integrated fuel bunkering verification scada system

Product Description Document

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Management Brief

The Situation

Marine fuel costs represent well above the 60% of a ship's operating cost. With increasing oil prices and conservation efforts, careful fuel management and increased engine efficiency have become vital for environmental and financial reasons. Fuel flow measurement with Coriolis technology provides the foundation for increased fuel efficiency and accurate accounting of fuel purchases. Even a medium-sized 30,000 DWT vessel can consume 20 tons of fuel oil per day, which at today's prices is greater than USD6,000. This white paper describes how ACMECo Coriolis meters can decrease the cost and waste associated with the fuel supply chain, from on-shore blending and barge loading to ship bunkering and fuel efficiency optimization.

The challenge

Bunkering is the process of supplying fuels to ships for their own use. The process is highly regulated by the Port Authorities. Quantity measurement is integral and primary part of the bunkering process. Field statistics prove that there is a steady trend of discrepancy between quantities reflected in the bunker delivery documents and the actual. In view of fuel cost contributing well above the 60% of a ship's operating cost, ship management is highly focused in this subject, constantly seeking opportunities for process improvement. Even a medium-sized 30,000 DWT vessel can consume 20 tons of fuel oil per day, which at today's prices is greater than USD6,000.

The technology enablers

The evolving technology in measurement and sensing, the increasing reliability and long lasting free of service life of the equipment, as well as the new era of information dissemination and presentation capabilities, are definitely offering the opportunity to make a big leap forward in the bunkering information quality challenge. Fuel flow measurement with Coriolis technology provides the foundation for accurate accounting of fuel purchases.

How To

"FBV-Relay" is an integrated fuel bunkering supervisory control and data acquisition[1] system, designed to offer a complete solution to the above mentioned issue. It is a product which is capturing the fuel quantity and quality data, fitted just on the custody transfer point, at the manifold of the vessel. The field installed "black-box" data are transmitter wirelessly to a "cloud-based[2]" data repository with perpetual retention period archive. A cloud-based reporting tool is allowing controlled access to data, anytime, anywhere, on a need-to-know basis. Reports for single bunkering or multiple over a time period, along with data analytics are available to eligible users of the system; typically ship management headquarters officers and/or nominated staff members.

[1] SCADA

[2] Cloud based computing is the next stage in the Internet's evolution, providing the means through which everything from computing power to computing infrastructure, applications, and business processes can be delivered to end recipient as a service wherever and whenever is needed.
The "cloud" in cloud computing can be defined as the set of hardware, networks, storage, services, and interfaces that combine to deliver aspects of computing as a service. Cloud services include the delivery of software, infrastructure, and storage over the Internet (either as separate components or a complete platform) based on user demand.
Cloud computing has four essential characteristics: elasticity and the ability to scale, self service provisioning, automatic deprovisioning, and application programming interfaces (APIs) enabling automated information retrieval (e.g. export data to corporate ERP systems). This flexibility is what is attracting businesses to move to the cloud.

What is the present document

This document describes how Martechnic Ltd. “FBV-Relay” system, based on a high grade Coriolis metering device, can decrease the cost associated with fuel bunkering. The “FBV-Relay” product design and features are presented in detail.

Introduction

This document describes how Martechnic Ltd. “FBV-Relay” system, based on a high grade Coriolis metering device, can decrease the cost associated with fuel bunkering.

Although some fuel oil suppliers have advanced laser level gauges, multiple sample points, and highly accurate look-up tables, a Coriolis mass measurement completely avoids the problems inherent in volumetric tank measurement. Coriolis meters deliver the mass total without all the measurement conversions. In addition, because the mass of air is negligible, ship owners do not pay for air that has intentionally or unintentionally injected into the fuel. Coriolis mass flow technology is the optimal solution for HFO bunkering, where customer billing is based on mass.

