October 14, 2010

School of Engineering Science

Simon Fraser University
8888 University Drive
Burnaby, BC
V5A 1S6

Re: *ENSC 440 Functional Specifications for Clean Marine Systems Shoreline Oil Detection System*

To Whom It May Concern;

The following documentation outlines Clean Marine Systems ENSC 440 project functional specifications for their shoreline oil detection system. It will list the projects high level functionality, which will then be used as a guide in the development stages of our products life cycle.

Clean Marine's Shoreline Oil Detection System is designed to be placed along the shoreline of an oil spill hazard zone, where it will constantly measure the water for oil content. If oil is detected it will alert the concerned parties via wireless communications.

Clean Marine Systems is a young and dedicated team of engineers. This document accounts for every functional detail of the project, and also incorporates the test plan to ensure each detail is adhered to, which shows how committed Clean Marine Systems is to developing superior, long lasting products.

Sincerely,

James Kennedy

James Kennedy

Chief Executive Officer
Clean Marine Systems

Enclosure: *Clean Marine Systems Shoreline Oil Detection System Functional Specification*

Functional Specification

Shoreline Oil Detection System

James Kennedy, CEO
Ahmed Saleh, COO
Ned Tobin, CFO
Farid Mabrouk, CTO

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Executive Summary

Environmental disasters come in two forms, natural and man-made. Natural disasters can be experienced in the form of hurricanes, earthquakes, flash floods or volcanoes. They aren't any less destructive than man-made ones, but the fact is that no one company or society is directly responsible for them. Man-made disasters, on the other hand, come in a much larger variety, such as nuclear reactor blow-offs, collapsing bridges, falling buildings, or chemical spills. At Clean Marine Systems we are aimed at protecting the environment from one such man-made disaster, oil spills, more specifically off shore oil spills from giant ocean tankers or oil drilling platforms.

Man-made ocean environmental catastrophes generally occur because the ocean is one of the harshest environments on the planet. Conditions make everything decay, corrode, malfunction, contaminate, or become covered with marine life; all the ocean's impacts demand constant maintenance and testing to ensure that a disaster does not occur by a machine malfunction.

Given the extremities, ocean oil exploration continues forward which ensures the need for proper and effective monitoring of such oil exploration projects. The objective of Clean Marine's project is to develop a Shoreline Oil Detection System that will be strategically placed along the shoreline, and other such delicate marine ecosystems, continuously monitoring the oceans water levels to detect if the water has become contaminated with oil. In the event that oil is detected, the Shoreline Oil Detection System will alert the concerned parties of the situation, which will ensure that the most effective disaster recovery is implemented, saving marine life, time, and money.

Clean Marine's Shoreline Oil Detection System will go through two main stages in its lifecycle. The first stage will be a proof of concept prototype, with a more robust construction that will focus on ensuring the following functionalities work as desired:

- Detect the presence of oil in salt water
- Process oil detection, and send commands to the transmission device
- Transmit alert signals to concerned parties

Stage one is aimed to be finalized by early December, 2010.

The second stage will seek to refine the prototype into a fully functional, ready for the assembly line product focused on creating a user friendly device that looks aesthetically pleasing and provide seamless operation. This will be a result of extensive product testing and refining.

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Introduction

Clean Marine Systems' Shoreline Oil Detection System is an oil detection unit that will sit on the surface of the ocean, surrounding ocean habitats that require special care and attention to guard against disastrous ecological contamination. The Shoreline Oil Detection System will detect the content of oil in the oceans water with two electrodes that will be strategically placed just below the water surface. A microprocessor will then decode the analog reading from the two electrodes and based on a comparison algorithm it will determine whether the level of contamination is above or below the critical level. Upon critical level detection, the microprocessor will transmit an alert via cellular network to an operator.

Scope

This document will outline the proposed functionalities for Clean Marine Systems Shoreline Oil Detection System, listing system requirements based on desired functionalities. It will also provide a development test plan that will be used to ensure the Shoreline Oil Detection System meets our product requirements.

Intended Audience

This document is intended to give the Clean Marine team a guide in the different stages of the project lifecycle. The team leader will use this to track the project progress, the engineers will use this document to keep their efforts aligned with project goals, and the testing team will use this document to ensure all desired functions have been implemented and are working as outlined.

Classification

In this document the following convention will be used to denote the product's functional specifications:

[Rn-p] Functional requirement description

'n' is the requirement number in this function specification.

