1 m^3	Three x 1 m^3	**Three x 1 m^3**	☑	☑
Discharge test post-treatment	N/A	N/A	**Three x 1 m^3**	Exceeds	Exceeds
Discharge control	Three x 1 m^3	Three x 1 m^3	**Three x 1 m^3**	☑	☑
In tank test	N/A	N/A	**Three x 1 m^3**	Exceeds	Exceeds
In tank control	N/A	N/A	**Three x 1 m^3**	Exceeds	Exceeds
Measurements, Physical					
Temperature	Required	Required	**In-line**	☑	☑
Ballast water flow rate	N/A	Required	**In-line**	Exceeds	☑
Ballast water pressure	N/A	N/A	**In-line**	Exceeds	Exceeds
Treatment power consumption	N/A	Required	**Portable**	Exceeds	☑
Salinity	Required	Required	**Sample**	☑	☑
pH	N/A	Required	**Sample**	Exceeds	☑
Total suspended solids	Required	Required	**Sample**	☑	☑
Turbidity (NTU)[3]	N/A	Required	**Sample**	Exceeds	☑
Particulate organic carbon	Required	Required	**Sample**	☑	☑
Dissolved organic carbon	N/A	Required	**Sample**	Exceeds	☑
Dissolved oxygen	N/A	Required	**Sample**	Exceeds	☑

Project Viability



Certification Example

Competitive market for treatment RDTE

Existing Facilities:

Land-based Example: NRL Key West – Verification: ~$200k

Shipboard Example: R&D Trial (Three Tests) (Not Including System Installation Costs) ~$200k

Total Cost: ~$400k for Certification

Golden Bear Facility:

Unique Meeting IMO G8 Shipboard and Land-based Requirements

Total Cost: ~$250k for Certification (Assumes similar level of effort as NRL Facility)

Competitive Advantage Factor of 2

Project Viability

- Integration with the Pacific Ships Initiative
- Demand for Facilities and Sources of Support
- **Operational Costs and Handling**
  - Two Week Testing Effort ~$100k (Not Including Admin Overhead)
  - One Week Testing Effort ~$70k (Not Including Admin Overhead)
  - Certification Effort is One Week plus Two Week Testing Effort ~$170k
- Group Discussion and Issues

Project Viability

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT LABOR (HOURS)	UNIT MATERIAL ($)	TOTAL LABOR (HOURS)	TOTAL MATERIAL ($)	TOTAL COST ($)	REMARKS
1	TECHNICIAN SUPPORT - TWO WEEK TEST								Use $75/hour
1.01	Maintenance, Set-up Commissioning	1	lot	64	4,000	64	4,000	8,800	
1.03	Operational Support	1	lot	80	2,000	80	2,000	8,000	
1.04	Maintenance, Decommissioning, Demobilization	1	lot	64	4,000	64	4,000	8,800	
	Sub-Total					208	10,000	25,600	
2	SCIENCE TEAM - TWO WEEK TEST								Use $50/hour
2.01	Preparations								
2.02	Protocol	1	lot	80		80	0	4,000	
2.03	Equipment and Supplies	1	lot	40	8,000	40	8,000	10,000	
2.04	Testing (Four Persons)							0	
2.05	Travel and Lodging (Assume from Seattle)	1	lot		10,560	0	10,560	10,560	
2.06	Mobilization	1	lot	48	1,200	48	1,200	3,600	2 persons, 3 days
2.07	Testing Efforts	1	lot	320		320	0	16,000	
2.08	Demobilization	1	lot	48	1,200	48	1,200	3,600	2 persons, 3 days
2.09	Post Testing Analysis	1	lot	160	500	160	500	8,500	
2.10	Report and Closure	1	lot	80		80	0	4,000	Includes Fittings/Valves
	Sub-Total					776	21,460	60,260	
3	VESSEL CREW SUPPORT - TWO WEEK TEST								Use $75/hour
3.01	Crane Operation and Loading Supervision	1	lot	16		16	0	1,200	
3.02	Technician Supervision	1	lot	30		30	0	2,250	Three weeks, 2 hours/day
3.03	Ballast Planning and Operations	1	lot	80		80	0	6,000	One Mate Full Time, 2 Weeks
3.04	General Support	1	lot	40	600	40	600	3,600	Miscellaneous Efforts
3.05	Crane Operation and Un-Loading Supervision	1	lot	16		16	0	1,200	
3.06	Maintenance and Demobilization Check List	1	lot	16		16	0	1,200	
	Sub-Total					198	600	15,450	
					SUBTOTALS	1,182	$32,060		
					TOTAL ESTIMATED COST			$101,310	

Project Viability

Benefits to California Maritime Academy/MARAD

Integration with the Pacific Ships Initiative

Demand for Facilities and Sources of Support

Operational Costs and Handling

Group Discussion and Issues

- x

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4:00 pm Adjourn

Logistics and Administration

SeaGrant Proposal

- Completion and Submission of Proposal by 10 January 2007
- Handling of Capital Funding
- Development and Submission of MARAD/CMA Terms of Use Agreement

Further Development of Operations and Maintenance Plan

Group Discussion and Issues

Logistics and Administration

COST ESTIMATE SUMMARY - CAPITAL FUNDS

ITEM	DESCRIPTION	LABOR (HOURS)	MATERIALS ($)	SUB-TOTAL ($)	MATERIAL MARKUP	CONTIN-GENCY	TOTAL ($)	PERCENT
1	BASELINE MODIFICATIONS	2,800	102,000	242,000	15,300	36,300	293,600	76.6%
2	SUPPORT SERVICES	280	12,100	40,100	1,800	6,000	47,900	12.7%
3	GLOSTEN CONTRACT DESIGN PACKAGE		25,000	25,000	3,800	3,800	32,600	7.9%
4	UW CONSTRUCTION SUPPORT	120	3,000	9,000	500	1,400	10,900	2.8%
5	CMA SUPPORT (TBD)			0	0	0	0	0.0%
6	MARAD SUPPORT (TBD)			0	0	0	0	0.0%
		_	_	_	_	_	_	
	SUB-TOTAL	3,200	$142,100	$316,100				
	MODIFICATION LABOR RATE	$50	PER HOUR					
	MATERIAL MARKUP	15%		21,300				
	ESTIMATE CONTINGENCY	15%		47,400				
	TOTAL ESTIMATED COST			$384,800			$385,000	

Meeting Objectives Review and Action Items

Meeting Objectives

Viability of project. Ability to attract ballast research and testing efforts, while enhancing the ship's primary mission of training ship's officers.

Management of capital improvement effort. Ability to complete SeaGrant proposal (deadline 10 January 2007) and details of managing efforts and funds if successful.

Management of operations following capital improvement. Ability to receive, evaluate and execute ballast research and testing efforts.