However, metering HFO is not an easy application for flow measurement technologies, even those with direct mass capability. Flow meters must be able to handle the thick, viscous bunker grades used, along with any impurities that have not been filtered out, and varying amounts of gas in the oil. This makes for a very challenging application, not to mention other environmental influences such as vibration and the need for low pressure drop. Therefore, to achieve the expected accuracy and efficiency, only high grade Coriolis mass flow meters should be used in marine conditions.

The “FBV Relay” product is based on a high quality Coriolis mass flowmeter; it’s design and features are presented in detail in the pages to follow.

Part I : Product Features

The product is comprised from a base unit containing the measurement device itself, and a number of options.

FBV-Relay Base Unit

1. **Measures** fuel oil delivered during bunkering process in terms of MDT, i.e.:
    a. **Mass**
    b. **Density**
    c. **Temperature**
2. Measuring equipment is **installed** at the manifold of the vessel.
3. Equipment is by design a "**black-box**" device, not allowing any external intervention.
4. **Autonomy** is maximized by embedded battery support, capable to sustain a typical bunkering process duration (actually exceeding 24 hours).
5. **Report** measured data as:
    a. Batch totals (i.e. throughout the overall bunkering process)
    b. Detailed time series of MDT measurements

FBV-Relay Options

1. **Extended reporting** with:
    a. Exceptions report, unveiling deviations from acceptable fuel quality
    b. Activate alarm in case of severe or sustained continuous deviations
2. **Relay** bunkering data directly **to ship management** H/Q via **GPRS**; no local visibility on-ship.
    a. Data visualization and reports extraction via a cloud-based application offered in SaaS scheme**.**
    b. Automated data forwarding via Web Services API (both Client and Server web services option available)
3. Bunkering data **local upload** (encrypted and password protected) via **USB** connectivity.

Part II: Product High-Level Overview

FBV-Relay architectural design

"FBV-Relay" is an integrated fuel bunkering volume supervisory control and data acquisition system, designed to offer a complete solution to ship management needs.

As it is depicted in the schematic diagram of Figure 1[3] following below, FBV-Relay is a closed-box device with its power supply (240 or 24 VAC) being the only functional requirement.

This equipment is fitted on the custody transfer point, at the manifold of the vessel. Bolted fuel supply flanges, in either side, may have an outside diameter which will vary from approx. 220 to 780mm (defined upon order). The device is intended to fit in fuel supply pipe with ID 6", 8" or 10".

