Chevron / OSPR
Oil Spill Response Technology Workshop

March 2nd, 2017 ~ San Ramon, California

Accidents *Need Not* Happen
Strategies for Early Warning
Spill Detection & Containment
Using UV-Fluorometry

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Slick Sleuth™

Oil Spill Sensor & Alarm

- **Real-Time Detection**
- **Reduced Risk**
- **Best Practice**
- **Ounce of Prevention**

…Pound of Cure!

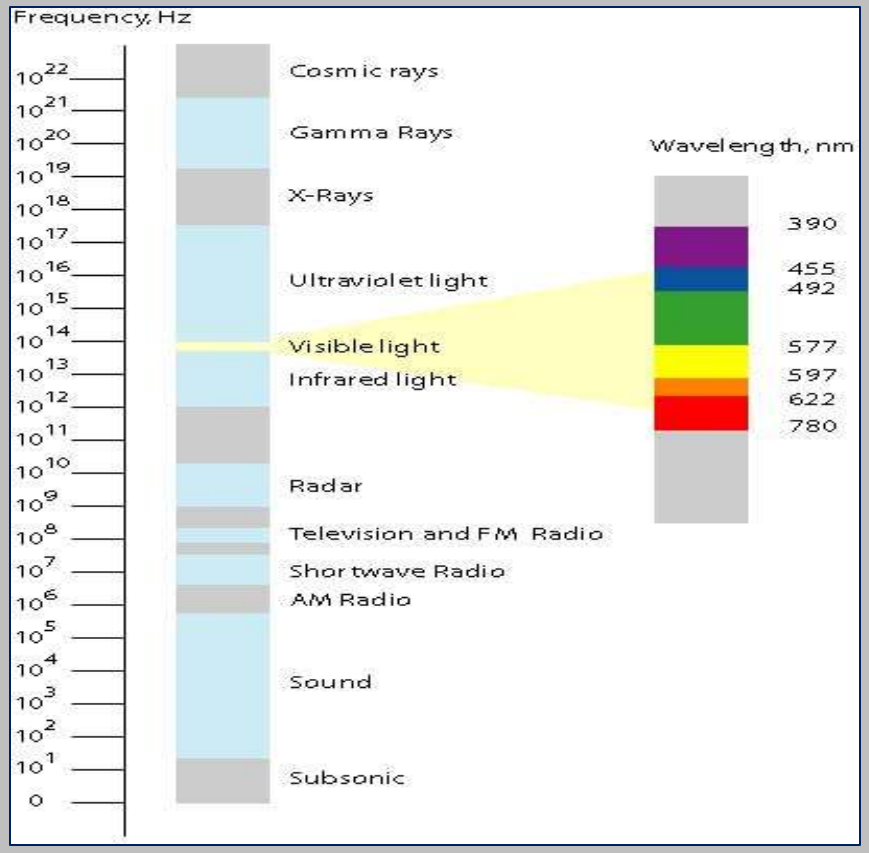
Remote Oil Spill Detection

- **Optical (Non-Contact) Oil Detection Sensor**
- **Early Detection = Early Response & Containment**
- **Detects Oil Sheens & Slicks on Water and on Ground**

SS300 / 320

SS100

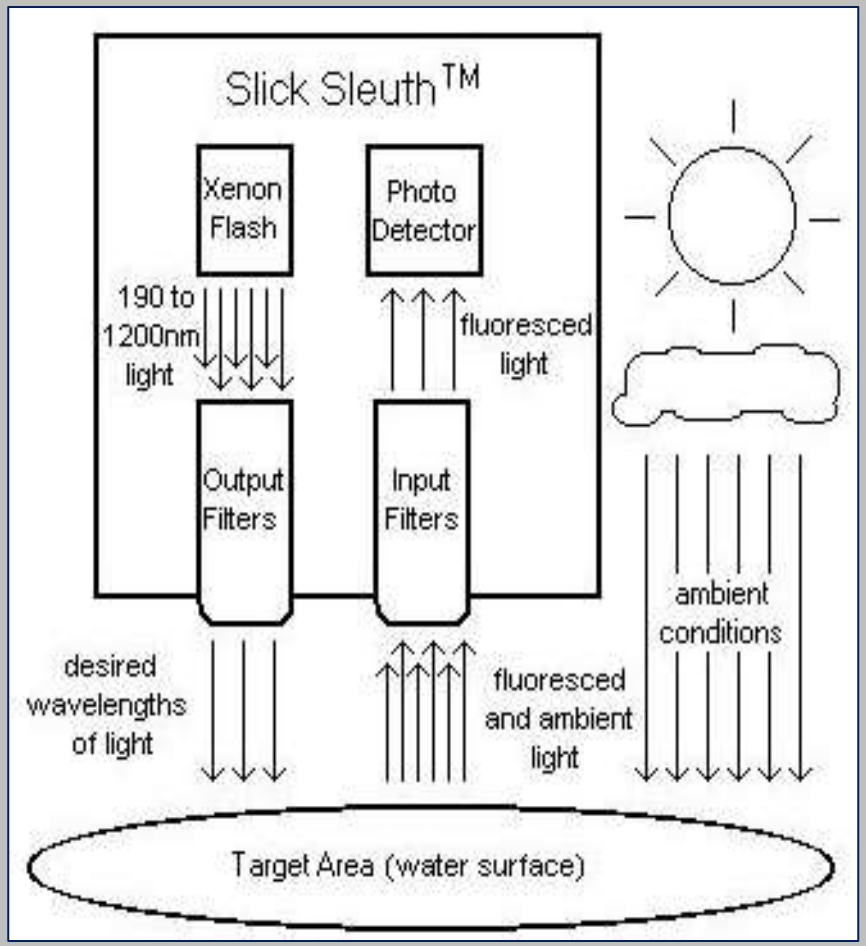
Theory of Operation



Remote Non-Contact Sheen Detection

Monitors for hydrocarbons using Ultraviolet (UV) source for excitation & detection of fluorescence

Oils typically absorb light between 300 - 400nm, then emit light in the longer 450 to 650nm range



- **Extremely Sensitive**
- **No Probe, No Fouling**
- **Immune to Ambient Conditions**

