OCTOBER 26TH 2023

CSL's Fleet Management

Successful Journey through Advanced Analytics and towards AI

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Frederic Lavoie CSL

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Maya HTT

mayahtt.com/ai

Product Lifecycle Management

Process Simulation

Composites

AI & Big Data Analytics

Optimization Services
Automation, Standardization & Compliancy

IIoT and Digital Twin

Custom Engineering Applications

Manufacturing Simulation

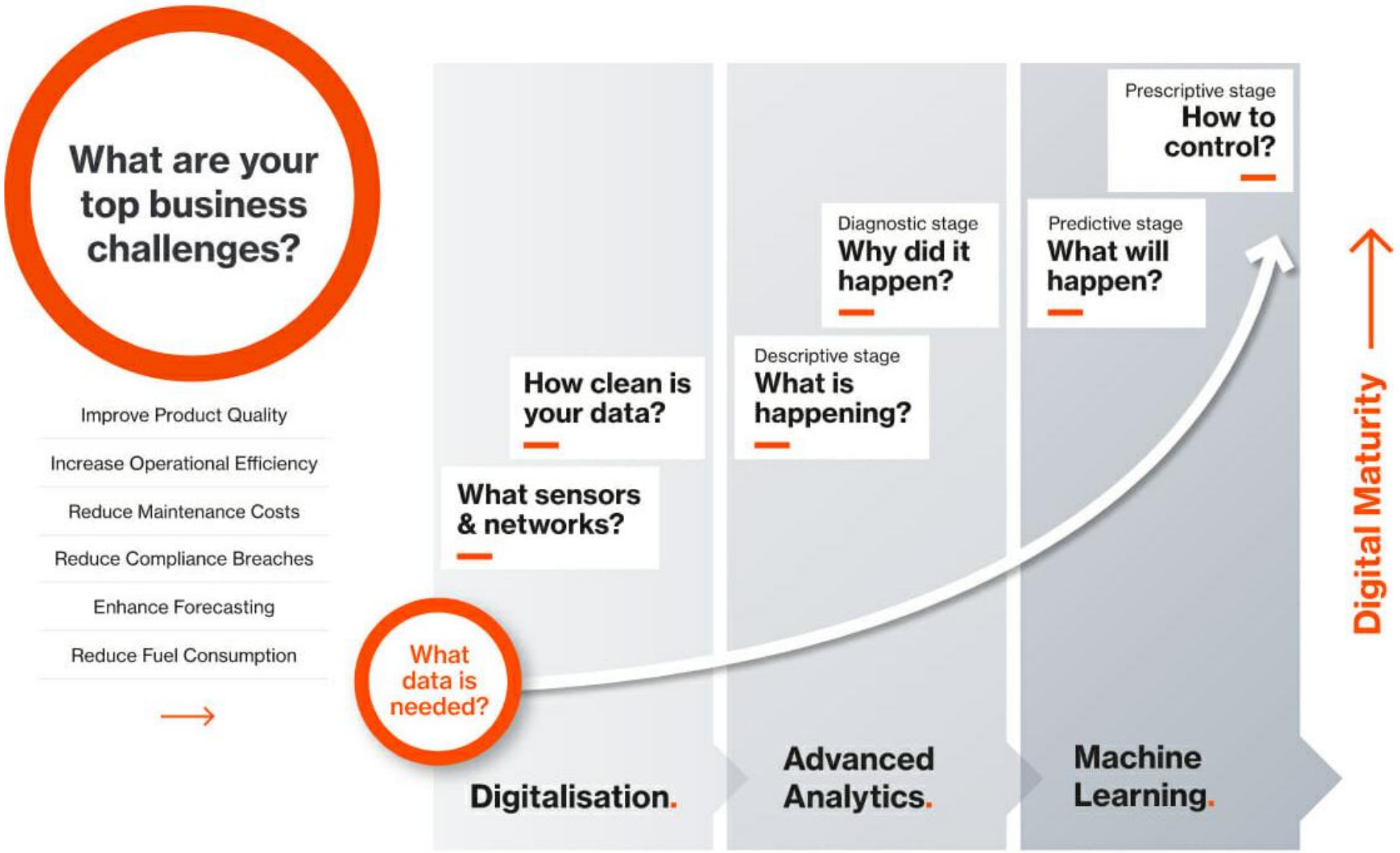
Cloud Applications

40+	Software solutions developed & maintained
12+ Years	Partnership with AVEVA™ PI System
75%	Engineers & Scientists
22%	PhDs