Action Items

- **Review Dockside Treatment Container Location if Cost Require - Glosten**

- **Develop Operational Check-off List -Bill**

Meeting Objectives Review and Action Items

Action Items

•Review Dockside Treatment Container Location if Cost Require - Glosten

- PR Concern with Dock Side System
- Permitting concern with discharges to/from dock

•Operations/Maintenance –Bill/Kevin (Draft for 10 Jan)

- Proposal Checklist/Format
- Demobilization Checklist
- Precommissioning Checklist
- Operational Checklist

•Use of Vessel

- Use of Ship Letter from MARAD Administrator – Carolyn (7 Dec)
- Use of Ship Letter from CMA – Keever (7 Dec)
- Proposal Requirement: Agreement for Use of Ship
  - Draft Terms of Agreement for Use of Ship (Between Administrator (CMA/MARAD) and PI) – Paul/Carolyn (Draft)

•Capital Improvements - Glosten

- Crane Certification Review and Improvement Operations
  - Five Year Certification ~$30k
  - Annual Reinspection/Service -$8k to $12k
- Review Shore Crane Usage Fee ~$2000
- Tank Coating Needs Review (MOA Use)
- As-builts for Electrical and Ballast System
- Valve Monitoring
- MARAD Memo Pick-ups

Meeting Objectives Review and Action Items

<u>Action Items</u>

•Viability

- CMA Educational Benefits (Research, Applied Physics, Biology, other) and Opportunities, Funding Request for Program Set-up – Dan Weinstock/Jim Buckley/Donna Nincic (Send to Michael)
- PI Endorsement Letters - Jeff
- Vendor Support Letters – Kevin
- Ports Endorsement Letters (if allowed) - Admiral

•Admin

- Contact NOAA with regard to MARAD receipt of funds – Kevin
- MARAD review of internal costs
- Gain Standard Terms and Conditions for Modification Package – Kevin/Bill
- Western Region MARAD – Contract Administration
- Review CMA Viability of PI Status - Michael
- MARAD Security Control – CMA/MARAD (MOA with PI Draft)
- Proposal Review Effort - Glosten

TS Golden Bear –
Ballast Treatment Test Facility
Stakeholders Meeting – 28 November 2006

Presentation for:
TS Golden Bear **Stakeholders**
28 November 2006, California Maritime Academy, Vallejo, CA

Presented by: Kevin J. Reynolds, PE, The Glosten Associates, Inc.

Letters of Support:

- MARAD (*Golden Bear* Owner)
- California Maritime Academy (*Golden Bear* Operator)
- International Maritime Organization

U.S. Department
of Transportation
**MARITIME
ADMINISTRATION**

Administrator

400 Seventh Street, S.W.
Washington, D.C. 20590

December 15, 2006

Michael S. Bittner, Ph.D.
Dean of Sponsored Projects and Extended Learning
The California Maritime Academy
200 Maritime Academy Drive
Vallejo, CA 94590

Dear Dr. Bittner:

The purpose of this letter is to confirm the Maritime Administration's (MARAD) partnership with the California Maritime Academy in using the GOLDEN BEAR for ballast water technology research. I appreciate the California Maritime Academy's willingness to coordinate the experimental efforts and use of the vessel.

It is my understanding that the design team, scientists, and appropriate California Maritime Academy and MARAD personnel have discussed the prospective modifications and they agreed that the modifications will not impact cadet training or pose a hazard to the operation or structure of the vessel. We will coordinate with you in the future regarding developing a Memorandum of Agreement (MOA) for prospective users.

MARAD is committed to working with the public and private sector to facilitate the testing of promising technologies by providing our vessels as ballast water test platforms. It is through cooperative effort, such as with the GOLDEN BEAR, that we may be able to make a difference.

I look forward to working in partnership with you in this effort. If you have questions regarding the project, please contact Dr. Carolyn E. Junemann from the Office of Environmental Activities at (202)366-1920.

Sincerely,

Sean T. Connaughton
Maritime Administrator

CAL MARITIME

December 11, 2006

Michael S. Bittner, Ph.D.
Dean, Sponsored Projects and Extended Learning
Cal Maritime
200 Maritime Academy Drive
Vallejo, CA 94590

Dear Dr. Bittner:

The California Maritime Academy (CMA) is the operator of the USTS GOLDEN BEAR, a U.S. government owned (Department of Transportation, Maritime Administration) vessel. The GOLDEN BEAR is operated by the California Maritime Academy as a training ship. As the operator, CMA is responsible for all regulatory issues on the vessel, as well as safety and operational concerns.

This letter is written to show the support of the vessel operator for a ballast water test platform project for installation onboard the vessel, provided the owner allow this function to have a secondary role for the operator of the vessel in the loan agreement; and further, that the platform installation is adequately funded to cover all operational and safety concerns.

The California Maritime Academy, as a campus of The California State University, is committed to conducting research to improve the viability of port operation in our state and along the West Coast, and we feel that this project is well suited to perform these tasks.

We look forward to continued cooperation with all stakeholders as this proposal moves forward.

Sincerely,

John M. Keever
Vice President, Marine Programs & Student Development

cc: B.Eisenhardt, B. Davidson, C. Junemann, K. Reynolds, T. Margan, F. Johnston

Global Ballast Water
Management Programme

GEF undp IMO

A cooperative initiative of the Global Environment Facility,
United Nations Development Programme and International Maritime Organization.

6 January 2007

Michael S. Bittner, Ph. D.
Dean of Sponsored Projects and Extended learning
The California Maritime Academy
200 Maritime Academy Drive, Vallejo, CA 94590

Dear Dr Bittner

The IMO-GloBallast Partnership Programme, which is currently under preparation by GEF, UNDP and IMO wishes to express its strong support for the proposed initiative by California Maritime Academy to develop a ballast water treatment test platform by adapting an existing ship (*Golden Bear*) for this purpose. From our discussions with our industry partners and GloBallast Partnering Countries, it was very clear that lack of such shipboard test facilities and appropriate infrastructure to promote R&D in ballast water management are some of the immediate hurdles in addressing this global issue.

I also understand that this proposed initiative would be linked to another proposal to NOAA (Pacific Ship Initiative) for developing a land-based test facility and that both these initiatives will go hand in hand in supporting ballast water R&D, testing and evaluation. GloBallast representative participated in the stakeholder meeting of the PSI held in Seattle in November 2006. The vision of PSI was very impressive considering the usage of an existing facility at Marrowstone and the use of a MARAD ship for shipboard trials as two important components of such an initiative. We believe that development of these RDTE facilities will mark an important milestone in the global efforts to find solutions to the ballast water issues. It is of highest interest to GloBallast Partnership that shipboard test facilities such as this proposed facility will be developed in several regions, however in a coordinated fashion. GloBallast Partnership, therefore, is extremely interested and willing to play a coordination role in catalyzing and facilitating the communications between such developments around the world, including the proposed similar facilities in developing countries. GloBallast could also be one of the vehicles to feed back the experiences and lessons learned from such test facilities to the IMO-MEPC process. Considering the planned activities under this proposal and its vision to support ballast water technology innovations, we are confident that the proposed *Golden Bear* initiative will make a positive contribution to the global efforts in protecting our marine environment. Please let us know, if there is anything else we could do to help in this effort.

Sincerely,

Jose Matheickal, Programme Manager

Programme Coordination Unit
Global Ballast Water Management Programme
International Maritime Organization
4 Albert Embankment, London SE1 7SR UK
Tel +44 (0)20 7587 3279, Fax +44 (0)20 7587 3261
Web: http://globallast.imo.org

Training Ship Golden Bear

Modifications to Support Full-Scale Ship-Based Ballast Water Treatment Experiments and Aquatic Invasive Species Education: Phase 2

Letters of Support (Potential Investigators):

- Old Dominion University
- University of Maryland
- University of Michigan
- University of British Columbia
- University of California, Irvine

OCEAN, EARTH & ATMOSPHERIC SCIENCES
OLD DOMINION UNIVERSITY

The Department of
Ocean, Earth & Atmospheric Sciences
Old Dominion University
Norfolk, Virginia 23529-0276
(757) 683-4285
Fax (757) 683-5303

7 January 2007

Michael S. Bittner, Ph.D.
Dean of Sponsored Projects and Extended Learning
The California Maritime Academy
200 Maritime Academy Drive
Vallejo, CA 94590

Dear Dr. Bittner,

I'm writing in support of the proposal to NOAA to outfit the *Golden Bear* as a test vessel for ballast-water technology. It's a great idea and I am pleased to have learned about it from Jeffery Cordell (University of Washington).