Key Drivers

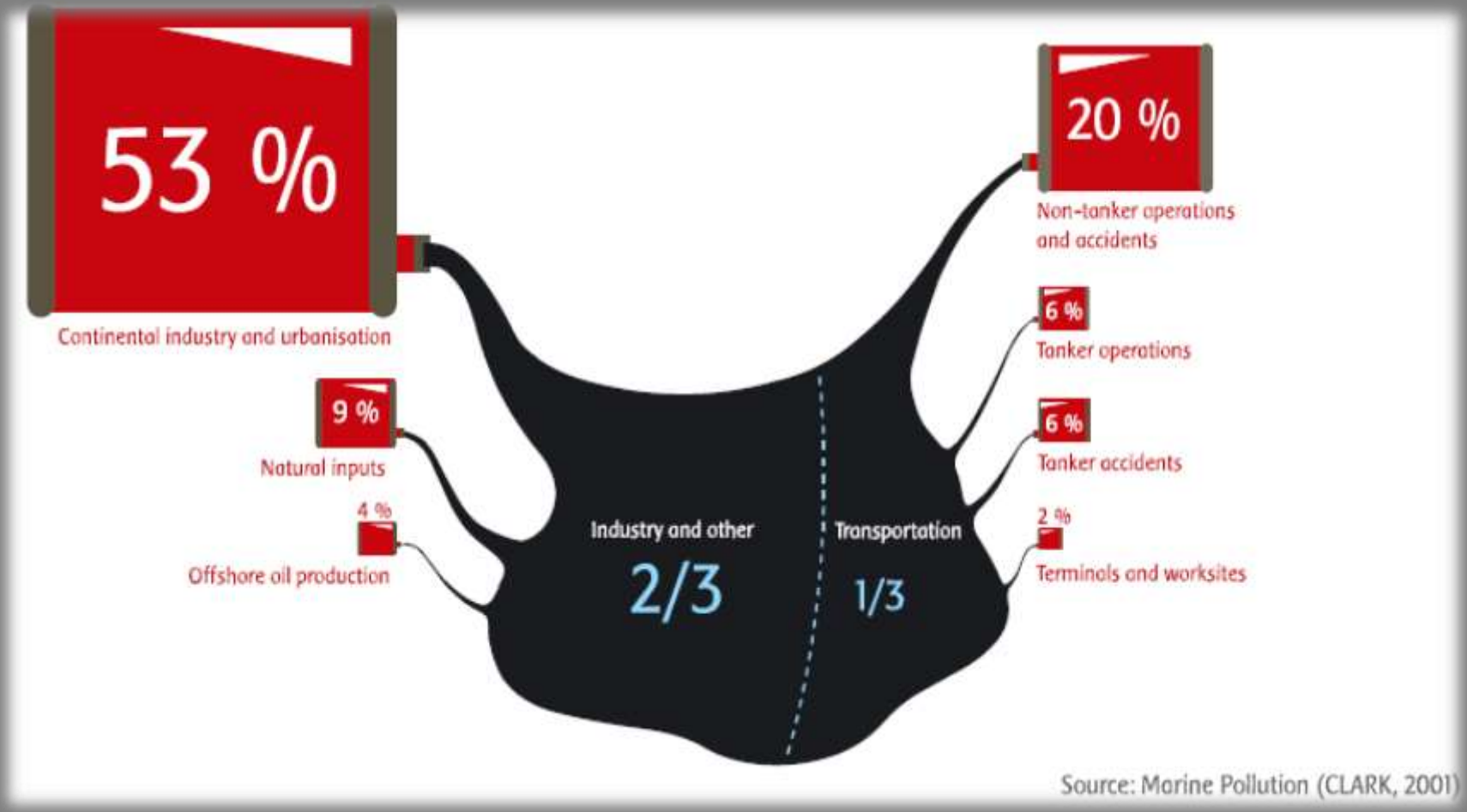
- **Reduced Risk = Cost Benefits**
- **Minimize Clean-Up & Inventory Loss**
- **Protect Corporate Image**
- **CSR & Environmental Stewardship**
- **Compliance w/ Pollution Regs & Best Practices**




In-Shore Spills Are A BIG Issue

Approximately:

- **12,000 – 15,000 Oil Spills are *Reported* Annually in USA***
- **Over 50% of *Reported* Spills Occur Inland***



** Texas Water Resources Institute*

Risk Assessment Strategy

Probability

Medium High Critical

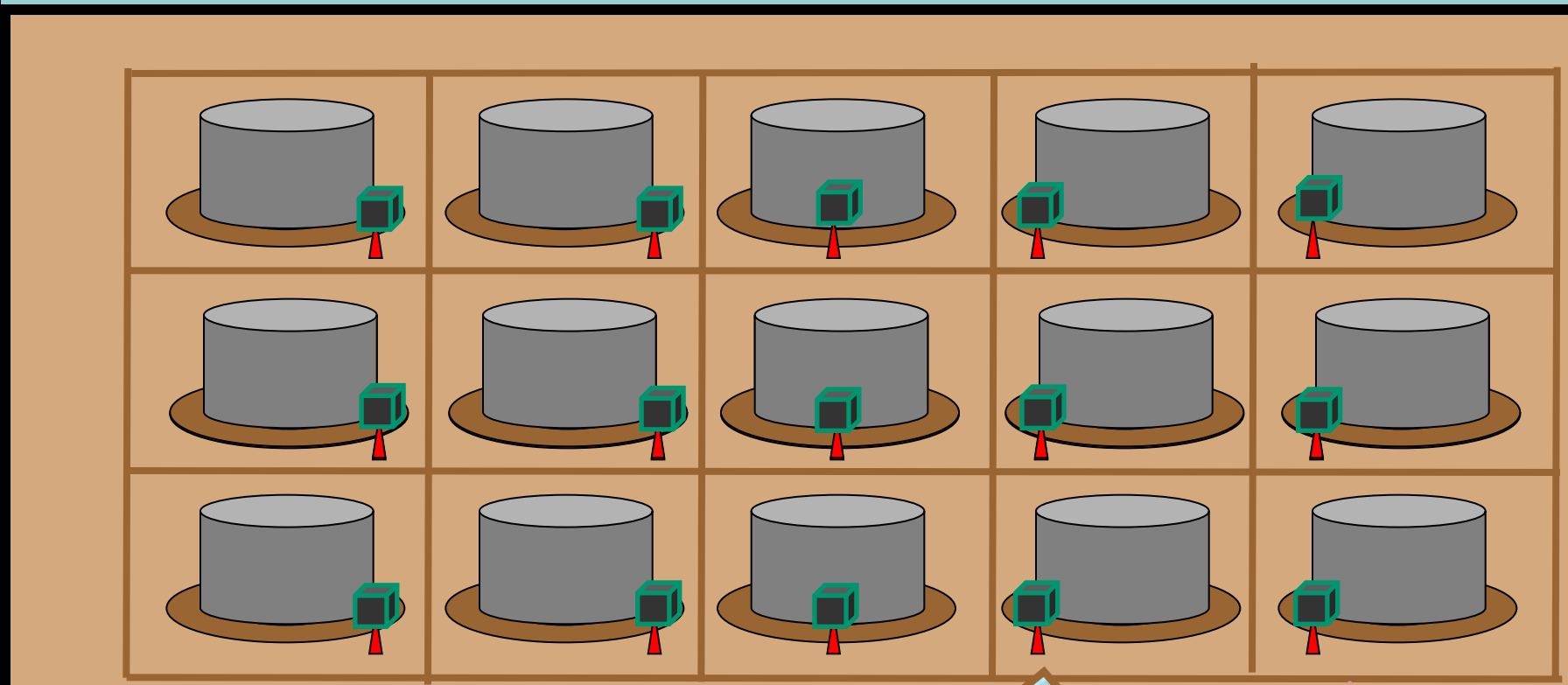
Low Medium High

Low Low Medium

Consequences

- **SPCC - Prevention & Response Plan**
- **API - Recommended Industry Practices**
- **"Heat Mapping"**
  - **Potential Sources of Oil Spills**
    (Tanks, Pipelines, Couplings, Processes, etc)
  - **Drainages, Outfalls, Control Points**
  - **Problem Areas i.e. Prior Spills/Releases ?**
  - **Environmental Sensitivity Indexes**
  - **Modeling**
  - ***Integrated* Risk Mitigation Plan**
    - **Prevention**
    - **Monitoring**
    - **Control**
    - **Containment**

Strategic Monitoring is Key



Tank Dike Alarms
(Model SS 100 x15)

Outfall/Failsafe Alarm
(Model SS300)