IIoT + AI | DIGITAL TRANSFORMATION JOURNEY

Create a backlog of business challenges & move forward in an agile way

IIoT, AI & Big Data



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Benefits

Compliance / Process Digitalization	Energy Management	Asset Management
10% of benefits	**50% of benefits**	**40% of benefits**
Automatic Infringement detection – Pre-warning reduces infringements **Automatic reporting – reduces manual reporting time from hours to minutes**	**One Example based on the 2022 speed optimization trial:** **~3 - 5% fuel saving per vessel per year** **=** **Fuel for ~210 cars for a year (8 vessels)**	**Potential failure avoidance:** **133 Failure Avoidance** **68 Downtime Avoidance** **Significant Value or projected savings**

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AVEVA

The AVEVA™ PI System at CSL

CSL TACOMA

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MFD5	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	

SHEILA ANN

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	ECR MOXA 1	
Flow Meters	ECR MOXA 2	
Torque Meter	ECR MOXA 2	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	

CSL TECUMSEH

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MFD5	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	

CSL TARANTAU

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MFD5	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	

RT. HON. PAUL E. MARTIN

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MFD5	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	
FIRM	SIP PLC	

CSL METIS

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	Hijoy Switch	
Ammeters	DAP Panel	
Flow Meters	AMS	
Torque Meter	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	
FIRM	SIP PLC	

CSL SPIRIT

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	ECR MOXA 1	
Flow Meters	ECR MOXA 2	
Torque Meter	ECR MOXA 2	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	

CSL FRONTIER

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	Prasis Cab./ECR MOXA	
Ammeters	Prasis Cab.	
Flow Meters	Prasis Cab.	
Torque Meter	Prasis Cab.	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	

CSL KOASEK

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MPC1 & MPC2	
Flow Meters	AMS	
Torque Meter	AMS	
Ammeters	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	
FIRM	SIP PLC	

CSL KAJIKA

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MPC1 & MPC2	
Flow Meters	AMS	
Torque Meter	AMS	
Ammeters	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	
FIRM	SIP PLC	

ADELIE

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
Ammeters	DAP PLC	
FIRM: Fike, CE1210 MOXA 1		
Flow Meters	ECR MOXA	
Torque Meter	ECR MOXA	
SUL	CP Lean Processor	
OWS	WhiteBox Recorder	

AKUNA

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MPC1 & MPC2	
FIRM: Fike, CE1210 MOXA		
Flow Meters	ECR MOXA	
Torque Meter	AMS	
Ammeters	AMS	
OWS	WhiteBox Recorder	

DONNACONA

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
Ammeters	DAP PLC	
FIRM: Fike, CE1210 MOXA 1		
Flow Meters	ECR MOXA	
AMS	Phoenix Cont. Firewall	
DEF PMS	Phoenix Cont. Firewall	
Ballast PLC	Pleiger MOXA + Redlion	
SUL	CP Lean Processor	
OWS	WhiteBox Recorder	
Pitch	LIPS (MOXA + WAGO)	

THUNDER BAY

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MFD6	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	

BAIE COMEAU

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MFD6	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	

BAIE ST. PAUL

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MFD6	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	

WHITEFISH BAY

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MFD6	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
SUL	CP Lean Processor	
OWS	Alfa Laval BlueBox	

ELANORA

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MPC1 & MPC2	
FIRM	SIP Panel	
Flow Meters	AMS	
Torque Meter	AMS	
Ammeters	AMS	
SUL	CP Lean Processor	
OWS	WhiteBox Recorder	

GOLIATH

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	NCU + onboard	
FIRM: Fike, CE1210 MOXA		
Ammeters	AMS	
SUL	OPC Server (PC cabinet)	
OWS	WhiteBox Recorder	

KONDELI

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MPC1 & MPC2	
FIRM: Fike, CE1210 MOXA		
Flow Meters	AMS	
Torque Meter	AMS	
Ammeters	AMS	
OWS	WhiteBox Recorder	