I have studied the microbiology of ships' ballast water for more than a decade and since its inception in 2001, have served as a member of the Coast Guard/EPA ETV Ballast-Water Technology Panel. It's clear the biggest "leap" in ballast-water technology testing is the move from full-scale, land-based facilities to a ship-board demonstration. As I understand the essence of the proposal, the *Golden Bear* would be available for "plug-and-play" operation with a variety of treatment systems that fit into deck vans. This modular approach makes logistical sense, is fiscally sound, and will move us quicker to determining the best type(s) of technology to be used in treating ballast water. Furthermore, having a dedicated platform is essential, as the on-again, off-again nature of working on commercial vessels has proven not to be an effective strategy.

Finally, it may serve as a significant measure of my support to inform you that I am submitting two proposals to the above-referenced NOAA call for proposals. While my proposals are not involved with outfitting a ship, I appreciate (all too well) that there are only a limited number of dollars to go around. Nonetheless, efforts such as the *Golden Bear* proposal are important; I wish you a successful outcome. Once she's re-fitted, I would hope someday to get onboard and employ my analytical techniques for testing the efficacy of ballast-water treatment technologies.

Sincerely,

Fred C. Dobbs

Fred C. Dobbs
Professor and Graduate Program Director
Department of Ocean, Earth and Atmospheric Sciences
Old Dominion University
Norfolk, VA 23529 757-683-5329 (phone) fdobbs@odu.edu (email)

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
Chesapeake Biological Laboratory

ALLIANCE FOR COASTAL TECHNOLOGIES

December 20, 2006

Michael S. Bittner, Ph.D.
Dean of Sponsored Projects and Extended Learning
The California Maritime Academy
200 Maritime Academy Drive
Vallejo, CA 94590

Dear Dr. Bittner:

I am pleased to hear about the California Maritime Academy and Glosten Associates proposal to the NOAA Ballast Water Technology Demonstration Program to support the adaptation of the *Golden Bear* as a ballast water treatment test platform. I have been involved in invasive species and ballast water treatment investigations since 1999 and have recently been leading the efforts to test a treatment system onboard an active vessel. While real world, shipboard studies are a critical step in determining treatment biological and mechanical efficacy, there are many logistic constraints in conducting scientifically sound evaluations onboard a commercial vessel. In particular, evaluation projects are far from a primary concern for the ship operator and crew. Therefore, even the scheduling of test runs and appropriate sampling of ballast water is often a challenge.

Many of these logistic constraints would be removed by having the *Golden Bear* available as a test platform. Not only would the vessel be set up to accommodate treatment testing with staff and time set aside solely for evaluation activities, but obviously the San Francisco Bay area is a particularly relevant environment for this type of work to take place.

I therefore hope that your proposal is funded and look forward to the opportunity to working with the California Maritime Academy and Glosten Associates on future studies. Please let me know if there is anything else I can do to help in this effort.

Sincerely,

Mario Tamburri

Mario N. Tamburri, PhD
Executive Director, Alliance for Coastal Technologies
Research Associate Professor, Chesapeake Biological Laboratory
University of Maryland Center for Environmental Science
PO Box 38 / One Williams Street
Solomons, Maryland 20688
Phone: 410-326-7440, Fax: 410-326-7428
Email: tamburri@cbl.umces.edu

NATURAL RESOURCES AND ENVIRONMENT
UNIVERSITY OF MICHIGAN

January 4, 2007

Michael S. Bittner, Ph.D.
Dean of Sponsored Projects and Extended Learning
The California Maritime Academy
200 Maritime Academy Drive
Vallejo, California 94590

Dear Dr. Bittner:

Thank you for the opportunity to comment on the proposal entitled "*TS Golden Bear*: Ballast Treatment Test Facility Concept Design." I am please to provide a letter of support for this project. I have been working for the past eight years on treatment options for overseas vessels that discharge ballast in the North American Great Lakes. Like many other sites, the Great Lakes continue to face the vexing problem of invasive species released by ballasted and unballasted vessels as part of international trade routes. Through my research I have investigated the potential efficacy of biocides for reducing the spread of these species; however, our efforts in this area have been thwarted by the lack of opportunity to test potential treatment approaches on actual vessels. Efforts that focus on developing appropriate testing platforms, such as those described in this proposal, are critical to advancing the science of ballast water treatment.

I believe that your proposal represents an important opportunity to improve our understanding of the real world efficacy and feasibility of treatment approaches in ballast tanks. I applaud your obvious efforts to integrate stakeholder interests in your planning process. I am also impressed by the range of testing options you are proposing in retrofitting the *TS Golden Bear*. I believe your proposed work represents a significant opportunity for U.S. and International collaborators to advance the current science of ballast water treatment.

I wish you the best of luck in this endeavor and look forward to any opportunity to participate on your project. Please let me know how I can be of help.

Sincerely,

Larissa Lubomudrov Sano, Ph.D.
Associate Director and Researcher
Cooperative Institute for Limnology and Ecosystems Research
School of Natural Resources and Environment
University of Michigan

I have reviewed the proposal from Jeff Cordell and the UW group and colleagues for retro-fitting the "Golden Bear" (GB) with a testing facility for a ballast water treatment. I am strongly in favour of a large shipboard scale approach since most of laboratory scale experiments conducted to date, while important to iron out the various concepts of the treatment efficacy measurement, were not done at a practical scale. The idea of using the GB as a testing vehicle for shipboard scale experiments would therefore very significantly advance the science and technology of ballast water treatment. Numerous experiments could eventually be conducted under realistic conditions in a variety of ecosystems and water bodies around the North American continent, overseas, and even into the Great Lakes. The results would be a major contribution to international initiatives to control aquatic invasive species spread via the shipping vector since new ships will eventually be equipped with ballast water treatment technology.

The proponents of the project have an excellent track record for research on ballast water treatment and aquatic invasive species studies. I can strongly recommend them for this research/

I hope your agency will provide the needed funding for this project.

Colin D. Levings
Scientist Emeritus and Sessional Researcher
Centre for Aquaculture and Environmental Research
Department of Fisheries and Oceans
4160 Marine Drive
West Vancouver BC
Canada V7V 1N6
Phone 604 666 7915
Email levingsc@pac.dfo-mpo.gc.ca

Adjunct Professor
Institute for Resources, Environment and Sustainability
The University of British Columbia
Aquatic Ecosystem Research Laboratory
428-2202 Main Mall
Vancouver, B.C.
Canada V6T 1Z4

UNIVERSITY OF CALIFORNIA, IRVINE

BERKELEY · DAVIS · IRVINE · LOS ANGELES · RIVERSIDE · SAN DIEGO · SAN FRANCISCO · SANTA BARBARA · SANTA CRUZ

January 5, 2007

Michael S. Bittner, Ph. D.
Dean of Sponsored Projects and Extended Learning
The California Maritime Academy
200 Maritime Academy drive
Vallejo, CA 94590

Dear Dr. Bittner;

This letter is an enthusiastic support for adapting the *Golden Bear* as a ballast water treatment test platform.