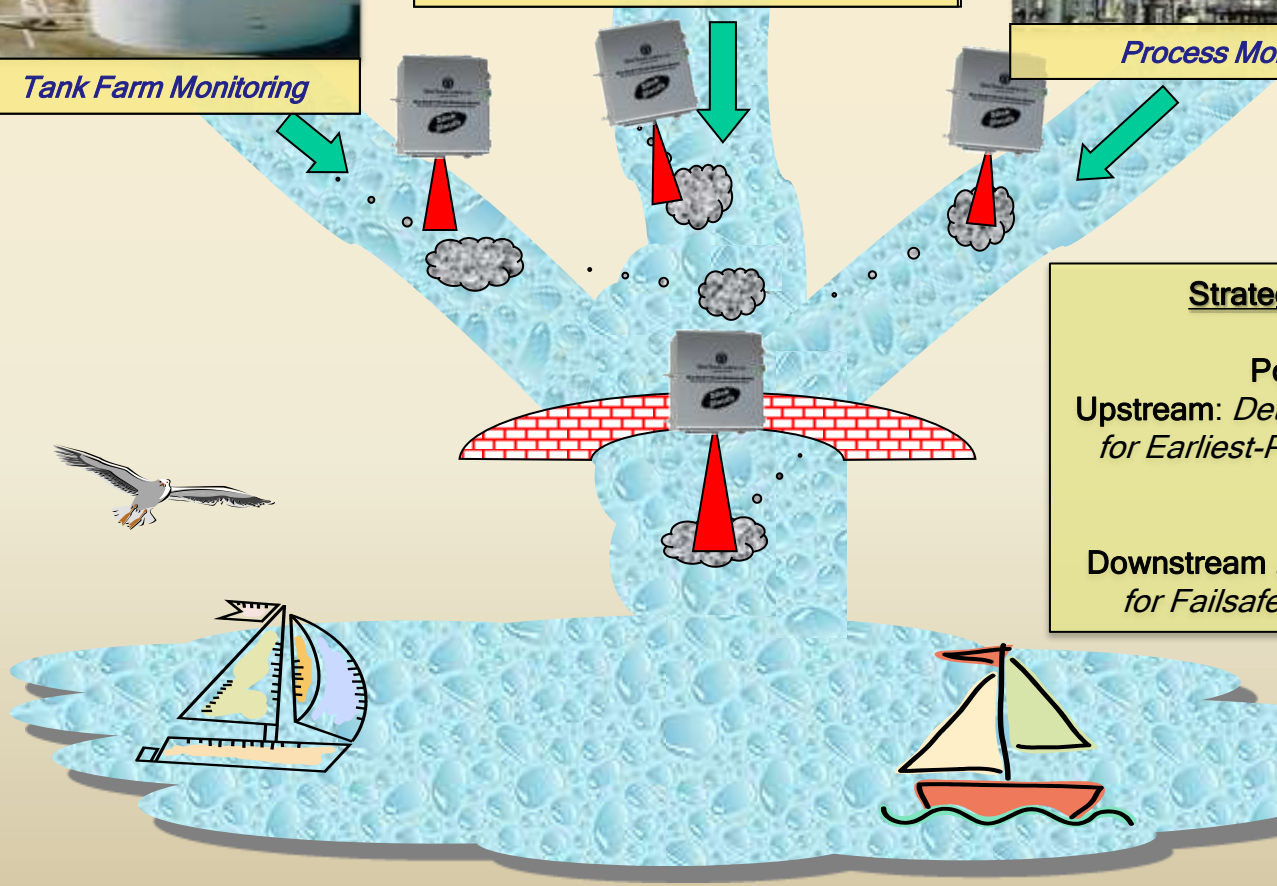
Drainage from
Tank Farm

Industrial 'Spillway' Safety Strategy

Tank Farm Monitoring

Heat Exchanger Monitoring

Process Monitoring

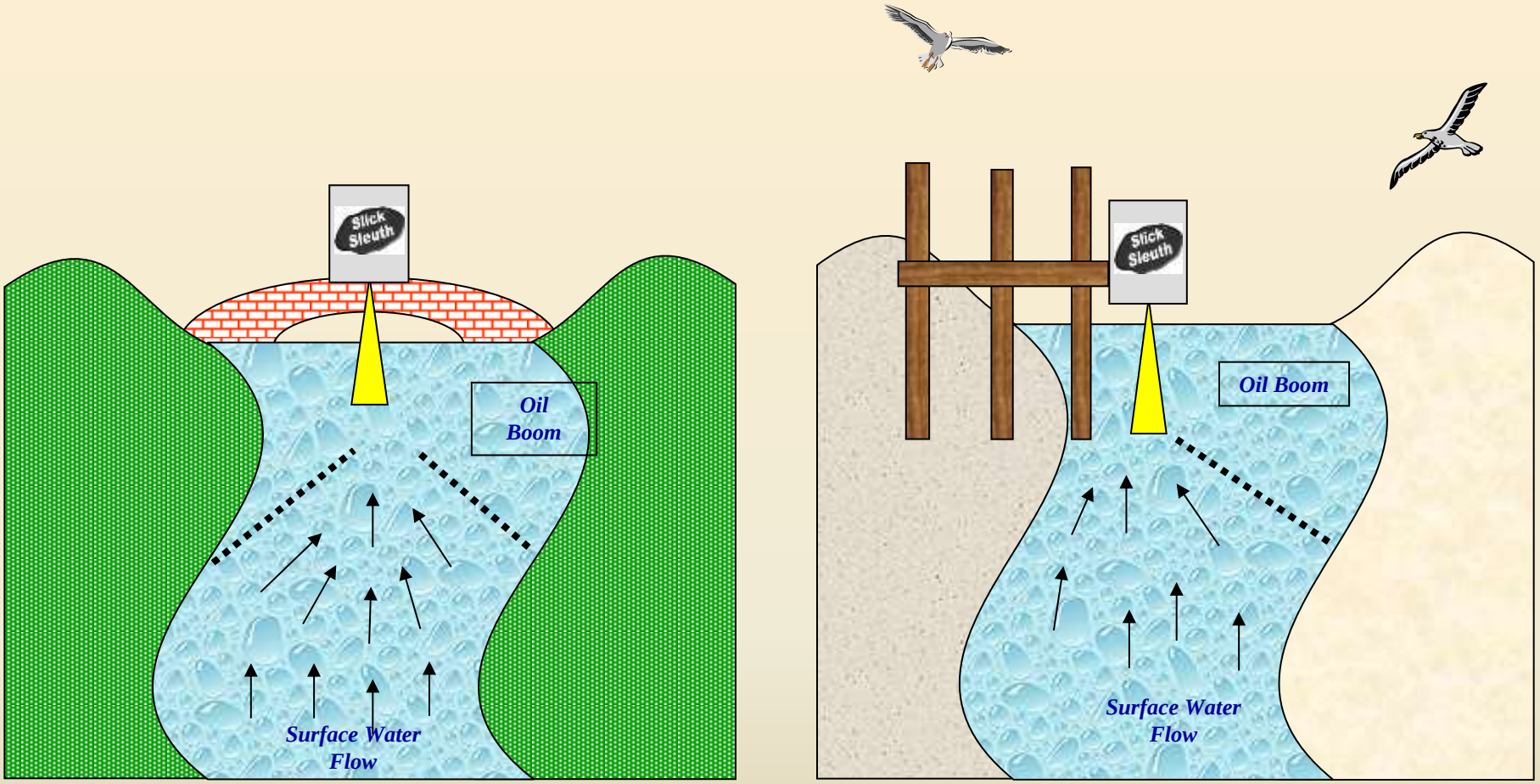


Strategic Deployment of Sensors

Point-Source Monitoring
Upstream: *Detection Near to Potential Source(s) for Earliest-Possible Detection & Containment*

Failsafe Monitoring
Downstream *Detection Near to Discharge Point for Failsafe Containment before Discharge*

Wide-Channel Monitoring Strategy



Example of Simple, Low-Cost, Surface Flow Control

A Useful Approach for Covering 'Wide Area' Applications with a Single Point Sensor