CSL NIAGARA

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
AMS	AM.PN05	
Flow Meters	AM.PN05	
Torque Meter	AM.PN05	
Ammeters	AM.PN05	
SUL	Hilscher NL-50-MPI	
OWS	WhiteBox Recorder	

CSL LAURENTIEN

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
AMS	AM.PN05	
Flow Meters	AM.PN05	
Torque Meter	AM.PN05	
Ammeters	AM.PN05	
SUL	Hilscher NL-50-MPI	
OWS	WhiteBox Recorder	

RH PAUL J. MARTIN

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
AMS	AM.PN05	
Flow Meters	AM.PN05	
Torque Meter	AM.PN05	
Ammeters	AM.PN05	
SUL	Hilscher NL-50-MPI	
OWS	WhiteBox Recorder	

CSL ASSINIBOINE

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
AMS	AM.PN05	
Flow Meters	AM.PN05	
Torque Meter	AM.PN05	
Ammeters	AM.PN05	
SUL	CP Lean Processor	
OWS	WhiteBox Recorder	

WYUNA

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MPC1 & MPC2	
FIRM: Fike, CE1210 MOXA		
Flow Meters	AMS	
Torque Meter	AMS	
Ammeters	AMS	
OWS	WhiteBox Recorder	

CSL RELIANCE

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
FIRM: Fike, CE1210 MOXA		
FIRM: LHD, CE1210 MOXA		
SUL	Redlion	
Flow Meters	ECR MOXA	
Torque Meter	ECR MOXA	
Ammeters	DAP PLC	
OWS	WhiteBox Recorder	

MAREEBA

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
FIRM	DAP PLC	
Ammeters	DAP PLC	
Flow Meters	ECR MOXA	
Torque Meter	ECR MOXA	
OWS	WhiteBox Recorder	

FERBEC

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	ECR MOXA 1	
Flow Meters	ECR MOXA 2	
Torque Meter	ECR MOXA 2	
Ammeters	ABB PLC	
OWS	WhiteBox Recorder	

CSL ST-LAURENT

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MFD6	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
OWS	AMS	

CSL WELLAND

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	NAV MOXA	
AMS	MFD6	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
OWS	AMS	

NUKUMI

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
Nav. Lights	NAV MOXA	
RAI	AMS	
AMS	MPC1 & MPC2	
Ammeters	AMS	
Flow Meters	AMS	
Torque Meter	AMS	
SUL	CP Lean Processor	
OWS	WhiteBox Recorder	

