MH Systems, Inc.

Mo Husain
President

October 31, 2008

Eileen Maher
Environmental Services Department
P.O. Box 120488
San Diego Unified Port District
San Diego, CA 92112-0488

Dear Ms. Maher,

Enclosed please find the Final Report package for the project, "Initiate Activities Required to Test Ballast Water Treatment by Gas".

The Report consists of 4 copies of the description of the work accomplished under each of the eight tasks, 4 copies of each of the ten drawings developed (two drawings consisting of three sheets each), Electric Load Analysis, and the Inert Gas Generator Installation Specification.

The submittal of the Report also consists of a 10 CD ROM.

Sincerely,

Mo Husain
President

Final Report – October 31, 2008

PROJECT: INITIATE ACTIVITIES REQUIRED TO TEST BALLAST WATER TREATMENT BY GAS - SDUPD Document number 52470, Oct 12, 2007

In accordance with San Diego Port's Environmental Committee's agreement with MH Systems, Inc. we herewith submit the Final Report (Draft) for the Project: "Initiate Activities Required to Test Ballast Water Treatment by Gas."

All of the tasks for this Project were required to support the project objective to develop the Contract Design of MHS ballast water treatment system installed on R/V Melville, a ballasting oceanographic research ship operated by Scripps Institution of Oceanography. Ships coming to our harbor must empty ballast water prior to loading. Ships discharging their ballast water taken in any other port are contaminated or inhabited with species that are injurious to indigenous species in our bays/ports – these water-bodies generally are connected to a vast network of inland water ways. A ballast water treatment system is required that can economically de-contaminate or 'kill' Aquatic Nuisance Species (ANS) and thus protect indigenous species, and restore (both flora and fauna) species, that are natural to our bay or port area of waters.

Eliminating the pollution of the San Diego Bay by polluted ballast water protects the bay water habitat and encourages restoration of marine life being damaged by the pervasive pollution. The ballast water system that can protect the San Diego Harbor has been developed by the naval architects and marine engineers of MH Systems with marine biology scientists of Scripps Institution of Oceanography (SIO).

The system is planned to be tested in full scale on R/V Melville. The funding provided by SDUPD was utilized to prepare the contract design. The following are the specific tasks required to be completed in accordance with the agreement:

1. Select the Inert Gas Generator
2. Identify and Select all Sensors
3. Complete the Preliminary Design of Control System and Hardware
4. Ship Check R/V Melville and Design Verification
5. Optimize Diffuser System
6. Coordinate Design Activities
7. Program management and Report Submittal
8. Liaison w/SIO

Task Description and Work Accomplished:

1. Select the Inert Gas Generator

The inert gas generator is the heart of the ballast water treatment system. The ballast is treated by inert gas. The inert gas is bubbled through the ballast water via a row of pipes with diffusers located at the bottom of the tank. The inert gas is from a marine inert gas generator and is composed of approximately 84% nitrogen, 12-14% CO_2 and about 2% oxygen. The ballast water will be equilibrated with gas from the inert gas generator. Accommodating a marine inert gas generator onboard R/V Melville is a challenging task because of the cramped spaces of the vessel. A standard generator had to be re-designed to fit in the R/V Melville. Our engineer, Steve Donley, is extensively experienced in designing inert gas generator (IGG) installation into tankers. He was responsible for this task. Examination was conducted of the products of worldwide candidate manufacturers for functions, price and shipboard fit. The IGG of Transvac in England was selected. The president and Chief Engineer of this company visited our office to review the design of their IGG in Melville and the selection was consummated with an agreement.

2. Identify and Select all Sensors

The inert gas generators are similar to small auxiliary boilers – this equipment and valves are all automatically controlled, via sensors, with manual override. The MH Systems BW Treatment system utilizes infusion of inert gas (by bubbling) until the ballast water attains a state of hypoxia with a pH of nearly 5.5. The gassing is controlled by the remote and automated control valving system, which can permit sequential tank treatment, or multiple tank treatment simultaneously. These functions are monitored and or controlled from inputs from the sensors. Several design reviews were made to determine all of the required sensing that the installed sensors would have to do. It was finally determined that only two types of sensors would be needed to remotely and automatically sense conditions and relay the information to the central control station. One sensor would sense the amount of dissolved oxygen in the ballast water, and the other would sense the pH. In consultation with the Scripps scientists, the minimum accuracy of the two sensors was determined to be plus/minus 1% Celsius for the temperature sensor (local reading), plus/minus 1% dissolved O_2 and plus/minus .01 for pH. This requirement was incorporated into the BWT System specifications. The shipyard will select the least expensive sensors that meet the specifications