'p' represents the specific stage in the lifecycle the specification will apply to, using the following table for reference:

I	Proof of concept prototype only
II	Proof of concept prototype and final product
III	Final product only

System Requirements

Overview

This document provides the specifications for the system described by the block diagram below.

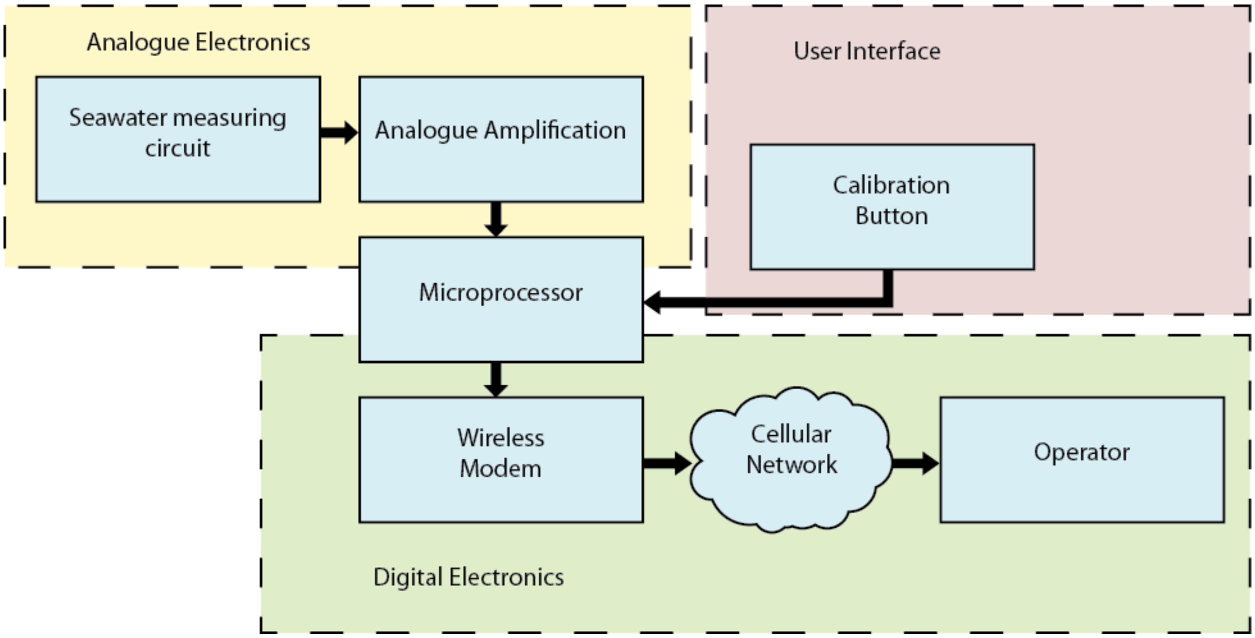

Figure 1 System Requirements Overview

The Shoreline Oil Detection System's electronics consists of a microprocessor which reads signals from an analog sensing circuit, interprets them, and then transmits necessary information based on that interpretation via a wireless modem. The system's user interface includes a calibration button that allows the microprocessor to take a baseline measurement of the water voltage level that the device has been placed in.

Due to the time and budget constraints of this project, we are building our prototype to use a cellular network for communication. We expect that a production version of this system will use a satellite network. This document describes the requirements for the cellular version.

Physical Requirements

[R1, III] The unit shall be able to float on water.
[R2, III] The unit shall be protected from the environment.
[R3, III] The unit shall be able to support solar panels.
[R4, III] The unit shall be made as small as possible.
[R5, III] The unit shall easily be attached to any size or shape of an anchored buoy.
[R6, III] The unit shall pack into itself for ease of transportation.

Electrical Requirements

[R7, III] The unit shall be powered from a 15 V DC solar panel. [4]
[R8, II] The unit's conductivity sensing shall be powered with DC voltage ranging from 1-1.5 V.
[R9, II] The unit's microcontroller and modem shall run on batteries at 6-20V max.[5]
[R10, III] The unit's batteries shall be rechargeable.
[R11, II] The unit shall get new test results every 10 seconds.
[R12, III] The unit shall have enough batteries to provide the necessary voltage requirements.
[R13, III] The unit's electrodes used in the sensing circuit shall be resistant to corrosion.

User Interface Requirements

In the sea

[R14, III] The unit shall have an easily performed calibration routine.