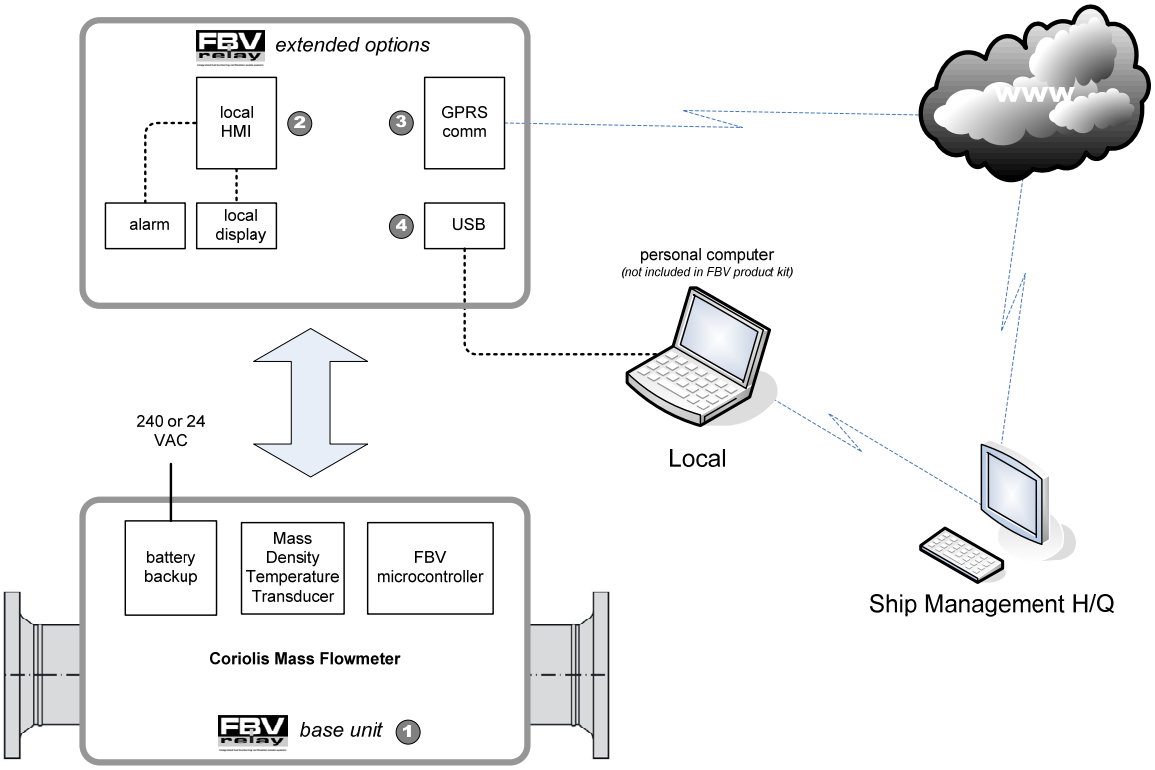

Figure 1

The device is capturing the fuel mass, density and temperature. Upon bunkering process completion, depending on the product options, they are either send to a remote destination, or made available locally via a USB connection.

In the first case, they are transmitter wirelessly by GPRS[4] to a "cloud-based" data repository with perpetual retention period archive. GPRS connectivity is considered an acceptable

[3] Schematic diagram not in scale
[4] Worldwide roaming data-only contract, at very low annual cost

low-cost solution in view of cellular phone network connection availability on almost all ports worldwide (where fuel bunkering may take place).

In the later case, or whenever no GPRS connection is available, then it is possible to export the data via a USB connection, to an encrypted, password protected package file. This file may be loaded via a web-based application onto the cloud-based repository, or send directly to the ship management H/Q.

A cloud-based reporting tool is allowing controlled access to data, anytime, anywhere, on a need-to-know basis. Reports for single bunkering or multiple over a time period, along with data analytics are available to eligible users of the system, i.e. typically ship management headquarters officers and/or nominated staff members.

Upon availability of the bunkering samples analysis results, it will be possible to store those data in the cloud-based repository. In turn, the cloud-based reporting tool will be able to report also the bunkering mass, beyond the originally measured volume.

When the local HMI[5] option is installed, then the system is displaying in real-time the fuel supply quantity and quality information, as well as triggers and shows alarms activated in case of severe or sustained continuous deviations from customer settings on fuel quality thresholds.

[5] HMI = Human-Machine Interface, is a small console (display & keyboard) which presents process data to the operator, and through which the operator controls the process or is configuring the device.

The big picture of an integrated SCADA system

Scaling the previous "FBV-Relay" unit description, across a large fleet where similar systems are installed, we may establish a geographically dispersed SCADA system, where all ships' massive outgoing data streams will be forwarded and stored in the cloud-based data repository, with practically perpetual retention duration.