3. Complete the Preliminary Design of Control System and Hardware

The MH Systems controls are active dynamically during the period of infusion of inert gas i.e. bubbles in the ballast water. The oxygen concentration and pH of the water of each tank is monitored and recorded for each tank, sequentially, in real time. The control system software of this Ballast Water Treatment System includes self-diagnosis of failed sub-systems as well as all monitoring equipment. The Control System subcontractor prepared the specifications for the contract system, which was incorporated into the BWT System specifications. It is a functional specification describing all of the functions that

the contract system must perform. The shipyard will select the hardware to accomplish these functions.

4. Ship Check R/V Melville and Design Verification

Comparison and verification of the existing drawings and plans of R/V Melville was required to ascertain that the drawings that MHS prepares are accurately based on R/V Melville's current configuration. The task required boarding the vessel and comparing the vessel's as-is configuration with the available existing drawings. Older vessels such as the R/V Melville generally get routine modifications, not reflected in any drawings. Two persons from MH Systems boarded the vessel in Koushung, Tawain to ship-check the vessel. During the ship check the two engineers determined the best compromise of the location of the inert gas generator. They also made tentative design decisions on how to provide the IGG with the necessary fuel, water and electricity. Of almost equal importance they made tentative design decisions on how the piping distribution of gas to all of the ballast tanks would be made through the various spaces in the ship.

5. Optimize diffuser System

The BWT system attains its lethality to "kill" organisms in ballast water by infusing inert gas. The 'infusion' of inert gas is done by diffusers, similar to those used in the wastewater treatment. Inert gas must be compressed to overcome the pressure head of the tank to add to the complexity of the design of diffusers; tank sediment is also a factor in the design of diffusers. Analytical work to derive the time required for optimal diffusion of inert gas into the ballast water was prepared. After comparing the physical and performance characteristics of diffusers from several manufacturers, the diffusers of Red Valve Co./Tidaflex of Carnegie, Pa. were selected. The services of a physical chemistry professor from the University of San Diego conducted analysis of the time-line for total diffusion.

6. Coordinate Design Activities

This task involved preparation of diagrammatic arrangements for Inert Gas Generator and IG distribution system, scrubber seawater supply system, effluent drain system, control air system diagram, tank sampling system diagram, etc. This task also included electrical power load analysis and electrical diagrams. The contract design set of drawings required for the ballast water system installation is listed below and included herein. Also the contract specifications were prepared and are enclosed herein.

Inert Gas Generator & IG Distribution System Diagram
52470-MHS-P0001
3 Sheets
Scrubber Seawater Supply System Diagrammatic Arrg't
52470-MHS-P0002
Effluent Drain System Diagrammatic Arrg't
52470-MHS-P0003
Control Air System Diagrammatic Arrg't
52470-MHS-P0004
Diesel Fuel System Diagrammatic Arrg't
52470-MHS-P0005
Enclosure CO2 System Diagram
52470-MHS-P0006
Enclosure Drainage System Diagrammatic Arrg't
52470-MHS-P0007
Inert Gas Distribution Piping Diagramatic Arrangement
52470-MHS-P0008
3 Sheets
Ballast Tank Sampling and Monitoring System Diagram
52470-MHS-P0009
Enclosure HVAC System Diagram
52470-MHS-P0010
BWT Electric Load Analysis
52470-MHS-E0001

7. Program management and Report Submittal

The function of program management included defining the program tasks, assigning budgets for each task, providing top-level management/guidance to all tasks, controlling expenditures of each task, submitting progress reports and rough Final Report, smooth Final Report and assisting in the presentation.

8. Liaison with SIO

MHS liaison with Scripps Institution of Oceanography's Marine Biology Research consisted of intermittent discussions and reviews of the required technical functions of the BWT system in Melville with the ongoing design of the physical installation. The MHS liaison with SIO Ship Operation and Marine Terminal Support (SOMTS) involved close coordination on Melville's movements to permit boarding and ship checking, (the ship was met in Koahsuing, Taiwan), receiving engineering interface information to install BWT system on R/V Melville and design reviews to insure that the installation will not interfere with any of the multitudinous missions that Melville must be capable of performing.