For the Operator

[R15, III] The unit shall send an alert to the operator.
[R16, III] The unit's alert shall stop when it is acknowledged.

Communication Requirements

[R17, III] The unit shall transmit alerts within 30 seconds of:

a) an alert being created, or
b) network signal being re-established

[R18, III] The unit shall transmit alerts through a cellular network.

Software Requirements

[R19, III] The unit shall be fast enough to take measurements with a frequency of 10 seconds.
[R20, III] The unit's microprocessor software shall be less than 128KB.
[R21, III] The unit shall pass data to a cellular modem.
[R22, III] The unit shall respond to user interface interrupts in less than 5 seconds.

Reliability Requirements

[R23, II] The unit shall reliably work for 5 years of deployment if maintained properly.
[R24, II] The unit shall be waterproof.
[R25, III] The unit shall be able to operate with temperatures of -30 to 50 degrees Celsius. [3]
[R26, III] The unit shall be able to withstand extreme weather conditions.
[R27, III] The unit's electrodes shall be changed easily (intervals of greater than 2 months).
[R28, III] The unit's battery shall last 15 hours without being charged. [2]
[R29, III] The unit's battery shall last 2 years. [1] [6]

Safety Requirements

[R30, II] The unit shall not harm any marine life or environment.
[R31, II] The unit shall not shock the user when touched.
[R32, III] The unit shall be enclosed with shielding that allows signal transmission.

Documentation

[R33, III] The unit shall have a setup guide.
[R34, III] The unit's documentation shall be understood by an audience with minimal technical background.
[R35, III] The unit's documentation shall be available in a softcopy upon purchase.
[R36, III] The unit's documentation shall be available in English, French.

System Test Plan

The seawater conductivity changes very fast depending on a variety of factors such as temperature, time, location, season, and weather. Several tests need to be performed to ensure the system is both durable and dependable. To achieve this, a three stage testing plan will be implemented.

The first stage of testing will be done in the lab on different samples of seawater, drinking water and water contaminated with oil. The purpose here is to see how much conductivity seawater exhibits and how much it differs from both drinking water and contaminated water. We will also test the sensitivity to electrode voltages for tolerance levels, and compare this to the digital data decoded by the processor. Software testing must be done as well, using a debugger to clean the code of any errors and miscalculations.

During the second stage of testing the unit will be taken to the sea for practical testing and measurements which will be taken at different times of the day, locations, and various weather conditions. This data will then be used in calibrating the system, which will then be tested by putting the unit into a mock real-time scenario in contaminated sea water in the laboratory, and also into the ocean again. We will also add oil to a clean sample of seawater and see how the system will respond, and how long it will take for the warning signal to be sent and received. In parallel with this process, we will be testing the cellular communication module to ensure it communicates with the microprocessor. This way of monitoring will allow us to collect real data in conditions that Clean Marine's Shoreline Oil Detection System will experience when deployed.

After the system passes the initial two stages of testing, a more rigorous prototype structure will be built, integrated, and tested for proper functionality, then taken to the sea to perform the final sets of testing before deployment. To ensure adequate stress testing the device needs to be tested in different locations, times of the day, and weather conditions, as in the second stage of testing. This will test the physical requirements of the system, putting it through stress testing with different weather conditions and times of year. At this point an in-lab stress testing mechanism will be built for vibration, heat, and pressure simulations to speed up the reliability testing procedure without sacrificing quality of testing performed.

All of the test data and recorded data from deployed data collection will build a database used for monitoring the functionality of the unit, which will grow, enabling testers to use more information to adapt the system testing to new environmental conditions the Shoreline Oil Detection System will experience, making it more rigorous and tough; able to survive in the conditions it will see in the ocean, thus improving reliability.

Conclusion

This document has outlined specific functions for each different part of Clean Marine's Shoreline Oil Detection System, leading all members of the development team in a focused and precise direction.

Using this valuable resource presented in the system requirements will ensure the team of engineers at Clean Marine Systems will create a fully functional stage 1 product, effectively able to be demonstrated to potential investors and other similarly interested parties.

The test plan will guide the testers in implementing test routines to ensure that the prototype created in the first stage does indeed do what the system requirements outline in this document.

Following this functional specification will allow us to create an aligned and productive environment for all engineers involved in the process.

James Kennedy
CEO

Ahmed Saleh
COO

Ned Tobin
CFO

Farid Mabrouk
CTO

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