As background, I have been involved in the application of ozone for ballast water treatment for the past six years. I have also been involved in technology development in the hazardous waste arena and have sat on a National Research Council sub-committee, looking at technology development and issues with acceptability.

From my experience, in innovative technology development, it is essential to have "test beds" for, not only examining alternatives, but also for educating the "younger generation" of professionals. A training ship, to change the "mindset" of the industry is essential and a platform on which to get long-term data is also necessary.

Technology development is a long and tortuous path. Acceptance of new technology by industry is also fraught with complications. This approach is innovative and exciting.

If you ever are in need of assistance or I can help in any way please do not hesitate to contact me, wcooper@uci.edu or by phone at 949-824-5620.

Good Luck!

Sincerely Yours,

William J. Cooper
Professor

THE HENRY SAMUELI SCHOOL OF ENGINEERING
DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING
IRVINE, CA 92697-2175

William J. Cooper, Professor of Civil an d
Environmental Engineering
PHONE: (949) 824-5620, FAX: (949) 824-3672

Training Ship Golden Bear

Modifications to Support Full-Scale Ship-Based Ballast Water Treatment Experiments and Aquatic Invasive Species Education: Phase 2

Letters of Support (Treatment Vendors):

- Maritime Solutions, Inc.
- Severn Trent De Nora
- Hyde Marine, Inc.
- Ecochlor, Inc.

MARITIME SOLUTIONS, INC.

17 Battery Place, Suite 913
New York, New York 10004 USA

Telephone: 1-212-747-9044
Telefax: 1-212-747-9240
e-mail: info@maritimesolutionsinc.com

RECEIVED
DEC 20 2006
THE GLOSTEN ASSOCIATES, INC.

December 18, 2006

Michael S. Bittner, Ph.D.
Dean, Sponsored Projects and Extended Learning
California Maritime Academy
200 Maritime Academy Drive
Vallejo, California 94590

Subject: *T.S. Golden Bear* Ballast Treatment Test Faculty
Letter of Project Support

References: 1. *T.S. Golden Bear* Ballast Treatment Test Facility, Concept Design Revision B, Glosten, 22 November 2006

Dear Dr. Bittner:

After studying the *T.S. Golden Bear* ballast treatment test facility concept design prepared by Glosten we have concluded that this is an excellent modification of an existing ship which could meet our treatment system testing needs. Of particular interest to our needs are the following:

- Installation on an actual ship removes concerns that test results could be different than testing which would be conducted in a land-based facility. As the *Golden Bear* is along side the dock for eight months a year, logistics planning with an actual ship becomes practical.

- We understand that the facility would meet the requirements of both the land-based and shipboard testing of the International Maritime Organization G8 Guidelines. Being able to conduct the land-based and shipboard testing concurrently will likely reduce costs as well as provide data more quickly.

- Your "plug and play" design would require no hard piping or cabling modifications to test our system. This offers significant financial, planning, and regulatory review advantages over the effort to install a prototype system on a vessel of opportunity.

- The location in Vallejo offers the biological intensity which our system seeks in proving itself. Documenting to our potential customers that our system performs under these challenging conditions increases our system marketability.

Please note that our system has completed basic research efforts and as such has no immediate need for research and development. Our immediate need is certification. As your proposed facility provides the platform for conducting the testing required for certification, we fully support your efforts. We look forward to the opportunity to bring our system to your facility for certification testing efforts.

Yours very truly,

Maritime Solutions, Inc.

Richard E. Fredricks
President

SEVERN TRENT DE NORA

19 December 2006

Michael S. Bittner, Ph.D.
Dean, Sponsored Projects and Extended Learning
California Maritime Academy
200 Maritime Academy Drive
Vallejo, California 94590

Subject: *T.S. Golden Bear* Ballast Treatment Test Faculty
Letter of Project Support

References: 1. *T.S. Golden Bear* Ballast Treatment Test Facility, Concept Design Revision B, Glosten, 22 November 2006

Dear Michael:

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1110 Industrial Boulevard Sugar Land, TX 77478
Telephone: 281.240.6770 Fax: 281.240.6762

Please note that our system has completed basic research efforts and as such has no immediate need for research and development. Our immediate need is certification. As your proposed facility provides the platform for conducting the testing required for certification, we fully support your efforts. We look forward to the opportunity to bring our system to your facility for certification testing efforts.

Yours very truly,

Rudolf C. Matousek

Rudolf C. Matousek
Manager of Technology
Severn Trent DeNora

1110 Industrial Boulevard Sugar Land, TX 77478
Telephone: 281.240.6770 Fax: 281.240.6762

December 16, 2006

RECEIVED
DEC 20 2006
THE GLOSTEN ASSOCIATES, INC.

Michael S. Bittner, Ph.D.
Dean, Sponsored Projects and Extended Learning
California Maritime Academy
200 Maritime Academy Drive
Vallejo, California 94590

Hyde Marine

HONEST SOLUTIONS. HONEST EQUIPMENT.

Hyde Marine, Inc.
28045 Ranney Pkwy., G
Cleveland, OH 44145-1144
440-871-8000
Fax: 440-871-8104
www.hydemarine.com

Subject: *T.S. Golden Bear* Ballast Treatment Test Faculty
Letter of Project Support

References: 1. *T.S. Golden Bear* Ballast Treatment Test Facility, Concept Design Revision B, Glosten, 22 November 2006

Dear Michael:

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- The location in Vallejo offers the biological intensity which our system seeks in proving itself. Documenting to our potential customers that our system performs under these challenging conditions increases our system marketability.

Please note that our system has completed basic research efforts and as such has no immediate need for research and development. Our immediate need is certification. As your proposed facility provides the platform for conducting the testing required for certification, we fully support your efforts. We look forward to the opportunity to bring our system to your facility for certification testing efforts.

Yours very truly,
Hyde Marine

Thomas Mackey
President

ecochlor

18 December 2006

Michael S. Bittner, Ph.D.
Dean, Sponsored Projects and Extended Learning
California Maritime Academy
200 Maritime Academy Drive
Vallejo, California 94590

Subject: *T.S. Golden Bear* Ballast Treatment Test Faculty
Letter of Project Support

References: 1. *T.S. Golden Bear* Ballast Treatment Test Facility, Concept Design Revision B, Glosten, 22 November 2006

Dear Dr. Bittner:

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- We understand that the facility would meet the requirements of both the land-based and shipboard testing of the International Maritime Organization G8 Guidelines. Being able to conduct the land-based and shipboard testing concurrently will likely reduce our costs as well as provide data more quickly.
- Your "plug and play" design would require no hard piping or cabling modifications for testing our system. This offers significant financial, planning, regulatory review advantages over the effort to install a prototype system on a vessel of opportunity.
- The location in Vallejo offers the biological intensity which our system seeks in proving itself. Documenting to our potential customers that our system performs under these challenging conditions increases our system marketability.

4389 Milner Road
Birmingham, AL 35242
205.298.2555
205.567.6990 cell
ecochlor.com

Please note that our system has completed basic research efforts and as such has no immediate need for research and development. Our immediate need is certification. As your proposed facility provides the platform for conducting the testing required for certification, we fully support your efforts. We look forward to the opportunity to bring our system to your facility for certification testing efforts.

Yours very truly,

Ecochlor, Inc.

