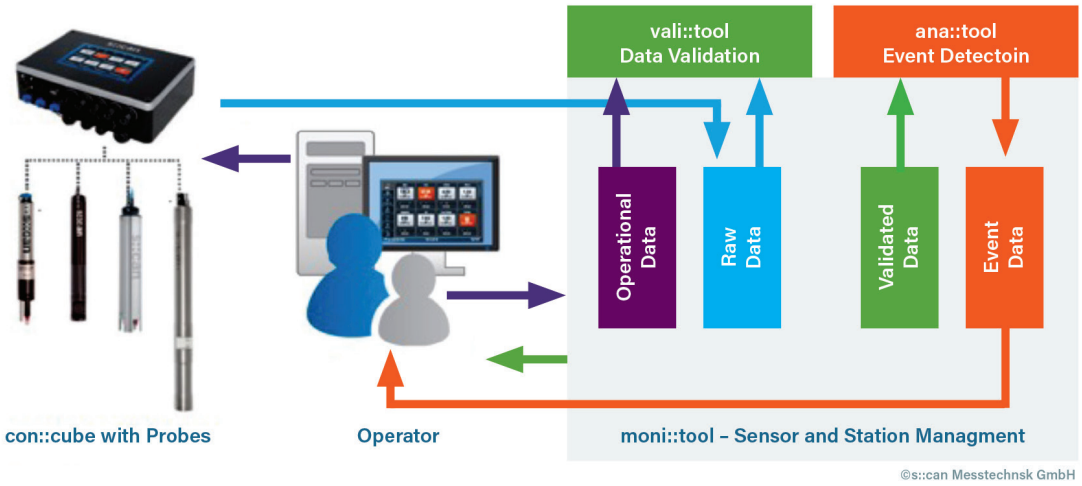
PROJECT ID:
584

Real-time Multi-contaminant Detection System (RMDS)



RMDS sensing system flow. (Diagram Credit: Autumn Resto)

OBJECTIVE

This project is developing an integrative approach that will enable near real-time monitoring of constituents of concern at shipyard drydocks.

PROBLEM STATEMENT

In order to achieve compliance with National Pollutant Discharge Elimination System (NPDES) limits, naval shipyards must monitor the levels of contaminants in drydock. Current infrastructure and monitoring equipment are either lacking or obsolete and represent a notable risk to continued operations. Current methods for metal sensing involve sending samples to laboratories with long turnaround times. The result is that violations are not known in time for immediate compliance. Department of Defense (DoD) environmental managers have voiced a need for a sensing system that can detect, in real-time (both with handheld and continuous applications), the exact constituents in effluent (discharge) water.

DESCRIPTION

In-depth research and alternatives analysis will be conducted to identify the sensing technologies that will meet the desired capabilities. This will be followed by sensor and data logging control array selection and development of the system plan and guidance. A test plan will be developed to assess sensor technologies for performance, including laboratory testing, simulated integration and testing in relevant and operational environments.

The project team will survey two main types of heavy metals sensing technologies. The first is a Nano-graphene based prototype sensor device. The conductivity (resistance) of the probe materials changes when bound to chemicals such as heavy metals, so the presence of these chemicals can be determined by measuring the sensor's resistance change. The second technology uses copper analyzers based on two types of methods: colorimetric (measure shifts in color to detect analyte) and carbon electrode stripping voltammetry.

The last method is used to detect quantity of specific ions species (as in those from different types of heavy metals) through the process of attracting ions through electroplating that species to an electrode in one step, and followed by the oxidizing of those ions from the electrode in a "stripping" step. This stripping step determines the quantity by measuring the current produced from oxidation. Various types of probes and sensing technologies for nutrients such as nitrogen species will also be surveyed.