Wide-Area / Environmental Monitoring Strategy

Control Center

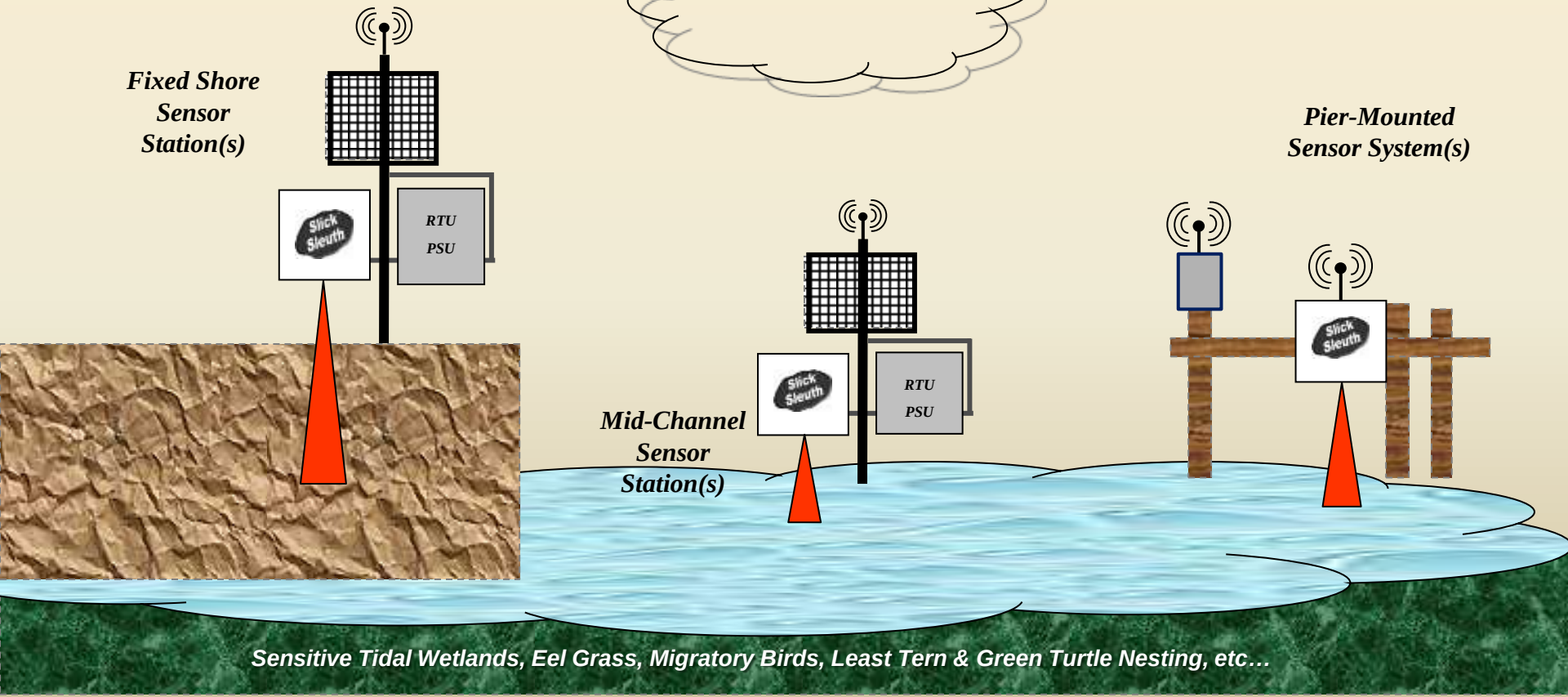
24/7 Alerts to any Web Enabled Device

Wireless Data

Fixed Shore Sensor Station(s)

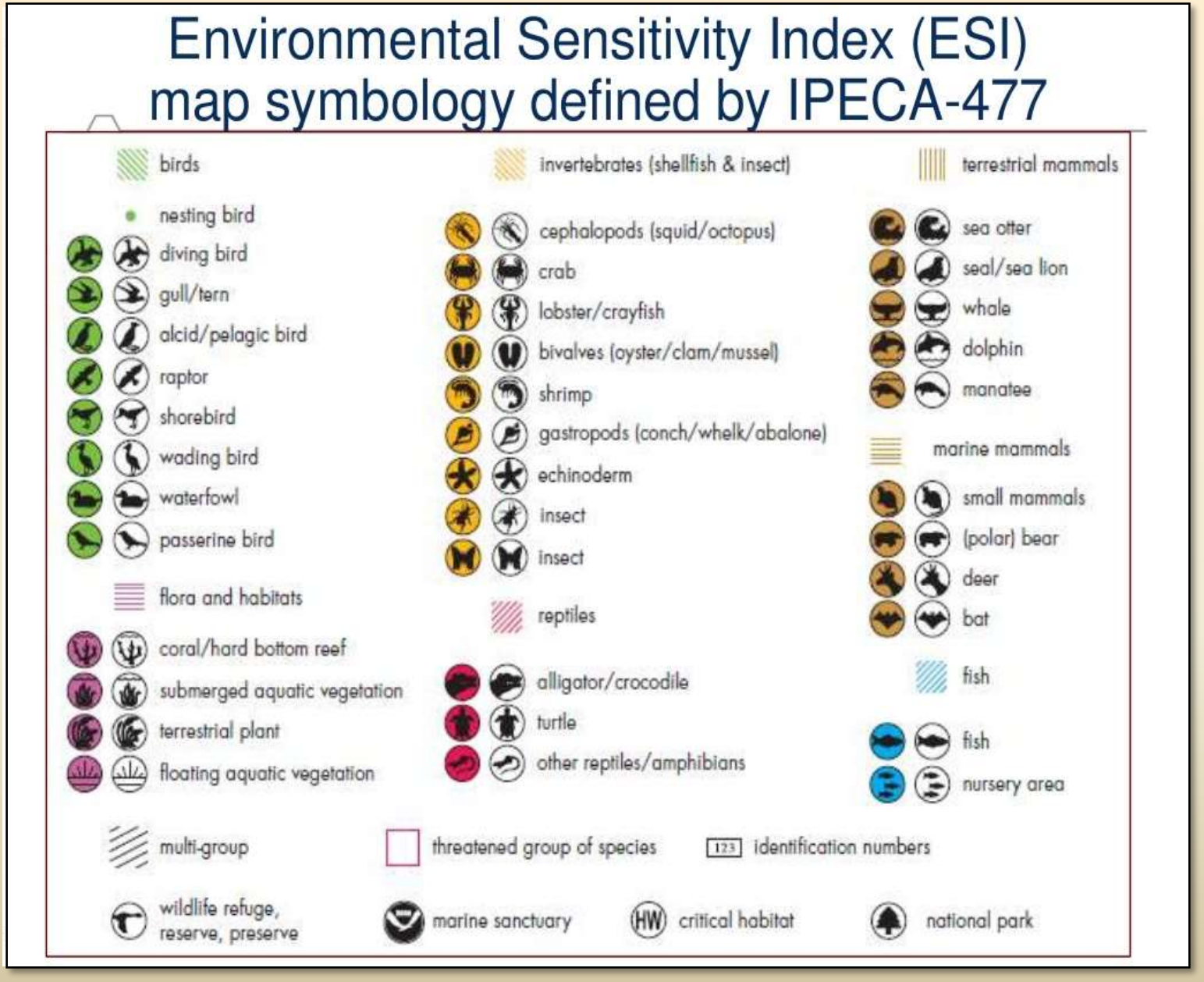
Pier-Mounted Sensor System(s)

Mid-Channel Sensor Station(s)