Tom Perlich
President

Letters of Support (Faculty at CMA):

- Chair of Sciences and Mathmatics
- Chair of Global and Maritime Studies

CAL MARITIME

November 30, 2005

Russell P. Herwig, Ph.D.
School of Aquatic and Fishery Sciences
Box 355020
University of Washington
Seattle, WA 98195-5020

Dear Dr. Herwig:

The Department of Sciences and Mathematics and I are fully supportive of your proposal to help us develop and team-teach a course on "Invasive Species" at the California Maritime Academy, California State University. This is a new and exciting new adventure for our faculty who have expertise in ocean politics and ship ballast water to join teaching forces with you and your colleague who are experts in microbiology and zooplankton ecology, respectively.

The course on Invasive Species will be a wonderful opportunity for our students to learn about a real-world issue such as non-indigenous species in a multifaceted way. The students will be able to learn about invasive species in terms of the politics involved, the effects of invasive species on the shipping industry, and how scientists studying invasive species can offer solutions to some of the problems caused by invasive species. Since the course will be an interdisciplinary course, this will allow students in different majors to take the course and fulfill their elective requirements. I am sure that my oceanography students who are pursuing our Marine Science minor will be excited to take your new course on Invasive Species.

I look forward to working with you and your colleagues from the University of Washington in the future. If there is anything that I can do to assist you, please let me know.

Sincerely,

Lloyd W. Kitazono

Lloyd W. Kitazono
Professor, Chair of Sciences & Mathematics
(707) 654-1149
lkitazono@csum.edu

CAL MARITIME

November 29, 2005

Dr. Russell P. Herwig
School of Aquatic and Fishery Sciences
Box 355020
University of Washington
Seattle, WA 98195-5020

Dear Dr. Herwig:

The Department of Global and Maritime Studies (GMS) at the California Maritime Academy would like to offer its enthusiastic support of your "California Maritime Academy Training Ship Golden Bear for Full-Scale Ship-Based Ballast Water Treatment Experiments and Aquatic Invasive Species Education: Phase 2" proposal.

As discussed during your visit to the Cal Maritime campus earlier this month, there are a number of ways the GMS department can contribute to, and benefit from, this initiative. The GMS department offers a major in Global Studies and Maritime Affairs whose core focus is the study of maritime policy issues. One of the four policy emphases in the major is environmental policy. To date we have not yet built up fully our course offerings in this area, and your invasive species initiative provides a wonderful opportunity for our campus.

Specifically, we would like to offer a three-unit introductory course in *Invasive Species* (targeted for Spring 2007) that would be both multidisciplinary and multi-institutional, and which would serve as a suitable elective for CMA students in different programs (Marine Transportation, Marine Engineering, Business, Global Studies, etc). The multidisciplinary approach would allow the class to be taught from the perspectives of the marine sciences; political and economic policy; engineering, and ship operations. We conceive of the course being team-taught, using faculty from our Science and Mathematics, GMS, Engineering Technology and Marine Transportation Departments. The multi-institutional aspect would be achieved by asking you and Mr. Cordell to participate as well, emphasizing the biological issues and your experiences in testing potential ballast water treatments.

At the same time as offering an exciting educational opportunity for our students, we would hope that the class could be used for you to recruit some student helpers for the shipboard ballast water research projects. This is an opportunity rarely afforded to students at an undergraduate institution. This said, I believe very strongly that having student assistants who come to the invasive species project from a number of different majors and areas of expertise could provide for a richness that might not otherwise be achieved were the project to rely exclusively on marine science majors.

In conclusion, I wish you all the best in your pursuit of this grant, and I hope very much that we will be able to work on this project as colleagues in the not-too-distant future.

Cordially,

Dr. Donna J. Nincic
Associate Professor and Chair, Global and Maritime Studies
California Maritime Academy, California State University
200 Maritime Academy Drive, Vallejo, CA, 94590
ph: 707.654.1202; e-mail: dnincic@csum.edu

5. OPERATIONS AND MAINTENANCE

Preliminary planning efforts have developed an operations and maintenance plan which appear to be both competitive with other possible facilities, as well as sustainable within the Golden Bear operational profile. Figure 9 provides an overview of the Operations Plan. The following are the strengths of this operations plan:

- Facility Maintenance: "Based on the limited scope of the proposal, MAR-611 assumes the Schoolship Program will be responsible for routine maintenance of any modified or newly installed piping, valves, electrical conduits, structural installations, pumps, which provide support to the plug and play system. These will be factored into the ship's maintenance regime." (MARAD Memo, Appendix B)
- The ballast test facility is designed for laying-up the system following each test cycle. This allows the break-out lay-up and all associated maintenance to be borne as a project cost. This eliminates costly overhead to the *Golden Bear*.
- A Contract Technical Coordinator will be utilized to facilitate communications between the vessel crew and the investigator team. This person(s) will essentially augment the vessel crew during testing periods. This person(s) will be responsible for break-out and lay-up of the system.
- The Operations Plan facilitates an "open-source" approach, allowing program like the Pacific Ships Initiative, Great Ships Initiative and other investigator teams to utilize the facility.
- This approach encourages direct student and faculty involvement in ballast treatment projects.

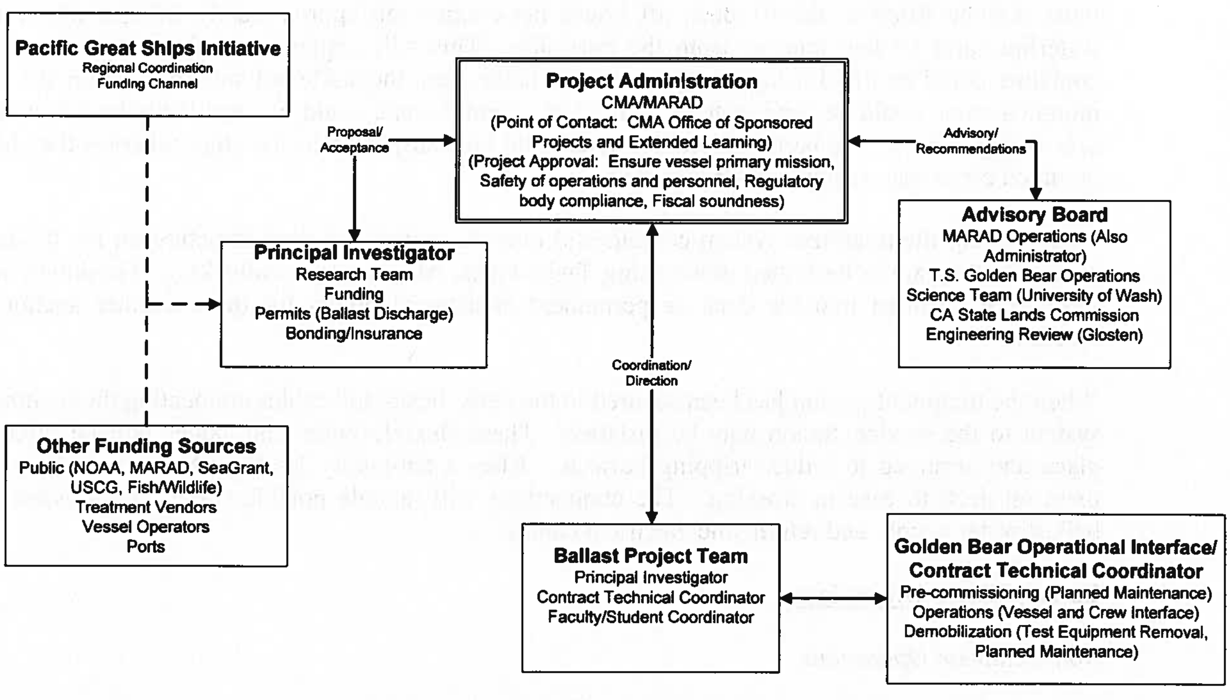

Figure 9 *Golden Bear* Ballast Treatment Test Facility Operational Coordination Diagram

Operational Costs with Hypothetical Cost Comparison

A cost estimate was developed to determine the cost for the technical coordinator, principal investigator team, vessel crew efforts and administration program costs for a certification effort which would meet both the land-based and shipboard Guidelines. It was determined to perform the testing in two cycles, each complete with mobilization, testing and demobilization. The first cycle would last four weeks resulting in two complete tests. The second cycle, six months following the first, would last five weeks resulting in three complete tests. The program cost, only excluding the treatment system hardware and treatment system technicians, is estimated at $300,950.

