# Naval Sea Systems Command Launches Game Changing Technology for Fuel Conservation

## GENISYS Software has the Potential to Enhance Warfighting Capability

**A NEW SOFTWARE** platform, created from existing technologies, is poised to provide the Navy's first truly complete picture of how energy is being used by ships and ultimately, how it can be conserved.

Every day, U.S. Navy ships consume approximately 80,000 barrels of oil worldwide as they train and perform their missions. Depending on the type of ship and the mission profile, conventionally-powered ships are often refueled every four to five days at sea.

The day-to-day decisions of operational commanders, as well as highly variable environmental and mission factors, can have a large impact on this energy consumption. As an example, a ship that is maintaining position within a specific latitude and longitude range offshore for ballistic missile defense purposes during calm seas may be able to safely secure engines and use drift operations at certain times to save fuel. However, a ship doing the same mission with high sea states, storms and strong currents typically cannot use drift operations, and will use much more fuel to stay in position.

To better understand how these many factors influence fuel use and draw applicable conclusions, it became apparent that disparate pieces of data would have to be combined from multiple systems. This would require an unprecedented level of cooperation among various commands. The Naval Systems Engineering Directorate, Technology Office at the Naval Sea Systems Command (NAVSEA 05T) with help from CDI Inc. leveraged existing technology from United States Fleet Forces (USFF) and Commander, U.S. Pacific Fleet (COMPACFLT) to create the Global Energy Information System (GENISYS). Built upon several existing technologies, GENISYS is designed to establish a clear link between fuel use data and mission/environmental data.

The Arleigh Burke-class guided-missile destroyer USS Truxtun (DDG 103) conducts a replenishment-at-sea. Truxtun successfully participated in a GENISYS eLogBook trial in December 2015.

*MCS2 Tony D. Curtis*

GENISYS will be utilized at the earliest stages of energy conservation—the design of more energy-efficient ships.

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## The Evolution of GENISYS

GENISYS effectively links three existing technologies to help provide a clear picture of the factors that affect fuel consumption.

### *1. The Integrated Condition Assessment System*

The Integrated Condition Assessment System (ICAS) was created to improve maintenance and increase operational efficiency onboard Navy ships. Approximately 16 years ago, engineers at Naval Surface Warfare Center Philadelphia Division (NSWC PD) installed sensors on shipboard engines and equipment on select ships. These sensors transmit real-time data to NSWC PD, and is used to address performance and maintenance needs and to identify potential class-wide problems.

In 2009, NAVSEA realized that they could tap into the ICAS signal to provide direct feedback to the ship regarding how fuel and electrical energy was being used onboard in real time. "We could track the fuel being burned to navigate the ship as well as how much fuel was being burned to make or create energy by various ship components—the Heating Ventilation and Air Conditioning (HVAC) system for example," said Michael Essig, Maritime Energy Manager at NAVSEA.

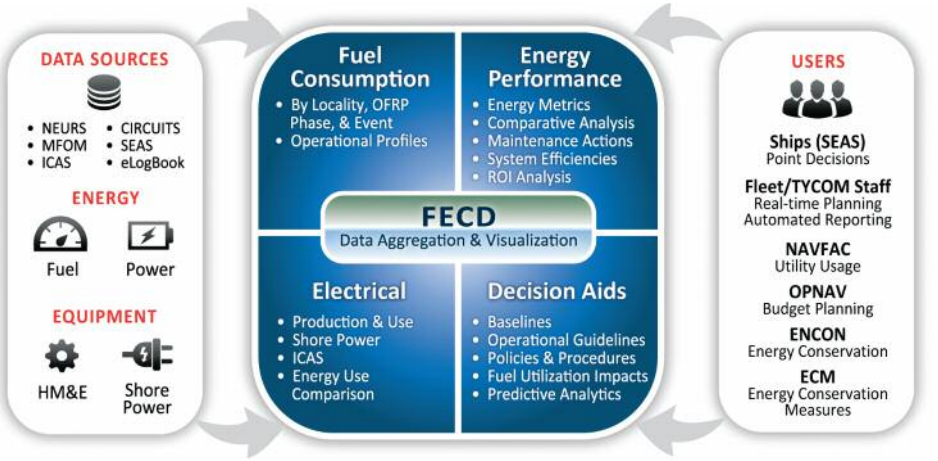
Using the information gathered by ICAS, the Shipboard Energy Dashboard was created in 2010. This system provides the Sailor with real-time situational awareness of the energy generation and demand associated with equipment lineups and efficiencies. Since 2012, NAVSEA installed Shipboard Energy Dashboards onboard 18 ships.