Sensitive Tidal Wetlands, Eel Grass, Migratory Birds, Least Tern & Green Turtle Nesting, etc…

ESI MAP STRATEGY



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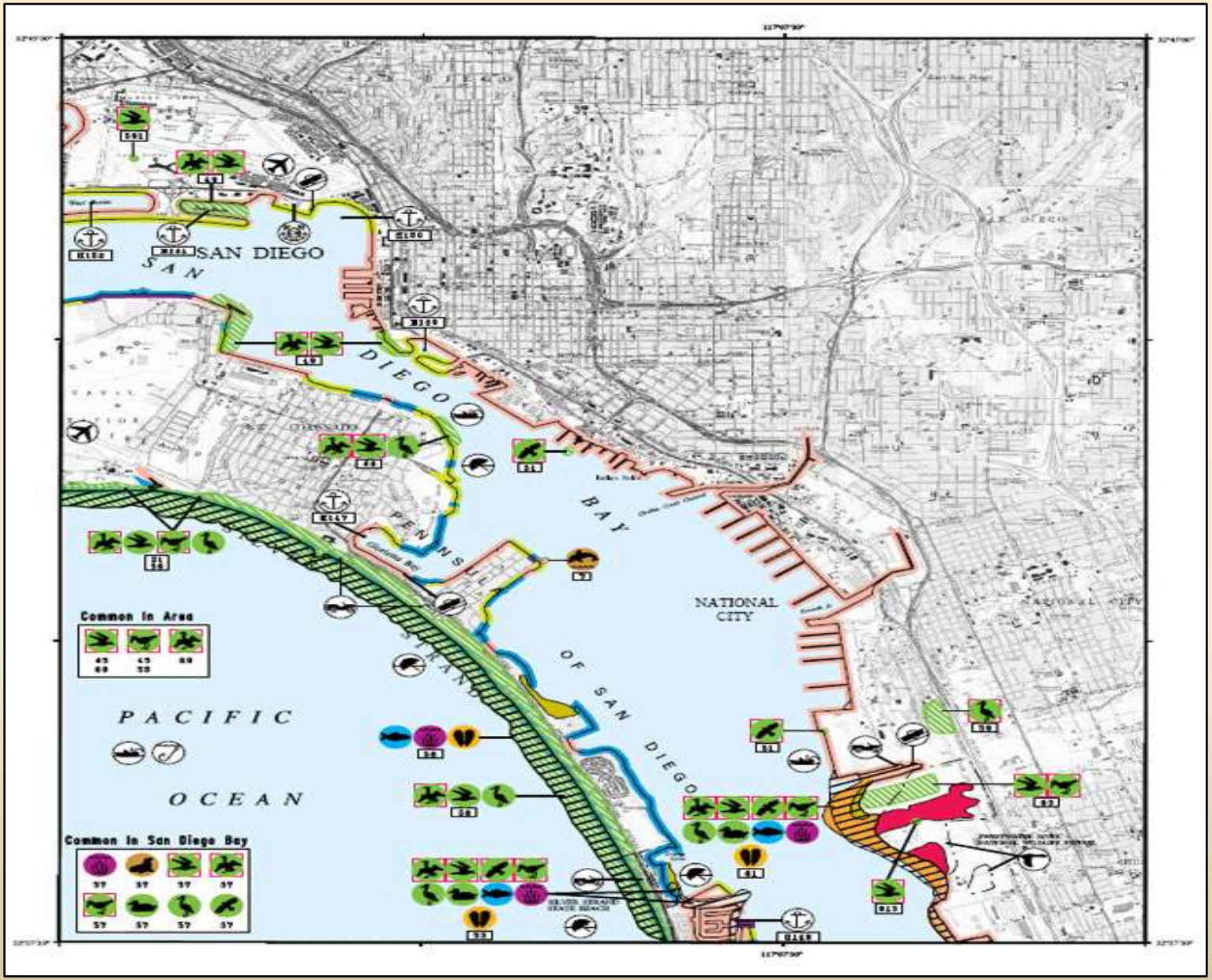


Wide Area Monitoring w/a System Array

Typical Monitoring Points @ Storage Terminal

Inside (Interstitial) & Under Tanks

Inside Tank Dikes & Secondary Containment

Floating Roof Drains / Valves

Outflows From Tank Dikes

Typical Monitoring Points @ Storage Terminal

Equipment & Mixing Pads

Sumps, Drainages, Outfalls

Oil/Water Separators

Install Examples @ Terminals / AST Facilities

photos courtesy National Grid

Monitoring for Leaks/Spills within Above Ground Storage Tank (AST) Facilities

Monitoring Points @ Terminal / AST Facility

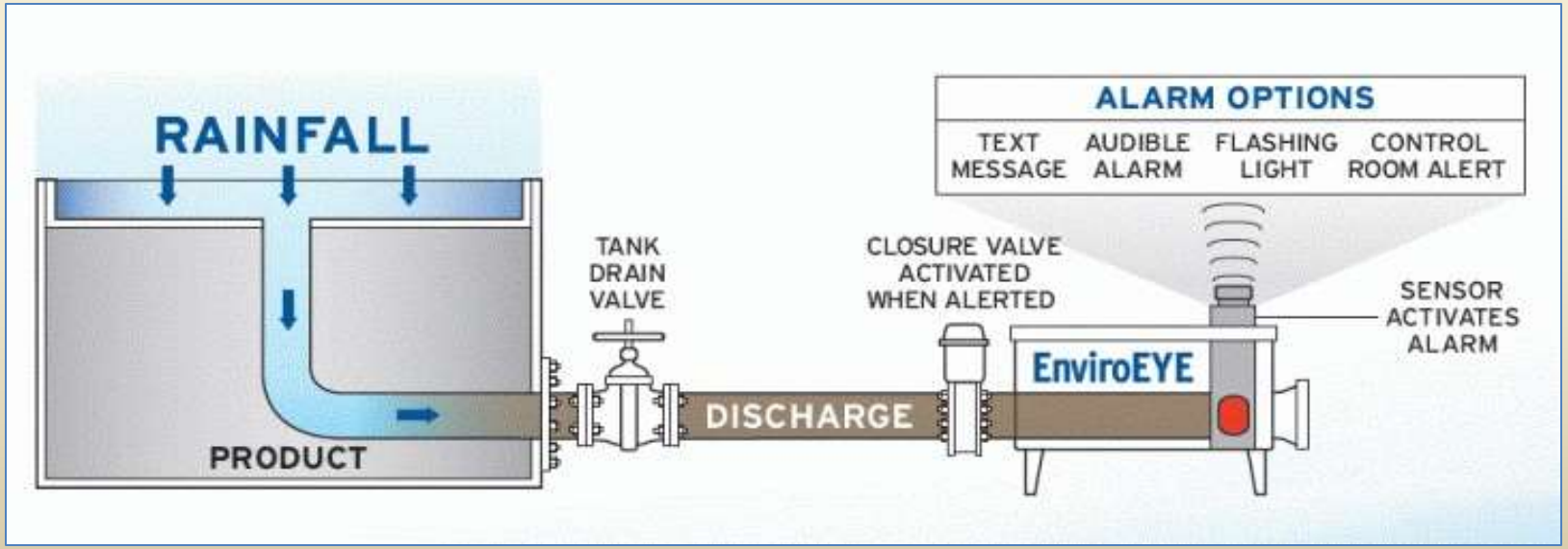
Monitoring for Leaks/Spill within Secondary Containment Above Ground Storage Tank (AST) Facility

photos courtesy
Magellan Pipeline

New System for Terminals / AST Facilities

EnviroEye System in Operation at Naval Air Station
(photos courtesy Pipeline & Terminals Management Corp - PTMC)