Based on the experience of the investigator team a similar shipboard trial effort on a vessel of opportunity would require three test efforts and range in cost between $180,000 and $250,000. Outfitting a vessel of opportunity would require piping and cabling modifications which could range from $50,000 (chemical dosing) to greater than $300,000. It is likely that land-based test facility costs would be similar to the Golden Bear costs. In sum, the Golden Bear facility can offer investigators a significant financial advantage.

Check-off List

An example check-off list has been developed which the investigator team must review and complete before testing efforts can commence. This list is provided at the end of this section.

Container Fastening

In order to connect a ballast water treatment system into the ballast system of the *Golden Bear* it must first be lifted to the 01 deck aft house deck extension approximately 20 feet above the waterline, and 50 feet inboard from the port side. This will require one of two options. The container could be lifted using a barge mounted crane from the starboard side of the ship, a shore mounted crane could be used instead, or the large fantail crane could be used if the load is within safe lifting limits. The barge mounted crane could be transported to the ship, whereas the shore mounted crane may require ship movement.

After placing the treatment system container(s) over the reinforced deck structure on the 01 deck extension they are to be lashed down using Twist-locks, bars, and/or turnbuckles. Tie-downs will have been installed into the deck as permanent attachment points for the container anchoring system.

When the treatment system has been secured to the deck, hoses and cables connecting the treatment system to the service station may be installed. These flexible hoses and cables will be fitted in place and arranged to reduce tripping hazards. Also, a temporary ladder may be installed over them on deck to ease in crossing. The connections will include potable water, compressed air, ballast water supply and return, and electrical cables.

Ballast Water Operations

Non-treatment Operations

Normal ballast system operations will not include operation and testing of a treatment system. The treatment system support modifications will not impact the ability of the vessel to perform normal operations and emergency operations provided that the manually operated isolation valves on the new piping arrangements are shut. The new isolation valves are on the discharge side of the ballast water treatment pump, and the treatment system discharge to the Overboard Discharge and Ballast Tank lines.

Ballast Water Treatment on Uptake

Testing of ballast water treatment on uptake requires that a single tank be filled completely with non-treated ballast water (control tank), while simultaneously a similar single tank be filled completely with treated ballast water (variable tank). This permits study of the affect of the treatment, in comparison to the many affects which are common to the two tanks regardless of treatment. Tanks 3-154-1 and 2 may be used interchangeably for these tests since they are similar in arrangement.

For both the control and variable tanks:

Figure 4 shows which valves are to be open or closed for the various treatment modes. See Mode 2 for this arrangement. The sea suction valve (valve A) will be open to the treatment system pump. Water will flow from the discharge of the treatment pump to the ballast treatment manifold on the main deck where the flow will be divided. Part of the flow will be supplied to the intake of the treatment container, while the remainder will be diverted through the control tank fill line. Control water will only be allowed to fill one tank. At the same time the discharge from the treatment container will be sent through the treatment fill line and flow into the variable tank. The flow of control water must be adjusted to achieve a similar flow rate to that of the treatment tank fill. This is to be accomplished by throttling valve F. Slip stream ports on the treatment supply and discharge pipes will allow sample collection before and after treatment while filling the tanks.

Control tank fill samples may be collected from a slip stream port connected to the control tank fill line on the main deck. The sampling process requires a total of three tanks, each with a capacity of at least one metric ton of seawater (approximately 267 gallons) as per Guidelines. One tank will contain treatment container supply water, one will contain discharge water from the treatment container, and the other will contain control water after passing through the treatment manifold.

Tank Monitoring

The Guidelines require that the ballast water remains in the ballast tank for five days prior to discharge and tank sampling efforts. While in-situ sampling during this five day period is not required by the Guidelines; however, it could provide important insight into the treatment process over time. Specific concerns may be how the efficacy and/or treatment concentrations vary over time.

In order to collect plankton samples from within one of the 3-154 ballast tanks the newly installed hatch must first be opened. The hatches used for this project will be bolted in order to ensure watertight closure. They may or may not be hinged. A plankton collection net may be sent through the top of each hatch, which will provide access from the top of each tank all the way to the tank bottoms. After collection of plankton samples is complete the hatches may be lowered and secured.

If a sample tube system is later installed it may be operated by first closing the sample discharge line used to fill sample containers, and opening the desired suction tube and recirc line. The pump will be started and allowed to run one or two minutes to flush the line. The sample discharge line may then be opened, allowing at least one gallon to flow through before sample collection begins. This will allow the sample discharge line to flush clean as well. After collection is complete the sample discharge line will be closed, the suction tube switched to the next desired testing location, and the system allowed to flush once more before collecting the next sample. When all samples have been collected the pump is to be shut down and all valves secured.

Ballast Water Treatment on Discharge

Ballast water treatment on discharge will be done in the same manner as uptake treatment, except that the valve line up for Modes 3 or 4 in Figure 4 will be used, and the tanks will only be discharged simultaneously in Mode 3. The slip stream sample ports will be used to collect treatment system supply and discharge samples from the treated tank(s). If separately discharging a control tank Mode 5 will be used. This allows the control tank to be discharged through the recirc line around the treatment system. In Mode 5 samples will be taken from the slip stream port on the discharge side of the treatment container. In Modes 3-5 samples will also be taken from the slip stream port in the overboard pipe in Shaft Alley. There should be 3 samples total form operation in Mode 3 or 4, and 2 samples total for Mode 5.

Blasting and Coating

The condition of the selected tanks is reported excellent. All coating damage from the modifications will be returned to original.

Sampling – Laboratory Facility

The previous sections detail the methods of gaining samples on ballast uptake, discharge and in-situ (ballast tank). In each case, the samples are collected within specified tank sizes or, in future modifications, directly to a portable container. In the case of portable containers used for ballast tank sampling the containers will be moved by hand to the biology lab for analysis. This would be relatively easy since the sample containers used should not exceed five gallons in volume and must be carried up only one deck to reach the biology laboratory. The ballast water collected on the aft 01 deck in the sample tanks will be available in the required quantity as per Guidelines, and will also be available for collection and transportation to the biology laboratory for analysis.

