Utilization of Automated Oil Spill Detection Technology for Clean Water Compliance & Spill Discharge Prevention

by

Chris R. Chase, Steven VanBibber

of

InterOcean Systems, Inc.
San Diego, California, USA

chrisc@interoceansystems.com
(858) 565-8400
Why Use Remote Oil Spill Sensors?

• Protect Business Interests via Remote Self-Monitoring

• Compliance w/ SPCC and other Clean Water Regs -for example CFR 40 112.7, 112.8, etc.

• Best Management Practice
• Good Engineering Practice

• Around-the-Clock Protection Against Spill Going Unnoticed for Any Length of Time!
Development Objectives

Early Warning Device for All Types of Oil Spills
- Preventative Countermeasure
- Analogous to a “Smoke Alarm” for Oil Spills
- Surface/Near-Surface
- Highly-Sensitive Sheen Detection
- Broad Range of Oil Pollutants
- Freshwater or Marine Environment

Non-Contact Sensor
- Optical Sensor
- Low Maintenance, Non Fouling
- Easy to Use and Install

Early Prototype ~ Spring 2004
Development Objectives

Automated
- Remote Monitoring
- Network Addressable

Versatile
- Adaptable for Varied Applications & Settings

Exceed Tidal Range
- +/- 5 Meters Above Target

Affordable
- Commercially Viable
- Turnkey System
Stages of New Sensor Development

- Market Research
- R & D
- Build Prototypes
- Lab & Field Testing
- Apply Lessons Learned
- 1st Production Units, #1,2,3…
- Ongoing Sensor/System Improvements Based on Extensive Customer Feedback (Present Phase)

Current Production Unit ~ Spring 2006
Theory of Operation

Basic Operation

- **Slick Sleuth™**
  - Xenon Flash
  - Photo Detector
- **Output Filters**
- **Input Filters**
- Fluoresced light
- Ambient conditions
- Desired wavelengths of light
- 190 to 1200 nm light
• Differential Measurement
Anomaly Detection

• Rejects Ambient Conditions
  i.e. Water Surface, Sunlight, Foam, etc.

• User Adjustable Sensitivity
  Baseline + Offset = Detection Threshold

• Discrete or Scaled Output
  Yes/No Detection vs.
  Proportional Signal (0-30,000 counts, 0-20mA)
Characterizing Detection of Hydrocarbons Using UV Light Source
Characterizing Detection of Hydrocarbons Using UV Light Source
Typical System Features

- Local Alarm & Status Lights
- Serial Connector for User Setup w/PC
- 4-20 mA Output &/or Relay Contact Output
- AC or DC Power Input
- UV Transmission & Photo Receptors
- Purge Compatible

Slick Sleuth™ Oil Spill Monitoring System
Model SS200 ADS (Autonomous Detection Station)
Standard User Interface

Slick Sleuth Utility Program

Version 1.30

Message Sent: 03 P s @
Message Received: 03 P 00005 i @

SEND COMMAND

Real Time Logging

Detection Setup
Flash Count (B): 10
Flash Interval (C): 01
Auto Period (P): 0005

User Baudrate
- 300
- 1200
- 2400
- 9600
- 19200

Comm Port
- None
- COM 1
- COM 2
- COM 3
- COM 4
- COM 5
- COM 6
- COM 7
- COM 8

Expected Checksum: i
Address: 03
Timeout (sec): 5

Commands
- Address (A)
- Flash Count (B)
- Flash Interval (C)
- Del Request (D)
- Request Data (E)
- Baseline (I)
- Report Baseline (J)
- Set Mode (L)
- Enable sp degraded status (M)
- Auto Period (P)
- Request Status (S)
- Send Offset (T)
- Request Temp (V)
- Set Baudrate (Z)

RESET
Typical System Configuration

NEMA IP66 Housing
- Weatherproof Stainless Steel Enclosure
- Operable in Hazardous Environments Optional

AC Power
- Solar/DC Battery Power Optional

Hardwired
- Radio, Cellular, or Satellite Telemetry Optional

Analog Output
- Digital (RS232 or RS485) Interface, Plus:
- 4-20mA (for SCADA, PLC, etc)
- Relays (PLC, Actuation of External Valve/Pump)
- Dummy Lights & Alarms
- Real Time Spill Notification via Phone or Pager

Autonomous System
- Network Control/Display Software Optional

Autonomous Spill Detection Sensor
‘Peering’ Down Into Deep Pit Sump at GenCo
(photo courtesy of Entergy, Arkansas)
Application Examples

Power Generators & Distributors
- Fossil Fuel-Oil
- Hydro-Electric
- Nuclear
- Remote Substations