Flow Chamber & SS100 Sensor

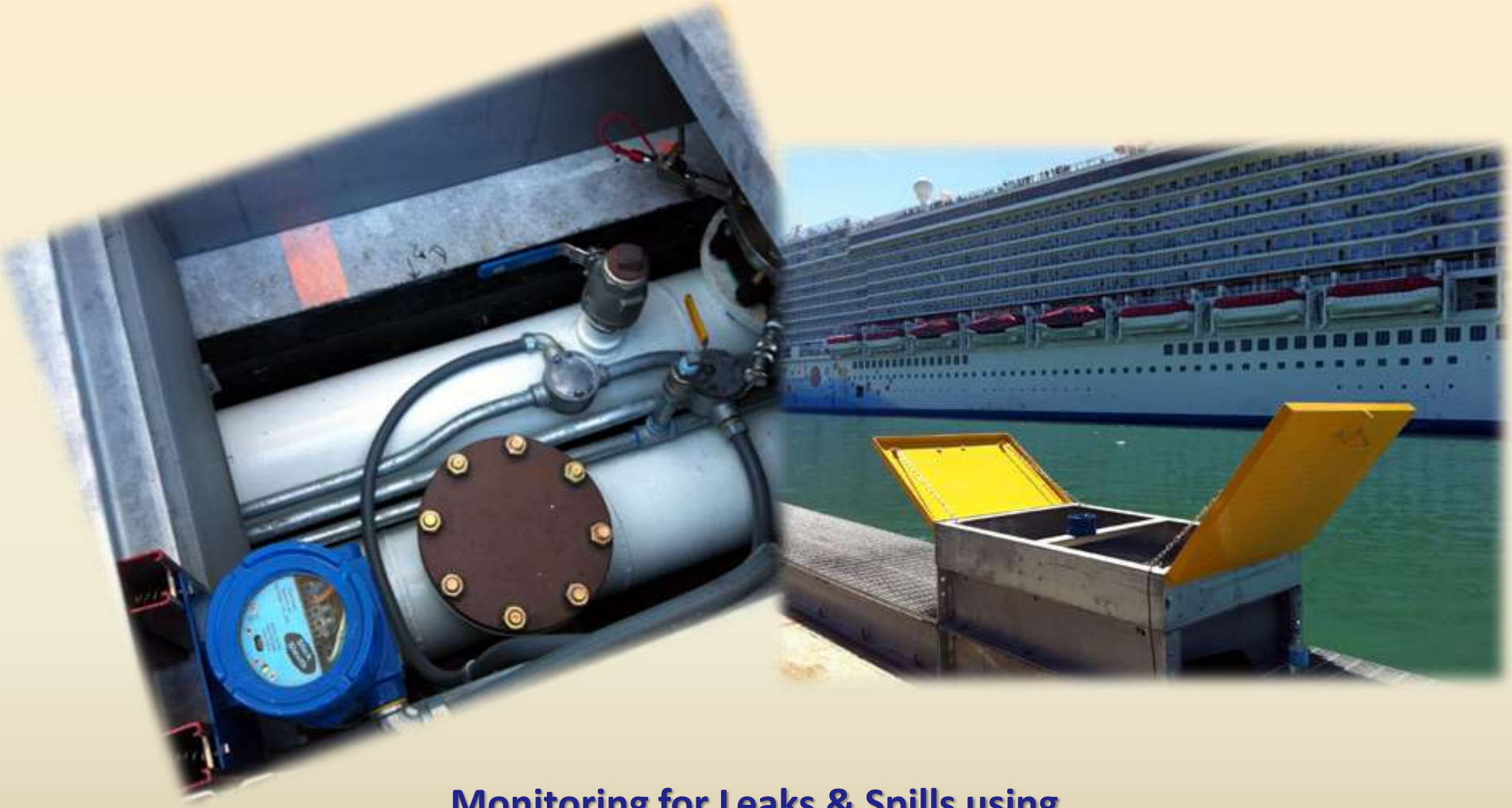


Monitoring System & Automated Containment for Floating-Roof Tanks

New System for Terminals / AST Facilities

Monitoring System & Automated Containment for Floating-Roof Tanks

Monitoring Secondary Containment of Pipes on Piers



Monitoring for Leaks & Spills using SS100s at major Cruise Ship Terminal

photos courtesy
Seaport Canaveral
Florida, USA

Automated Containment Example

Slick Sleuth Automated Detection & Containment (with Bay Saver)
Oliver Tambo Intl Airport
photos courtesy of ACSA

Automated Containment Example

Autonomous Spill Detection Sensor @ Electrical Substation
Detection Shuts-Off Pump & Sends Real-Time Alert to Control Center

photo courtesy
Cleco Power

Automated Containment Example

Autonomous Spill Detection Sensor
w/ Actuator Valve Control & Real Time Alert to Central Control

photo courtesy
Dominion

Discharge Monitoring ~ Refinery

Autonomous Spill & Leak Detection
Monitoring for Oily Discharge in Industrial Storm Water Sewer
(photo courtesy SK Energy)

Discharge Monitoring ~ Refinery

Detectors at Select Points within Marine Terminal

(photos courtesy SK Energy)

Discharge Monitoring ~ Refinery

Spill & Leak Detection Sensor ~ Discharge Monitoring at Refinery

photo courtesy Shell Oil

Discharge Monitoring ~ Power Plant

Spill Monitor & Alarm
Sump Application

(photo courtesy Pennsylvania Power & Light)

Spill Monitor & Alarm
Outflow Application

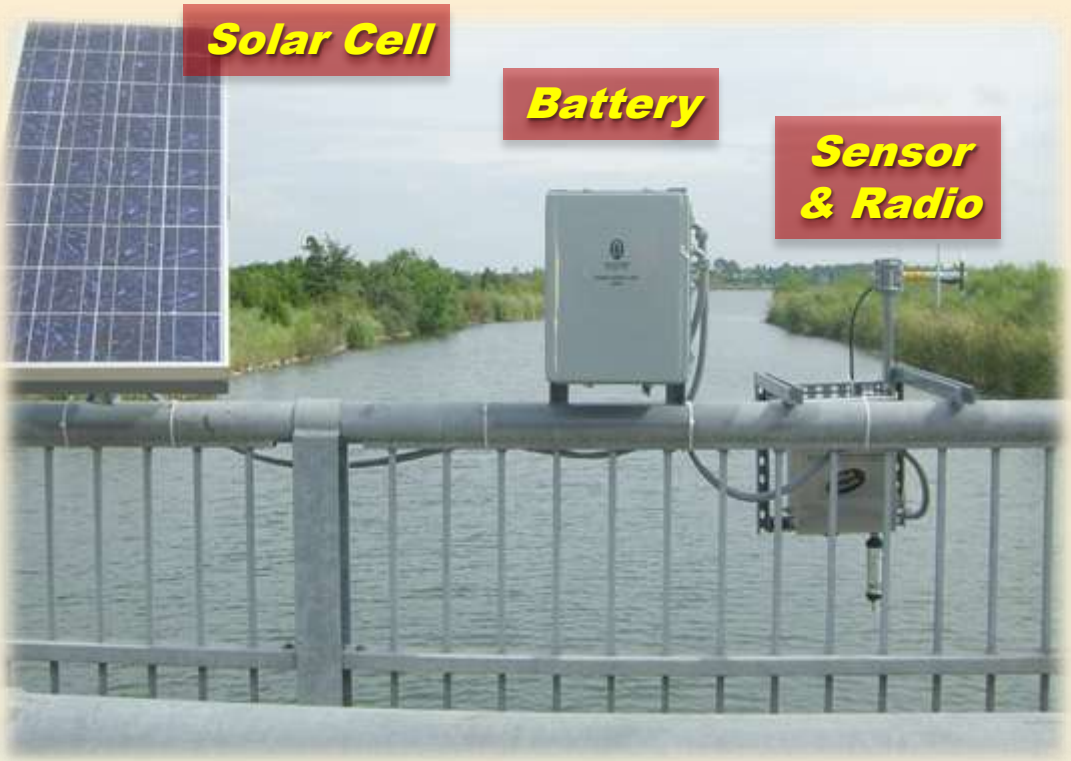
(photo courtesy Endesa)