### *2. The Energy Figure of Merit*

Under a separate effort, USFF was looking for a way to better train and evaluate ship's crews regarding the effects that a ship's environment (waves, wind, currents, etc.) and mission requirements had on fuel and energy efficiency—for example, how to differentiate the efficiencies of two ships performing different missions in different environmental conditions. USFF developed a new formula known as the Energy Figure of Merit, which helped ships analyze the impacts of environmental elements, mission requirements and maintenance. The formula informed the ship of how energy was truly being used onboard while taking into account all the other external variables.

### *3. The Fleet Energy Conservation Dashboard*

Meanwhile, COMPACFLT was trying to better analyze shore energy use and ways to decrease the Navy's carbon footprint. Newly-hired energy managers monitored and studied how shore power and energy were being used to create the Fleet Energy Conservation Dashboard (FECD). This web-based graphical interface provides an on-line view of energy information and enables users to identify trends and problem areas. Once deployed, FECD will be used to identify and cut energy costs for homeport ships. In-service engineering agents supporting the Fleet




FECD is a web-based graphical user interface that provides an online view of energy information, enabling users to make informed decisions. The user has the ability to drill down and roll up cost and energy data by date, time, fleet, ship type, class, flight, homeport, system, equipment type, equipment, as well as other criteria.

will use the FECD to evaluate and compare performance of various systems and equipment.

## Achieving A Real-time Energy Picture

As the NAVSEA team studied the potential for combining these systems, the first problem they encountered was the fact that none of these systems was able to communicate with each other.

However, before integrating each part, some changes had to be made to the planned "backbone" of the system—the Shipboard Energy Dashboard. The dashboard, as it existed, allowed some capability for users to input a limited number of mission codes. However, these codes were insufficient for capturing the myriad real-life scenarios that encompass a mission activity.

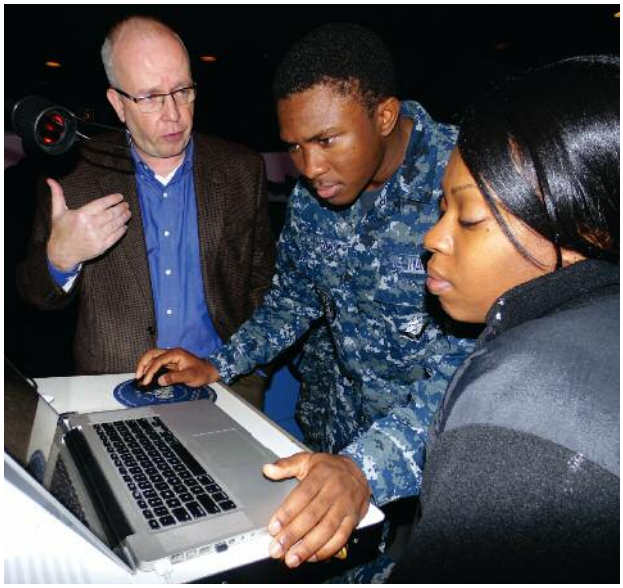
The GENISYS team realized that achieving an accurate real-time energy picture would mean inputting data from the ship's log.

## eLogBook

A ship's log is a daily chronology of a ship's location, movements, and selected other data. Information has always been entered into these logs by hand. In order to capture the data needed to create GENISYS, without creating more work for Sailors, the best solution was to digitize these logs at the point of collection.

Created in 2014 with the assistance of Beacon Interactive Systems, eLogBook is an electronic tool that allows Sailors to enter information into a database instead of writing it out by hand. To save time and improve accuracy, this software platform includes templates pre-populated with some generic data. eLogBook also digitizes and integrates various shipboard operational data logs, so that everyone onboard ship has instant access to real-time data on mission parameters, operations, combat systems, and daily fuel, oil, and water usage.

The eLogBook tool has the additional advantage of eliminating the problems associated with the archiving of physical log books.