Industrial / Manufacturing
- Steel & Aluminum
- Pulp & Paper
- Food Oils & Ethanol

Offshore Industry
- Platforms & Rigs
- Marine Terminals
- Loading/Transfer Buoys

Transportation
- Ports & Harbors
- Marinas & Fuel Docks
- Shipyards
- Airports
- Railways
- Military

Environmental
- Stormwater Monitoring
- Inland Waterways
- Aquaculture & Fish Farms
- Sensitive Wildlife Habitats

Oil / Petrochemical
- Oil Refineries & Blending Plants
- Oil Production Facilities
- Pipelines, Storage, & Tank Farms

Water Quality
- Wastewater Treatment
- Desalination
- Intake Protection
Application Examples

Significant Application for Slick Sleuth: Industrial Facilities

- **Spill Alarm**
  - for Early Warning

- **Prevention & Early Containment of Spills,**
  - **--Prior to Discharge!**

- **Strengthen Regulatory Compliance**
  - &

- **Contingency Response Capabilities**
Application Examples

Autonomous Spill Detection Sensor Station (5 Stations Total)
photo courtesy of Shell Australia
Application Examples

Autonomous Spill Detection Sensor w/DC Power System
photo courtesy of Shell Australia
Application Examples

Spill Monitor Installed Over Separator / Discharge Control Point at Major Power Generation Facility

photo courtesy of Delta Electric Sydney, Australia
Application Examples

Autonomous Spill Detection Sensor Over Grated Sump
Remote Gas Compressor Station, West Virginia
Application Examples

Autonomous Spill Detection Sensor
w/ Actuator Valve Control & Real Time Alarm to Control Center
Application Examples

Automated Real Time Monitor, Alarm & Pump Shutoff

photo courtesy of Dominion Transmission, WV, USA
Application Examples

Autonomous Spill Detection Sensor
‘Peering’ Down Into Refinery’s Sewer
(photo courtesy of SK Oil, S. Korea)
Application Examples

Real Time Monitoring of Outfall Points at Production Facility in South America

photos courtesy of Occidental E & P
Amazon Jungle, Ecuador
Remote Networked System

- Remote Sensor Array

- Remote Networked System
  - Pager
  - PAGER
  - SLICK
  - SLEUTH
  - POWER SUBSYSTEM
    - SOLAR PANEL
    - CHARGE REGULATOR
    - BATTERY
  - TELEMETRY SUBSYSTEM
    - ANTENNA
    - RADIO TRANSMITTER
  - DETECTOR SUBSYSTEM
    - LIGHT SOURCE
    - OPTICAL PROCESSOR

- User Point of Contact
  - X8

- Optional Output to
  - Audio Alarm

- Optional Event Log
  - Printer

- Remote Sensor Array
Networked (Harbor) Sensor

Example

Prototype Installation ~ Spring 2005
San Diego Bay

Radio Telemetry
- Un-licensed Spread Spectrum

Self Contained Solar Power
- w/ Internal Rechargeable Batteries

Universal Mounting Bracket
- Install on any Existing Structure
  (mounted to pier face in this photo)

Optical Sensor
- 60 sec. Automated Sampling Interval
- 14° Conical Energy Beam
  Excites & Scans Target Surface
Remote Networked System

900MHz, 2.4 GHz, or 5.8 GHz
Bi-Directional Communications using Unlicensed Spread Spectrum Radios

Other telemetry methods include Cellular (e.g. GSM) or Satellite (e.g. Iridium)
Remote Networked System Display

Slick Sleuth™ Software Monitoring Screen:
Showing an Oil Spill Detection/Alarm Event (graphically pinpointed in red). The Inset Table Automatically Displays Detailed Real Time Information for Each Remote Station.
## Remote Networked System Display