Testing will be performed to determine which sensors will quickly, accurately, and consistently detect high levels of target constituents. Field and laboratory tests will include elements such as batch testing multiple effluent samples with varying types of pretreatment processes, and validating results with third party laboratory testing. In addition to a sensing technology, the team will also seek to integrate the technology with current infrastructure. To accomplish this, the team will work with the NESDI Sensor Interface & Instrumentation Monitoring (SIIM) Graphical User Interface (GUI) project team. The SIIM GUI technology provides the framework to interface with common Industrial Control Systems (ICS), and will provide the telemetry, GUI and data network for the sensing system this project will develop.

In terms of cybersecurity, the SIIM project is adopting a similar strategy as previous efforts of smart energy metering for installations, which will be integrated into the system to ensure network resilience, system availability, and data protection in compliance with the DoD's Risk Management Framework directive.

The sensor system designs should be completed and procurement largely completed in fiscal year (FY) 2021, with laboratory testing to begin the same fiscal year. This will be followed by relevant and operational field testing in FY22.

RETURN ON INVESTMENT

Current manual collection of samples is costly, time- and labor-intensive, and does not produce water quality data for two to three weeks. This burden of time relates to higher costs in repair, mitigation and regulatory fines. The use of a near real-time sampling system can greatly reduce if not eliminate these costs. Because this system has the potential to be installed at any established Navy installation, the associated return on investment could increase substantially.

NAVY BENEFITS

The ability for instantaneous copper and other metal sensing technologies that detects constituents down to 1-5 parts per billion (ppb) could have the potential to significantly reduce the risk of system damage or Notices of Violation (NOV).

The technology will be designed for customizability for different pollutants (as they vary by facility/location). Thus, it has the potential to be deployed at all permanent naval stations. The system will provide data logging for redundancy in case of unexpected network outages. This sensor could also assist with detecting illicit discharges where base subcontractors or tenants may be dumping chemicals and waste products at installations at undesignated locations, violating the installation's NPDES discharge permits. This project would significantly reduce the total ownership cost of related infrastructure at Navy installations.

TRANSITION DESCRIPTION

Stakeholders from Naval Facilities Engineering Command Southwest and Pearl Harbor Naval Shipyard & Intermediate Maintenance Facility (PHNSY & IMF) will be crucial to developing the final product. Upon successful completion of initial lab testing, the project team will build awareness of the project with both identified installation stakeholders and other potential DoD users. A technology transition plan will be developed to help streamline the transfer process. The team will also work with the NAVFAC Engineering and Expeditionary Warfare Center's acquisitions department personnel to prepare a general acquisition plan and package for the sensor array system.

The project team will work with naval shipyards, Public Works Officers and Environmental Program Directors to integrate the sensor array at DoD installations. A webinar will be developed, and final results disseminated via reports and symposiums with all identified stakeholders as well as state, federal and local municipal regulators. Follow-on work may include modifications of the array to encourage adoption at other DoD installations.

CONTACT

For more specific information about this project, contact the Principal Investigator at 805-982-3626.

ABOUT THE NESDI PROGRAM

The Navy Environmental Sustainability Development to Integration (NESDI) program is the Navy's environmental research and development, demonstration and validation (6.4) program, sponsored by the Chief of Naval Operations, Energy and Environmental Readiness Division (OPNAV N45) and managed by the Naval Facilities Engineering Systems Command (NAVFAC) out of the Engineering and Expeditionary Warfare Center (EXWC) in Port Hueneme, CA.

The mission of the program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes, materials, and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness and lethality. The program accomplishes this mission through the evaluation of cost-effective technologies, processes, materials and knowledge that enhance environmental readiness of naval shore activities and ensure they can be integrated into weapons system acquisition programs.

The program is the Navy's complement to the Department of Defense's Environmental Security Technology Certification Program which conducts demonstration and validation of technologies important to the tri-Services, U.S. Environmental Protection Agency and Department of Energy.

For more information, visit the NESDI program web site at www.navfac.navy.mil/nesdi or contact Ken Kaempffe, the NESDI Program Manager at 805-982-4893, DSN: 551-4893 or ken.kaempffe@navy.mil.