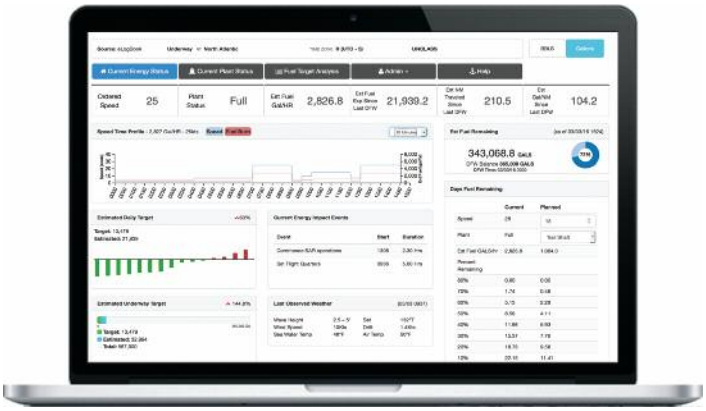
Jim Haley, Director of Energy & Maintenance Analytics at Beacon Interactive Solutions instructs crew of USS TRUXTUN during the GENISYS eLogBook trial in December 2015.

Quartermaster 3rd Class Brandon Shannon writes an entry into the ship's deck log during a quartermaster watch.
*MCS3 Betsy Knapper*


The eLogBook mobile tablet.

## Energy from Alternative Sources

**IN KEEPING WITH** the energy goals set by Secretary of the Navy Ray Mabus, the Department of Navy is seeking to lessen its dependence on fossil fuel and to provide 50 percent of overall energy from alternative sources by 2020.



The SEAS dashboard display.

## Putting it All Together

To merge the eLogbook with shipboard sensor data (provided by ICAS), the Shipboard Energy Dashboard was redesigned into an agile yet cyber-secure interface that manages shipboard energy and provides recommendations for actions to improve energy efficiency—the Shipboard Energy Assessment System (SEAS). Finally, all captured data will be sent electronically to the shore-based FECD (now new and improved by Frontier Technologies Inc.), where it is aggregated into a centralized data warehouse and analyzed to support various stakeholder needs. The overarching system encompassing SEAS, eLogbook, and FECD was formed and named GENISYS.

The numerous advantages GENISYS provides to the Navy cannot be understated. In addition to providing direct feedback and real-time recommendations to a ship's Commanding Officer so that he/she can make adjustments to improve efficiency, range, time-on-station and operational flexibility, GENISYS also creates a one-stop shop housed in the FECD. This resource allows users, via protected web access both ashore and at-sea, to view a variety of metrics, statistics and planning applications in real time, in a searchable, easy-to-access format.

"If I have a condition," says Essig, "and I have a desired outcome, then [with GENISYS] I can fill in the blank." This ability to program simulations using actual operational performance data will also add value to Navy training. The training environment allows for "what if" scenarios predicting energy outcomes of changes in equipment and speed using a library of real operational data. This potentially shortens the length of trainings, eliminates excess waste, and educates the warfighting force more effectively.

## The Future of GENISYS

NAVSEA will test the GENISYS software onboard eight Great Green Fleet ships toward the end of 2016. The goal is to monitor how the Great Green Fleet is operating, and confirm that the GENISYS models work as expected. Following the conclusion of the Great Green Fleet test, GENISYS will be rolled out for use Fleet-wide with enterprise Remote Monitoring (eRM) which is the follow-on equipment sensor and monitoring system that will replace ICAS. GENISYS will be added to the existing system onboard USS Arleigh Burke (DDG 51)-class destroyers in 2019. Navy cruisers and other classes will follow.

In addition to the energy gains that GENISYS could provide, the system also exemplifies an innovative Navy in action. Instead of creating a system from scratch, the GENISYS team focused on integrating systems already in use, and uses traditional Navy log-keeping in a modern way.

Down the road, GENISYS's creators envision that the system will be utilized at the earliest stages of energy conservation—the design of more energy-efficient ships. Essig sums up the future of GENISYS when he says, "Being able to have the real-time data captured by GENISYS and compare it to other ships within the Navy allows the Navy to build an accurate, Navy-wide assessment of how operations are done and determine ways to improve them. The Navy has collected operational and engineering data for ages. With powerful processors and agile data management we can finally put all that data together to create a true picture of energy use. We believe that that picture will tell us a lot."

Michael Essig
Naval Sea Systems Command
202-781-3171
DSN: 326-3171
michael.w.essig1@navy.mil