<table>
<thead>
<tr>
<th>Station Number</th>
<th>Station Location</th>
<th>Position Lat/Long</th>
<th>Detection Status</th>
<th>Todays Date</th>
<th>Time of Sampling</th>
<th>Next Sched Sampling</th>
<th>Actual Reading</th>
<th>Factory Threshold</th>
<th>Baseline Setting</th>
<th>ComLink Status</th>
<th>Sensor Status</th>
<th>Flash Level</th>
<th>Power Status</th>
<th>Station Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coronado</td>
<td>117° 13' 10&quot; 32° 42' 46&quot;</td>
<td>ok</td>
<td>6-May-03</td>
<td>15:20:00</td>
<td>15:30:00</td>
<td>243</td>
<td>1,000</td>
<td>226</td>
<td>ok</td>
<td>ok</td>
<td>100%</td>
<td>ok</td>
<td>12.18v</td>
</tr>
<tr>
<td>2</td>
<td>Harbor Front</td>
<td>117° 10' 20&quot; 32° 43' 00&quot;</td>
<td>ok</td>
<td>6-May-03</td>
<td>15:20:02</td>
<td>15:30:02</td>
<td>360</td>
<td>1,000</td>
<td>334</td>
<td>ok</td>
<td>ok</td>
<td>100%</td>
<td>ok</td>
<td>13.19v</td>
</tr>
<tr>
<td>3</td>
<td>Pt Loma</td>
<td>117° 14' 25&quot; 32° 41' 44&quot;</td>
<td>DETECTION</td>
<td>6-May-03</td>
<td>15:20:04</td>
<td>15:30:04</td>
<td>15,662</td>
<td>1,000</td>
<td>228</td>
<td>ok</td>
<td>ok</td>
<td>100%</td>
<td>ok</td>
<td>12.90v</td>
</tr>
<tr>
<td>4</td>
<td>Imperial Beach</td>
<td>117° 07' 33&quot; 32° 36' 28&quot;</td>
<td>ok</td>
<td>6-May-03</td>
<td>15:20:06</td>
<td>15:30:06</td>
<td>408</td>
<td>1,000</td>
<td>403</td>
<td>ok</td>
<td>ok</td>
<td>100%</td>
<td>ok</td>
<td>13.15v</td>
</tr>
</tbody>
</table>

### Slick Sleuth™ Software Monitoring Grid:

The monitoring grid provides a snapshot of all monitoring stations in the network. By ‘pointing and clicking’ on any particular station, the user may instantly pull up emergency response information, as well as modify setup parameters, view station history (logged data), etc.
Application Examples

Integrated Monitoring Systems

For Example:

- Oil Spill Detection & Alarm
- Mooring Load Monitor
- Current Speed & Direction
- Directional Wave & Tide
- Wind Speed & Direction
- Air & Sea Temperature
- Video, and Many More

(...Pending Installation on SBM in Asia)
Application Examples

General Arrangement for Installation of Slick Sleuth Spill Detection Sensor(s) on Offshore Loading Buoys
(SBM CALM Buoy shown here)

(+/- 12 VDC Power Input. Contact Relay Output.)

Slick Sleuth Model SS 200.
1 - 4 per Buoy.
Height ~ 2.5m.

(...Pending Installation on SBM in Asia)
Application Idea!

Strategically Position Sensors in Accordance with Area Contingency Plan &/or Environmental Sensitivity Index.

Display / Monitor Using GIS

Proposed Application:
*Early Warning Protection for Sensitive Eel Grass Habitat, San Diego Bay*
Milestones

Succeeded in Proof of Concept, Development, & Commercialization
• System Now Proven and Widely Used!!

Extensive User Installations in a Wide Range of Field Applications
• Shell Oil, Occidental E&P, SK Oil, Dominion Transmission, GS CalTex, Chinese Petroleum Corp, Madison Gas & Electric, Entergy Power, Delta Electric, Buckeye Pipeline, Royal Australian Navy, etc...

Patent Pending
• Process Patent Filed Winter 2005

Certified to EPA Standards (EPA/530/UST-90/009)
• 3rd Party Certification In Compliance w/ EPA Standards & Guidelines

Testimonial ~ Success Story!!
• A Spill was Prevented at a Major Refinery when: “Slick Sleuth Signaled an Alarm at the Control Center [Major Refinery]… On-Duty Personnel Hurried to Location and Discovered Spill in Process, Stemming From a Saltwater Heat Exchangers… Immediate Action Was Taken to Contain Spill and Correct Problem… We Were Very Impressed!!”
What’s Next?

**Increased Awareness**
- Introduce New Technology to Regulators, Environmental NGOs, Industrial Facility Managers & HSE Managers
- Especially Domestic Awareness?!

**Expanded Range of Field Applications**
- Inclusion as Spill Alarm / Monitoring Component of SPCC
- Recognition as a BMP & Best Engineering Practice
- Expanded Use in Inland Waterways and Ports & Harbors
- Use as Remote Early Warning Defense Mechanism to Protect Sensitive Habitats (Pilot Program?)

**Continued Sensor Development**
- Increased Range, to Enable Use on Offshore Platforms
- Integration into Explosion-Proof Housing for Class 1 Div 1

- *Ideas & Comments from Regulators and End Users ??*
Utilization of Automated Oil Spill Detection Technology for Clean Water Compliance & Spill Discharge Prevention

Chris R. Chase
chrisc@interoceansystems.com
+1 858 565 8400