FRONTENAC

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
OWS	WhiteBox Recorder	

OAKGLEN

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
OWS	WhiteBox Recorder	

SPRUCEGLEN

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
OWS	WhiteBox Recorder	

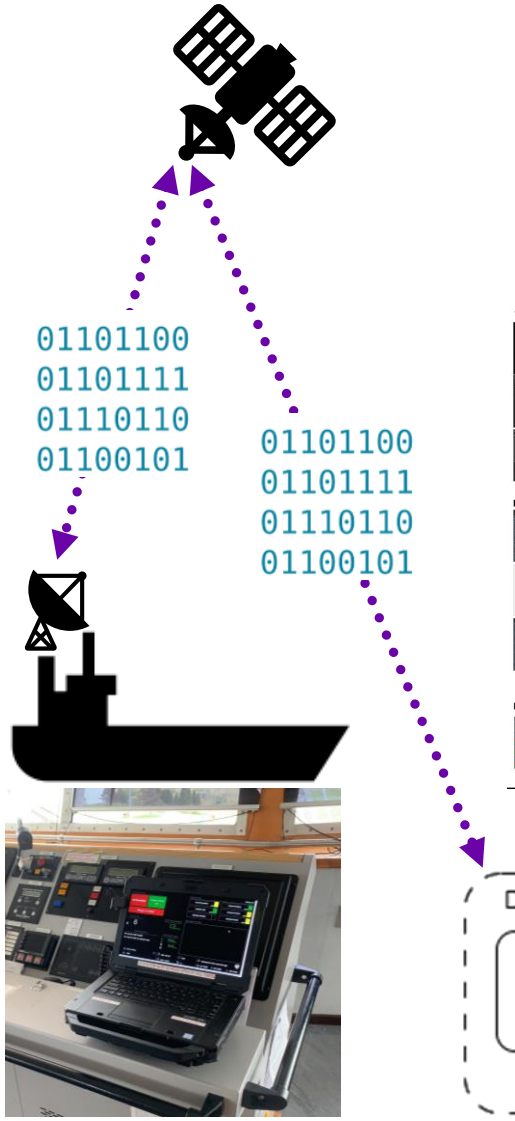
ATLANTIC HURON

Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
OWS	WhiteBox Recorder	

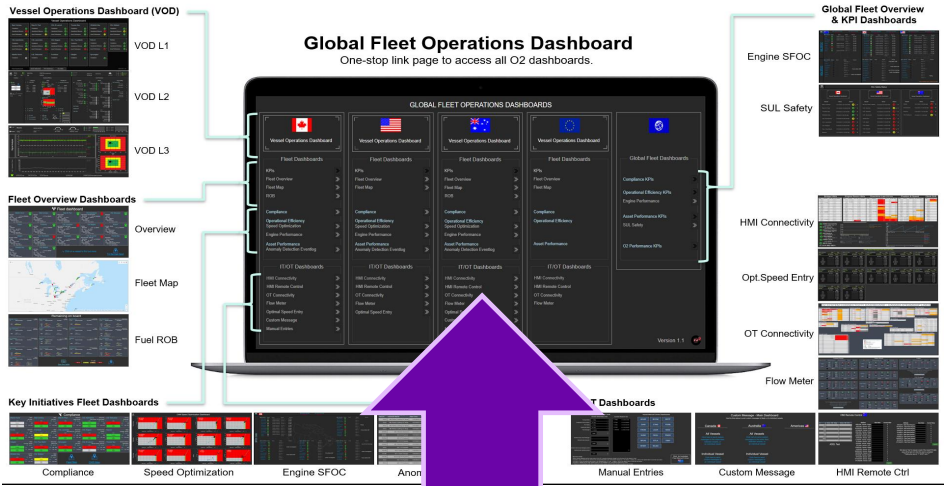
CSL TADOUSSAC

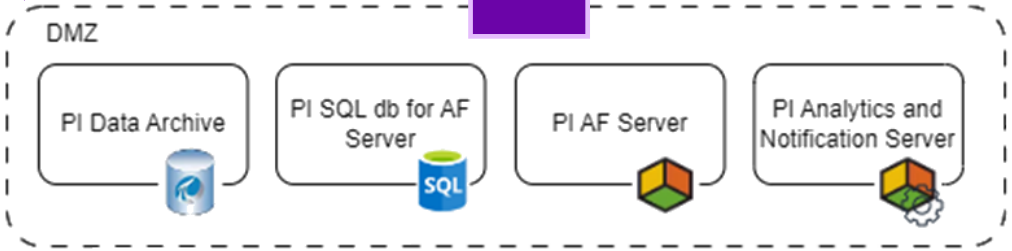
Data Source	OT Sensor	Status
ECDIS	NAV MOXA	
OWS	WhiteBox Recorder	

LEGEND	Explanation
	Data collecting and fully commissioned
	Data collecting and partially commissioned OR warrants additional verifications
	Data collecting, but not commissioned
	Sensor and/or cabling installed
	Sensor and/or cabling NOT installed