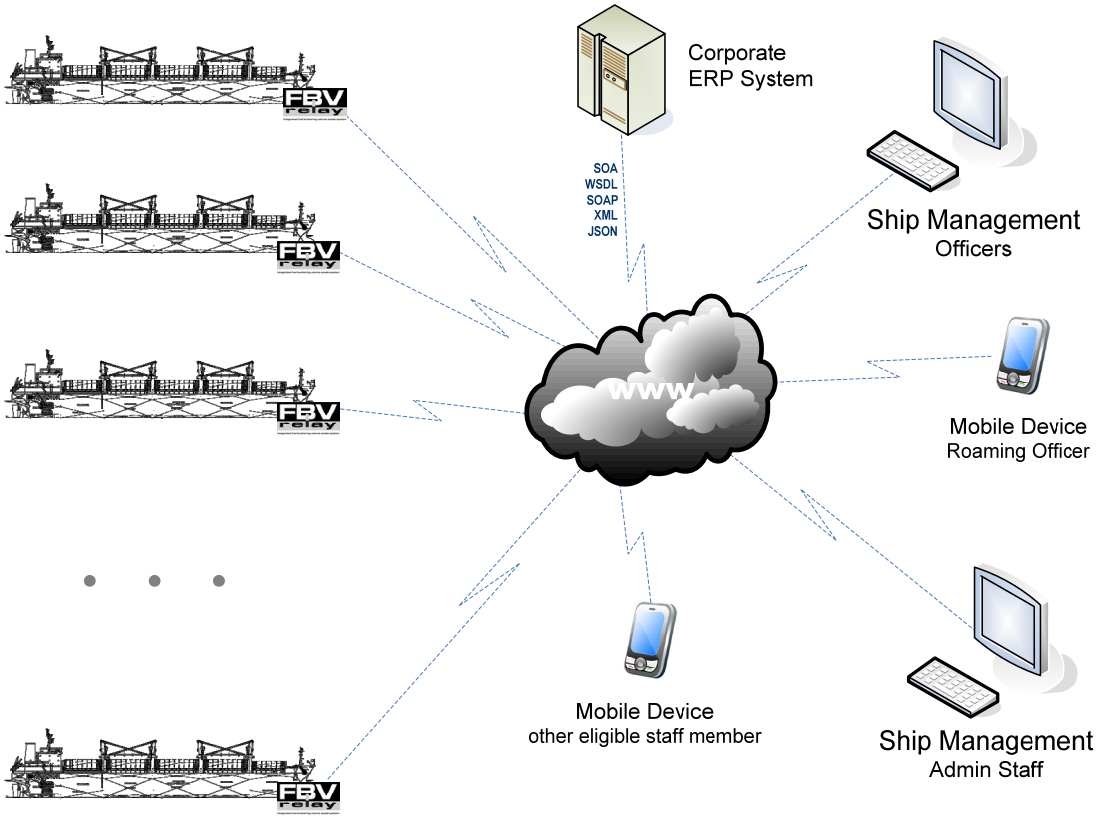

Figure 2

The offshore ship management headquarters and/or roaming officers, as it is diagrammatically shown in Figure 2, will be able to get ad-hoc, anytime, anywhere, information on fuel bunkering fleet activities.

The information provisioning schemes are virtually unlimited. Given the cloud-based system processing power and database scheme design, it will be possible to provide instantly either low level (micro) information, or high-level aggregate data (macro), such as:

- Information provided on a single vessel basis, for a particular bunkering event, or over a time period.
- Group of vessels consolidated information over a time period.
- Analytics with graph data visualization, with comparative reports
- Fraud detection reports may also be available after feeding the system with data associated to fuel consumption (as trip duration, etc). However, this extend may be fully exploited in high accuracy and hit rate, by expanding the "FBV-Relay" system into a more sensor-rich equipment on-board. This is a subject of another product

that is installed in the engine room and via "fieldbus[6]" is connected with the primary sources of the fuel consumption information, as well as the bunkering mass flowmeter.

[6] **Fieldbus** is the name of a family of industrial computer network protocols used for real-time distributed control, standardized as IEC 61158. A system with multiple transducers, scattered around the field, usually needs a distributed control system to function. In this hierarchy, there is usually a Human Machine Interface (HMI) at the top, where an operator can monitor or operate the system. This is typically linked to a middle layer of programmable logic controllers (PLC) via a non-time-critical communications system (e.g. Ethernet). At the bottom of the control chain is the fieldbus that links the PLCs to the components that actually do the work, such as sensors, actuators, electric motors, console lights, switches, valves and contactors.