Section 5 Attachments

5-1 Checklist

USTS GOLDEN BEAR

CALIFORNIA MARITIME ACADEMY

BALLAST TREATMENT TEST FACILITY OPERATIONAL CHECKLIST

These preparations do not exclude procedures and contingency plans contained in vessel operational procedures

DATES ______________________ LOCATION ______________

PRINCIPAL INVESTIGATOR ______________ SYSTEM TYPE ______________

PRINCIPAL INVESTIGATOR POC ______________ VESSEL POC ______________

INITIAL PREPARATION & SET-UP

- ☐ Meet with Chief Engineer and Chief Mate to review proposed plan with timeline
- ☐ Stability check of the proposed plan (Chief Mate)
- ☐ Masters signature of approved plan
- ☐ ID Principal Investigator Point of contact (PI-POC) - daily meeting schedule for "plans of day"
- ☐ Hazmat list to vessel with MSDS
- ☐ Hazmat disposal plan
- ☐ Spill response plan
- ☐ Ballast Permits
- ☐ CV / Resume / Info on all persons involved in vessel operations headed by POC with 24 hour contact for all personnel
- ☐ Location plan for equipment and gear
- ☐ Estimate Crane Requests - Schedule
- ☐ List / Arrangement of Ship's tools and equipment required
- ☐ Pre-installation Condition of hoses, piping, connections and cabling
- ☐ Notice to proceed with set-up (Chief Engineer, Chief Mate)

PRE-ACTIVATION INSPECTION OF PUMP AND CONTROLS

- ☐ Electrical
- ☐ Rotate by hand
- ☐ Fresh water flush
- ☐ Lube pump & motor
- ☐ Op. test

- ☐ Close and isolate unused portions of ballast system (with Chief Mate)
- ☐ Remove blanks and install spool pieces for ballast treatment system test pump
- ☐ Load & Secure treatment test ISO container
- ☐ Remove blanks and connect hoses with new gaskets (provide spares)
- ☐ Check circuits and make electrical connections
- ☐ Check support of all flexible hoses and connections

- [ ] Close breakers and supply service connections. Test
- [ ] Inspect temporary installations for proper safety and fire equipment (which Chief Engineer and Chief Mate; Fire ext., Eye wash, etc)
- [ ] Inspect ballast tank vents for obstruction
- [ ] Install drip pans at temporary connections as appropriate
- [ ] Prepare standby tool and wrench kit
- [ ] Check ballast monitoring system for accuracy
- [ ] Confirm soundings at sounding tubes: provide sounding equipment
- [ ] Post minimum ullage at each tank
- [ ] Post warning signs as appropriate (Hazmat, Tripping hazard)
- [ ] Agree on communication plan and distribute comm. equipment

BALLAST DAY CHECKLIST (FILL OR DISCHARGE)

- [ ] Inspect condition of hoses, connections, couplings and line up
- [ ] Check supports in way of shore connections, etc
- [ ] Conference with Chief Mate and PI-POC

____ Ballast Plan ____ Emergency response procedure ____ Shutdown

____ Rate and time ____ Re-check stability

____ POC Ship ____ POC Vender

- [ ] Establish and check communications (Stop/Start/Stop)
- [ ] Ensure paper work in order (Permits, Checklist, Approval)
- [ ] Test system with neutral water

BALLASTING OPERATION

- [ ] Commence on agreement of Chief Mate and Vender
- [ ] Monitor tank level indicators and soundings
- [ ] Follow plan for rate, top-off and switching
- [ ] On completion, clear hoses and lines, and secure valves
- [ ] Daily soundings during all operations and testing
- [ ] Entries in ballast log

ON DE-COMMISSIONING

- [ ] Confirm tanks: emptied, flushed, or filled with treated fresh water as per initial plan
- [ ] Confirm system is isolated, drained, flushed with fresh water and laid up
- [ ] Inspect condition of all hoses and spool pieces, flushed and secured for sea
- [ ] Inspect all temporary connections, cables, and mountings secured for sea
- [ ] Confirm all log entries and paper work in order
- [ ] Walk system and work locations with Chief Mate and Chief Engineer for proper secure and stowage
- [ ] All vessel tools and equipment returned and stowed
- [ ] Sign-off vessel

6. DISCHARGE PERMITTING

Marine Regulatory Review Process

The contract design package for these modifications will be submitted to the American Bureau of Shipping for review in way of vessel stability, machinery, electrical and structure. The result is expected to be a Plan Approval of that submitted package. The local ABS inspector will then verify installation in accordance with the approved plans. As the vessel is part of the Alternate Compliance Program (ACP), ABS will serve on U.S. Coast Guard's behalf in the review process.

Ballast Water Discharge

There are two primary concerns regarding the treatment of ballast water in regard to discharge: efficacy and toxicity. Each of these are reviewed in further detail in the Concept Design provided in Appendix B. The existing regulations regarding each of these aspects are under review and additional regulations are under development on the regional, national and international level. It is the intention of the program to coordinate with the California State Lands Commission to ensure compliance with the current requirements and any new requirements as they develop. This coordination will include at a minimum the U.S. Coast Guard, California State Lands Commission and Water Board.

Regional

The EPA is mandated with enforcing the U.S. Federal Water Pollution Control Act (Clean Water Act), the goal of which is to, "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The National Pollutant Discharge Elimination System (NPDES) is the mechanism for enforcing it. NPDES permits are administered on a state level for point sources.

There is an ongoing and significant legal battle regarding 40 Code of Federal Regulations (C.F.R.) § 122.3 (a), which exempts "any other discharge incidental to the normal operation of a vessel," i.e. ballast water, from the NPDES permitting process. There is a ruling by the U.S. District Court for the Northern District of California that this exemption is illegal as non-indigenous species (NIS) were considered a pollutant; the ruling currently under review with further findings expected in November 2005.

U.S. Federal (USCG)

The U.S. Coast Guard (USCG) has traditionally had the mandate for enforcing control of pollution from marine vessels. This is also clear in 33 C.F.R. § 151, which designates USCG as the agency to ensure compliance with MARPOL. USCG provides marine vessels flagged under the U.S. with a Certificate of Inspection that the vessel has been found in compliance with all applicable regulations, including environmental. USCG also enforces "port state control" over foreign vessels calling in the U.S., to ensure that they are in compliance with regulations as per their respective certificates and applicable U.S. regulations.

International (MARPOL, Ballast Convention, Active Substance Approval)

The International Convention for the Prevention of Pollution from Ships (MARPOL), and its Annexes and Amendments provide international regulation of most shipboard discharges that could be considered pollutants: oil, noxious liquid carried in bulk, harmful substances in packaged form, sewage, garbage and air pollution. The Annexes and Amendments to MARPOL are developed by Marine Environment Protection Committee (MEPC), a working group of the IMO.

MEPC working groups are currently developing Annexes and Amendments to the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (Ballast Convention). The Ballast Convention will enter into force if signed by 35 member countries representing at least 35% of world merchant shipping tonnage. Once in force, it will be the responsibility of member Administrations to enforce requirements on visiting vessels. "Administrations" refer to the governments and enforcement agencies of the IMO member nations. Applicability to pollution is found in Regulation D-3 of the Convention, Approval requirements for Ballast Water Management systems, which states: "Ballast Water Management systems which make use of Active Substances or preparations containing one or more Active Substances to comply with this Convention shall be approved by the Organization, based on a procedure developed by the Organization." Organization is defined as the IMO.

MEPC-53, which met in July 2005, adopted two Annexes to the Ballast Convention: Annex 3 – Resolution MEPC.125(53), Guidelines for Approval of Ballast Water Management Systems, and Annex 4 – Resolution MEPC.126(53), Procedure for Approval of Ballast Water Management Systems that Make Use of Active Substances. The Annex 4 procedure includes review from a Technical Group, GESAMP-Ballast Water Technical Group on Active Substances. The IMO will consider the Technical Group review before providing an approval. The approval scheme is shown in Figure 10.