PI Vision





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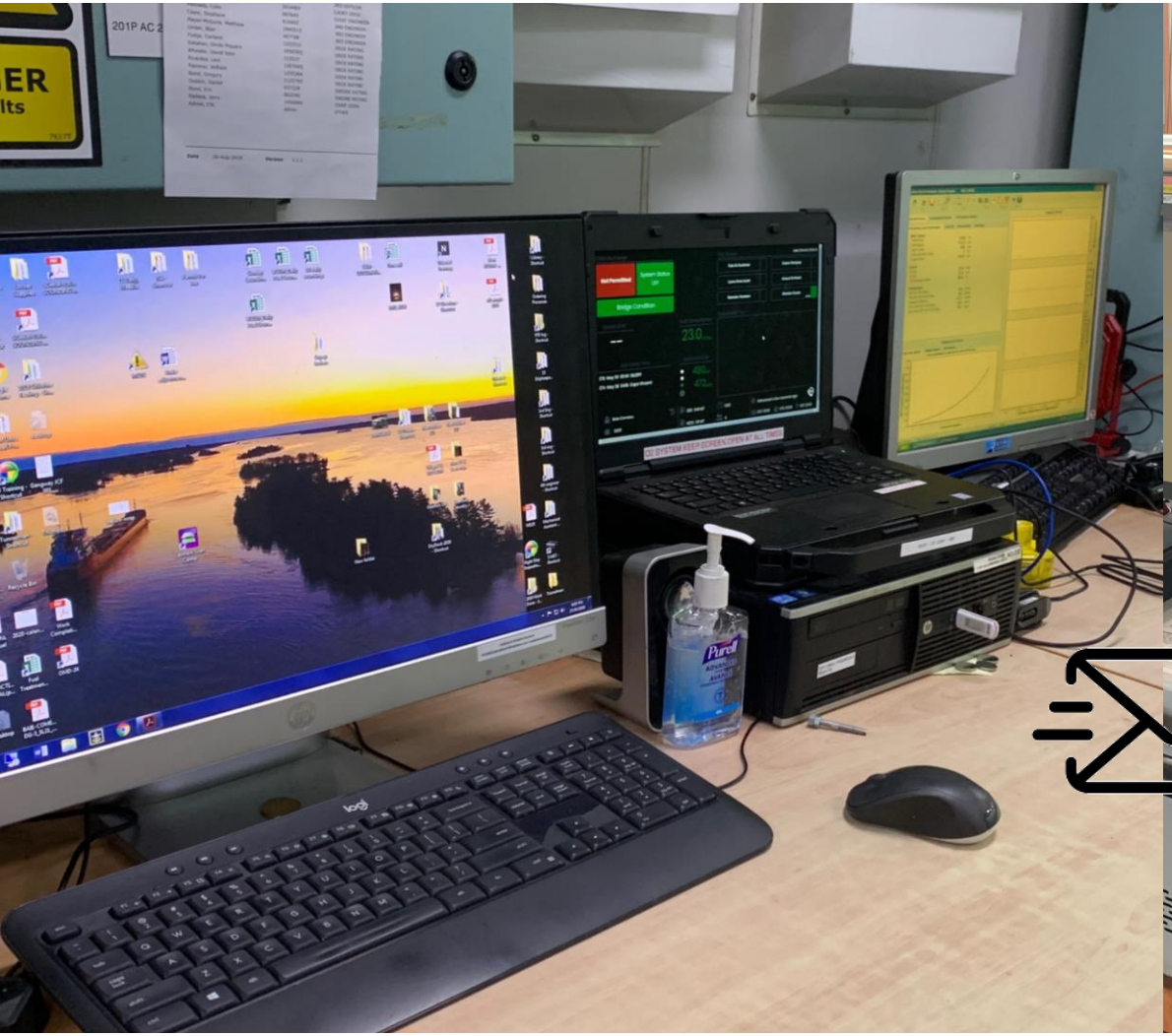
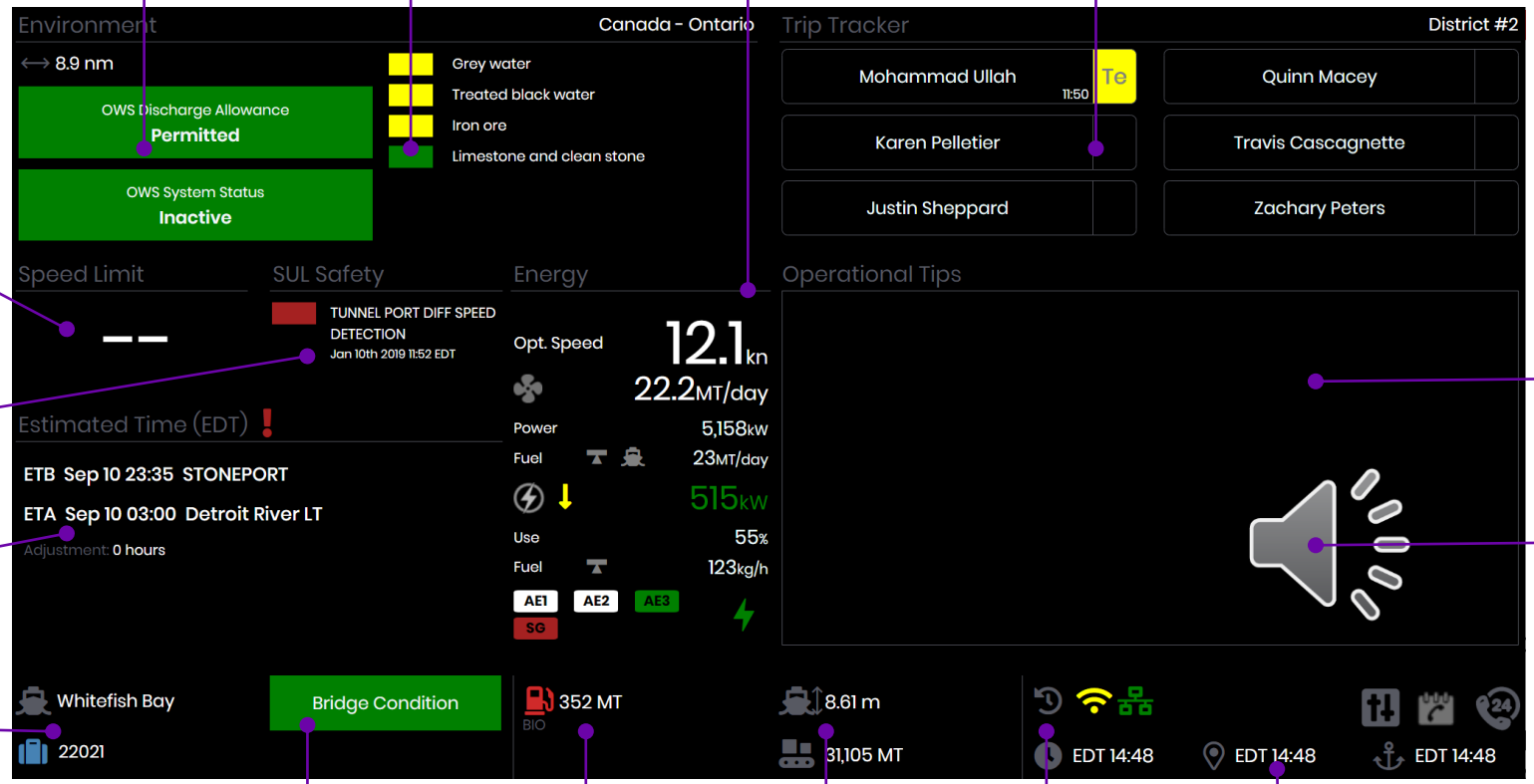
AVEVA