Discharge Monitoring ~ Power Plant

Power Plant – Cooling Water Discharge / Outfall
(note positioning of fixed-containment boom below sensor)

photos courtesy ATCO

Discharge Monitoring ~ Power Plant



Real Time Monitoring on Waterway
River Receives Water Discharged from Plant
Immediately Upstream from Municipal Reservoir

photos courtesy of
Austin Energy

Discharge Monitoring ~ Municipality

Real Time Monitoring & Control
Municipal Lift (Pump) Stations
5-Unit System, Northwestern USA

photos courtesy
U.S. Army Corps of Engineers

Leak & Spill Monitoring ~ Navy Pier

Fuel Pier Installation
Sensor w/ GSM Wireless Alert

Leak, Spill, Overfill Protection

Royal Australian Navy
(RAN)

Leak & Spill Monitoring ~ Port Application

Autonomous Spill Monitoring Array
Commercial Port & Oil Terminal

(photo courtesy Port of Koper, Slovenia)

Leak & Spill Monitoring ~ Marine Terminal

Marine (Oil) Terminal Application

(photo courtesy of SK Energy)

Leak & Spill Monitoring ~ Marine Terminal

Loading Pier Application Example

Typical Mounting Platform for Harbor and Terminal Pier Applications

Leak & Spill Monitoring ~ Marine Terminal

Terminal Application - Real-Time Spill Monitoring System

(photo courtesy of Transpetro)

Leak & Spill Monitoring ~ Marine Terminal

Oil Spill Monitoring Center, China
Multiple Ports & Terminal Facilities Monitored in Real-Time by Government Approved 3rd Party

client prefers not to be identified

Leak & Spill Monitoring ~ Offshore Terminal

Installation on SBM Offshore Loading Buoy

6 Slick Sleuth Sensors on total of 3 buoys.
Solar Power, Radio Telemetry, & Base Station Command/Control

photo courtesy of Chinese Petroleum Corp. (CPC)

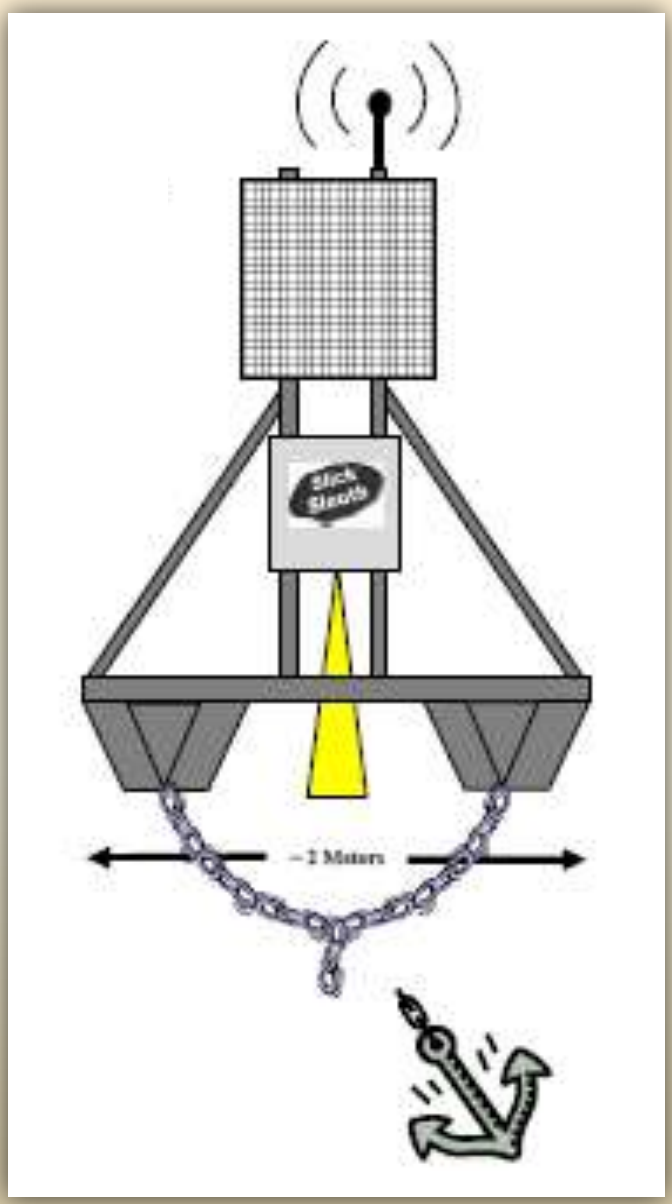
Leak & Spill Monitoring ~ Offshore Terminal

Installation on SBM Offshore Loading Buoy

Sensors Installed at 180° - 1ea at Hose Couplings and 1ea Opposite Side of Buoy

photo courtesy of Chinese Petroleum Corp. (CPC)

Spill Monitoring Buoy ~ Near-shore/Offshore Applications



"Slick Guard" Environmental Monitoring Platform for Offshore, Coastal, Ports & Harbor Applications

Spill Monitoring Buoy – DeSalination Plant

“Slick Guard” Environmental Monitoring Platform
for PROTECTION of Seawater Intakes @ Deasalination / IWP Plants

photo courtesy of Envitech / TAPCO

new… Rig Guard™

- **Detection of Crude, "Slops" & Diesel**
- **Real-time Protection for Manned & Un-Manned Platforms**
- **Available *as a* All-Inclusive *Service***

California ~ Tidal Wetlands

photo courtesy
Aera Energy
(now Oxy/CRC)

Real Time Remote Monitoring for Accidental Discharges at Wetlands Tidal Gate Control Point – Oil Production Site

California ~ Tidal Wetlands

photo courtesy
Aera Energy
(now Oxy/CRC)

Real Time Remote Monitoring
at Wetlands Tidal Gate – Oil Production Site

California ~ Tidal Wetlands

photo courtesy
Aera Energy
(now Oxy/CRC)

Example of Mounting Sensor on
Swinging Adjustable Deployment Arm

California ~ Tidal Wetlands

photo courtesy Aera Energy (now Oxy/CRC)