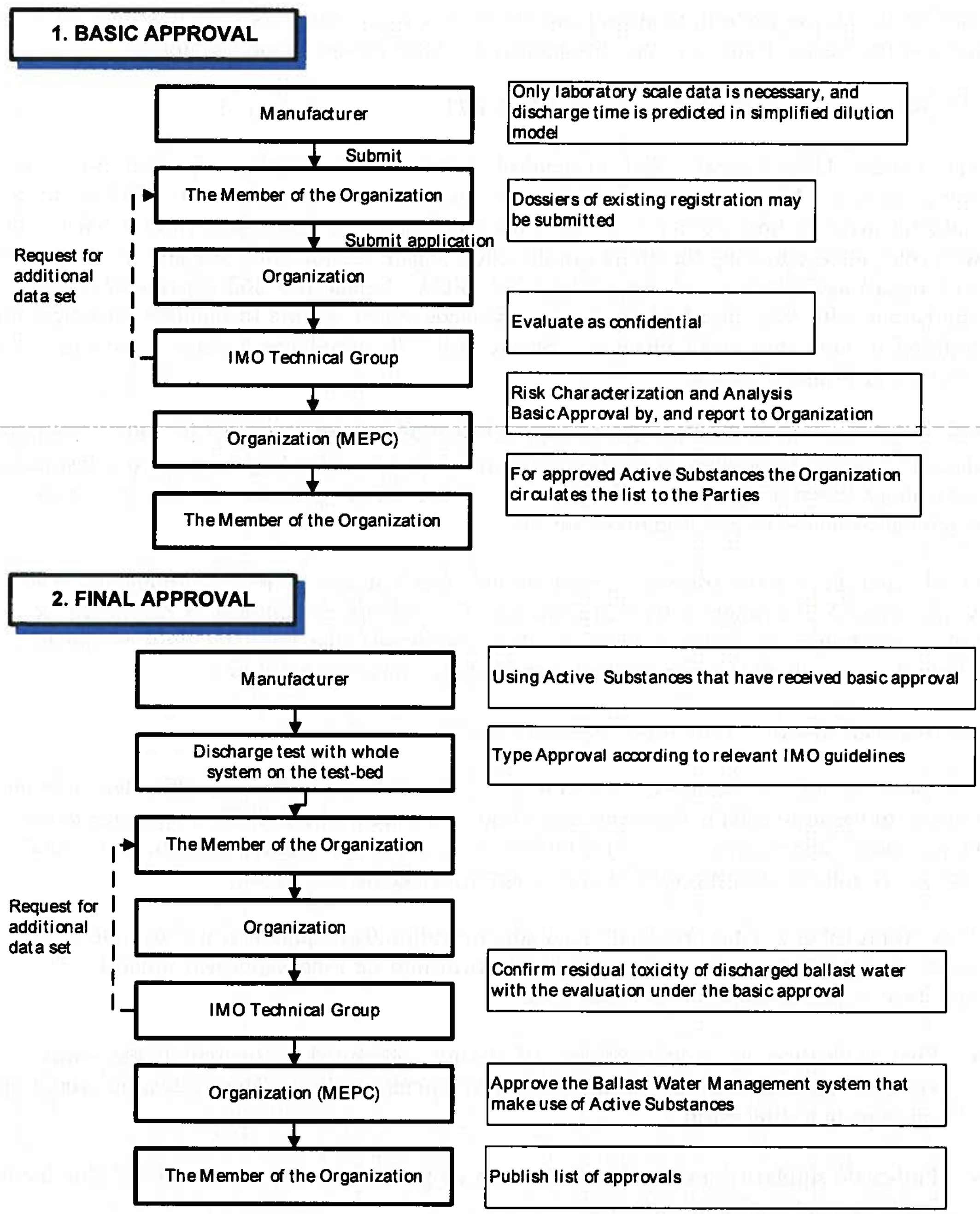

Figure 10 - IMO Final Approval Scheme for Ballast Water Management Systems that Make Use of Active Substances (Figure after Ballast Convention, Annex 4)

Toxicity Discharge

Regional

California has a program similar to Washington State which is run by the State Lands Commission. Washington State Department of Fish and Wildlife (WDFW) has a program in place including efficacy standards and an approval process. This process allows for "best available technology." One approval has been issued to date, with more expected in the near future. An approval means that the vessel can perform treatment instead of exchange. Approvals are provided on an interim basis of five years. California has also approved at least one treatment technology.

U.S. Federal (Senate Bills 363 and 770, STEP, ETV)

The current U.S. federal effort to control ballast vector invasive species stems from the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) and the National Invasive Species Act of 1996. This broad based bill mandates various federal agencies with roles in coordinating the effort. In the 2005 Senate session Bills 363 and 770 are conflicting with regard to amending and "improving" NANPCA. Senate Bill 363 appears to normalize U.S. regulations with IMO standards and may supersede states' efforts to regulate interstate trade, in addition to numerous other changes. Senate Bill 770 introduces a percent reduction concept, among many other changes.

USCG initiated the Shipboard Technology Evaluation Program (STEP) in 2004. This program seeks to promote technology evaluation on a best-available technology basis for one installation per technology-vessel class pair. The benefit of the STEP program is that the system-vessel combination would be grand-fathered for life.

USCG and EPA have formed a team in the development of an Environmental Technology Verification (ETV) program for ballast water. One facility is complete in Key West, with Great Lakes and Singapore facilities planned. It is envisioned that these facilities would be used to conduct the land-based testing detailed in the Ballast Convention Annex 3.

International (Ballast Convention, Annexes 3 and 4)

The objective of the Ballast Convention is to "prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments." The Ballast Convention provides a performance standard and requires Administration approval of ballast water management systems.

Type Approval is a status provided by an administration that equipment will operate as advertised. Annex 4, see Figure 1, incorporates type approval into its Final Approval process. The steps to gain Type Approval are given in Annex 3 as:

- First evaluation by Administration of design, construction, operation and functioning of system. This can include research and development testing. The evaluation would approve subsequent testing effort.

- Full-scale shipboard and land-based testing as per Annex 3, Parts 2 and 3. This includes at least six months of shipboard work.

- Type Approval by Administration for this equipment. There would be no more efficacy testing required for the approved equipment.

- Installation survey for each installation. This includes assuring that equipment is installed properly, manuals are in place, etc.

Pollution Control (Product Registration)

At the state level, product registration stems from the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) which includes consideration of economic, social, and environmental costs and benefits of the use of pesticides. The U.S. Environmental Protection Agency (EPA) defines a pesticide as "any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest."

While states do not register products or approve labels, they generally require a review for relevance in that state, prior to accepting its use.

EPA is charged with enforcement of FIFRA. EPA requires registration of any pesticides prior to commercial sales in any state. The registration review considers the environmental impact and ability of the product to work as advertised (efficacy). A successful registration would result in product labeling.

The International Maritime Organization (IMO) has formed a review committee called the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) to review "Active Substances." This group will review the impact of the active substance on the environment, but not its efficacy in the ballast water. IMO efforts are described in more depth in the Toxicity section of this report.

EPA offers an Experimental Use Permit (EUP) for national trials. However, the EPA EUP does not relieve additional review which may be required by the state.

California Department of Pesticide Regulation (CDPR) offers a Research Authorization (RA) for experiments.

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