MH Systems, Inc.

Progress Report - April 30, 2008

"Initiate Activities required to Test Ballast Water System by Inert Gas"

Note: The report includes percentage completion of tasks upto April 30.

Task	Inv #1	Inv #2	Inv #3	Inv #4	Inv #5	Inv #6	S.Tot for 6 Mo Expenditure	Task Compl. in %	Current Budget	**Suggested Revised Budget**
1. Select the Inert Gas Generator	$ 660	$ 168	$ 654	$ 1,170	$ 840	$ 1,200	$ 4,692	55%	$3,492	$ 8,492
2. Identify and Select all Sensors	$ -	$ -			$ -		$ -	Yet to Start	$1,529	$ 3,529
3. Complete the Preliminary Design of Control System and Hardware	$ 330	$ -	$ 84	$ 240			$ 654	20%	$1,835	$ 1,835
4. Ship Check R/V Melville and Design Verification	$ 820	$ 7,252	$ 745	$ 1,200			$ 10,017	75%	$14,707	$ 10,707
5. Optimize Diffuser System	$ 360	$ 360	$ 720	$ 1,320	$ 1,320	$ 1,920	$ 6,000	60%	$4,586	$ 8,000
6. Co-ordinate Design Activities	$ 252	$ 360	$ 360	$ 6,554	$ 4,098	$ 5,028	$ 16,652	75%	$19,221	$ 23,221
7. Program Management and Report Submittal	$ 770	$ 440	$ 880	$ 1,540	$ 1,120	$ 1,100	$ 5,850	50%	$10,930	$ 10,930
8. Liaison w/SIO	$ 240	$ -		$ 1,320	$ 1,560	$ 960	$ 4,080	50%	$7,552	$ 9,552
Travel	$ 3,048	$ 941					$ 3,989	70%	$4,704	$ 5,704
Subcontractor - Contract Design -**Note #1**							$ -	$ -	$22,974	$ 9,560
Subcontractor - Control System						$ 5,340	5340	80%	$8,470	$ 8,470
	$ 6,480	$ 9,521	$ 3,443	$ 13,344	$ 8,938	$ 15,548	$ 57,274		$100,000	**$ 100,000**
Note#1 - The design is being done in house due to the requirements for close review and information feed as subsequent technical identification is developed. Review by subcontractor is still desirable if funding pe permits, since they are design agent for several tanker companies										

Matching Fund Contribution
For
San Diego Unified Port District Agreement
To
"Initiate Activities Required to Test Ballast Water System by Inert Gas"

October 2007

Purpose: (a) To visit Singapore Shipyards for Installation of BWT on R/V Melville,
(b) obtain support from International Flag State (Singapore) and
(c) support from Singapore National University for BWTS

Singapore Trip Air Fare $ 1710 +$879 = ...	$2,589.00
Deduct personal Trip to Bangladesh	$ - 300.00
Sub Total.....	$2,226.00
Labor 8 days –8x8hrs= 64 hrs x $120/hr = 7,680	$7,680.00
Hotel, Meals, etc.	$2,400.00
Sub Total Singapore.....	$11,969.00

February 2008

Purpose: Request for Congressional Appropriation funding for BWTS installation on R/V Melville for $880,000

Washington Trip Air Fare.....	$ 240.00
Hotel and Meals	$ 625.00
Labor 5 days – 5x8 = 40 hrs x $120/hr = 4,4840	$4,480.00
Total Washington Trip	$5,345.00

July 2008

Purpose: To attend the IMO meeting regarding Ballast Water Management guidelines work sessions, including G(8) guidelines that regulates systems such as the MHS BWT Systems.

To visit Derbyshire factory where Transvac is designing an Inert Gas Generator for R/V Melville

London Air Fare.....	$1,095.00
Train Fare.....	$ 200.00
Hotels & Meals	$3,000.00
Labor 5 days – 5x8 = 40 hrs x $120/hr = 4,480.....	$4,480.00
Total UK Trip	$8,775.00

Total Matching Fund Contribution Up to April 30, 2008 **$26,089.00**