Real Time Remote Monitoring at Wetlands Tidal Gate – Oil Production Site

California ~ Tidal Wetlands

Real Time Remote Monitoring
at Wetlands Tidal Gate – Oil Production Site

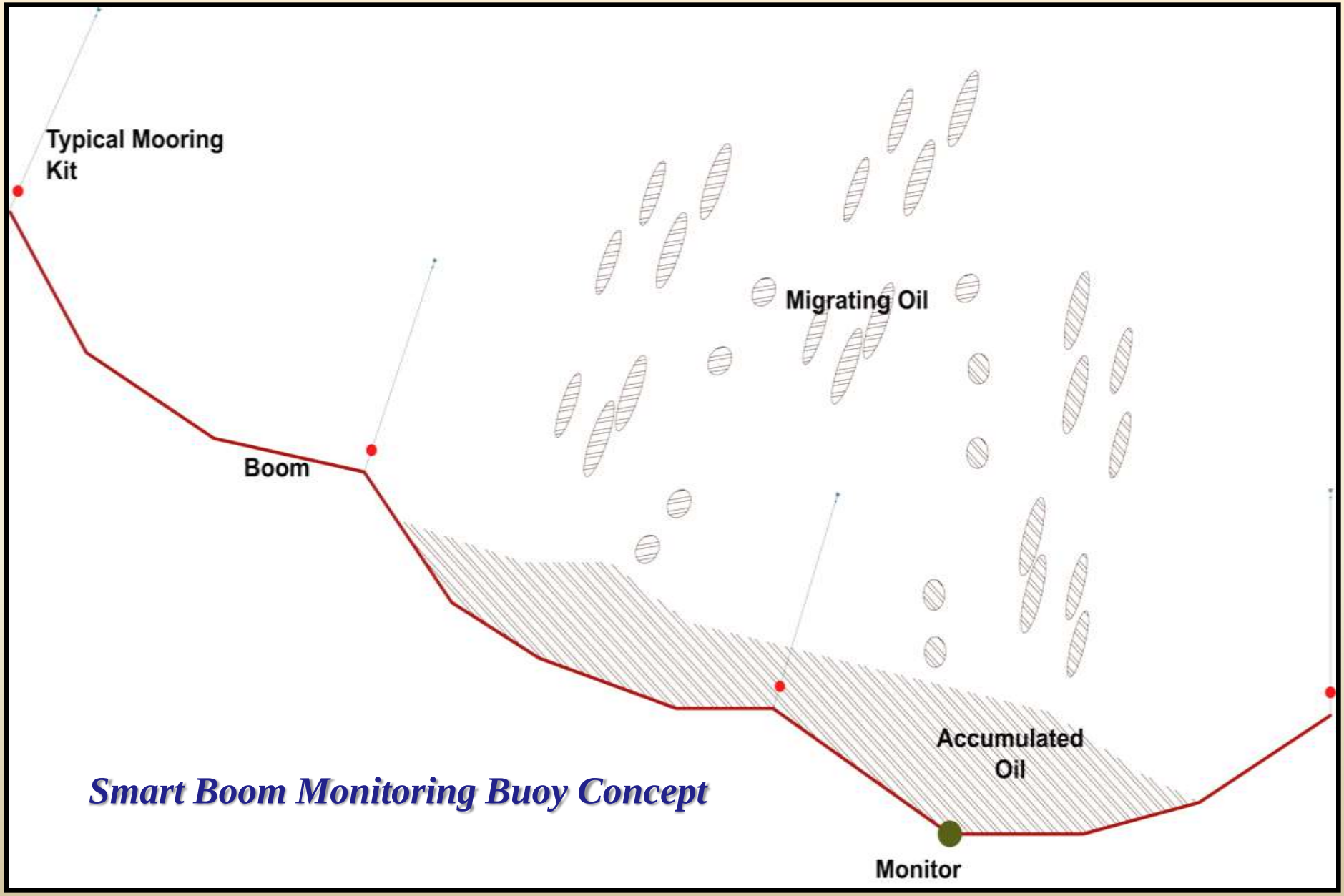
photo courtesy
Aera Energy
(now Oxy/CRC)

"Smart Boom" Monitoring System

GOOD BOOM..... ***BAD BOOM…..***

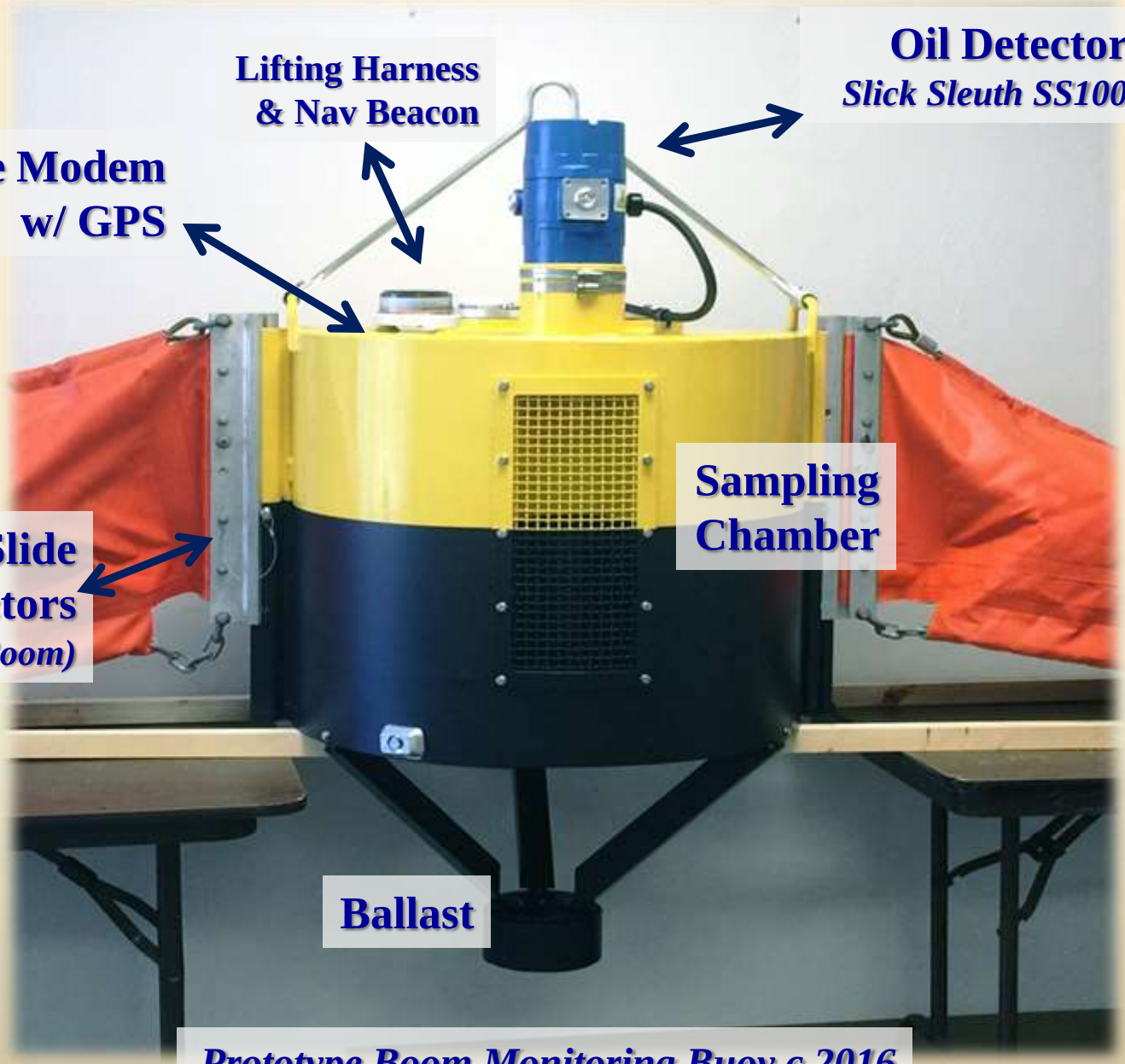
Nearly 800 miles of boom were deployed during the Macondo incident. Mixed results (like above) and industry demand prompted InterOcean and DESMI to initiate development of innovative new boom monitoring technology.

DESMI InterOcean Slick Sleuth™



Smart Boom Monitoring Buoy Concept

Boom Guard



Prototype Boom Monitoring Buoy c 2016

Boom Guard Testing at OHMSETT

Boom Guard Testing at OHMSETT

Questions?

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Slick Sleuth™