O2 is a data information system.
It must translate into human actions at some point to produce benefits. Crew & Office.

Crew Interface



O2 Vessel Dashboard



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Process digitalization

SEASON	PILOTAGE TRIPS	FUEL SOUNDINGS	CARGO UPLIFT	ETAs	NAVIGATIONAL TIPS
2020	12,989	7,834	89	959	3,500
2021	11,407	5,774	512	1,785	4,989
2022	10,942	3,637	500	2,798	5,026

Valuable business processes that were manual, tedious, error prone

- Strong adoption by the crew
- Easy, intuitive, saves time
- High level of data quality and consistency
- Single source of truth in O2, real-time access by subscribers

Navigational Tips

- Automatic
- Triggered by geofencing

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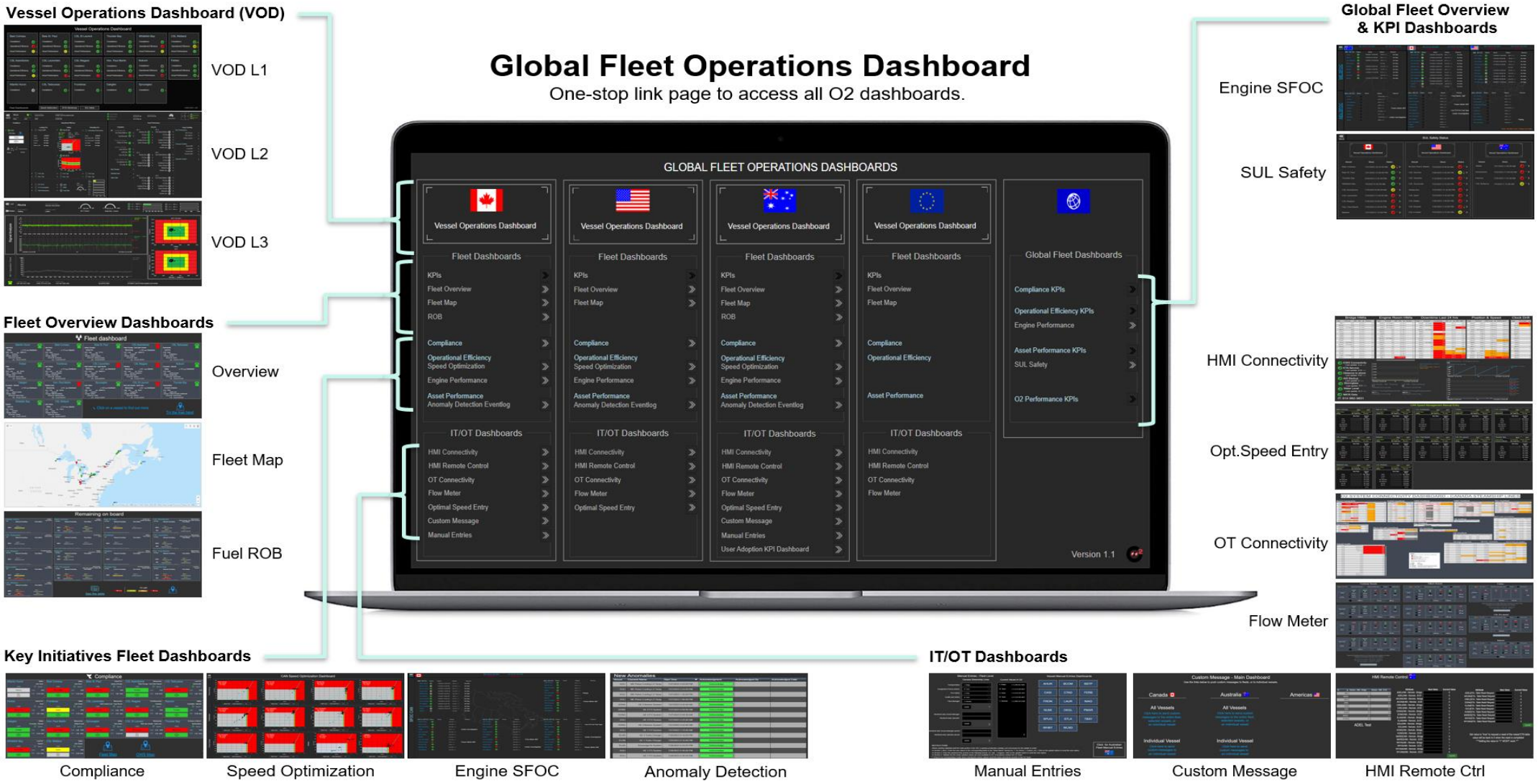
AVEVA

Office Interfaces using the Power of AVEVA PI Vision



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AVEVA

Where the AVEVA™ PI System becomes CSL's O2

Anomaly Detection & the AVEVA™ PI System

Supervision

Using the PI System for easy bulk deployment at scale

- Countless Attributes
- Close to 6000 PI analysis to make
- 960 Indicators for Asset Performance
- 166 Indicators for Operational Efficiency
- 51 Indicators for Compliance

Combine with expert knowledge

- **Monitors all ships across the globe 24/7**
  - 40 Main Engines
  - Over 100 Generator
  - Over 30 Steering Gears
  - Over 25 SUL's
  - … and a lot more assets

Notification

Using the PI System for Automated **PI Notification**
Most notifications are filtered by the shore team
False Alarm rate exceptionally good

- **Failure avoidance without the SPAM!**

Where CSL's Wisdom, Maya's Skills & AVEVA's PI System combines

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AVEVA

Assets, Smart Indicators, Anomaly Detection

Category				Total
Smart Indicators	458	297	243	998
Anomaly Detection	39	38	21	98
Repaired	31	32	20	83
Under Investigation	8	6	1	15

Assets Monitored by O2

Asset Types				Total
ME	15	8	6	29
AE	30	28	26	84
CPP	10	N/A	N/A	10
SUL	9	9	4	22
Thrusters	14	6	3	23
Steering Gear	10	2	0	12

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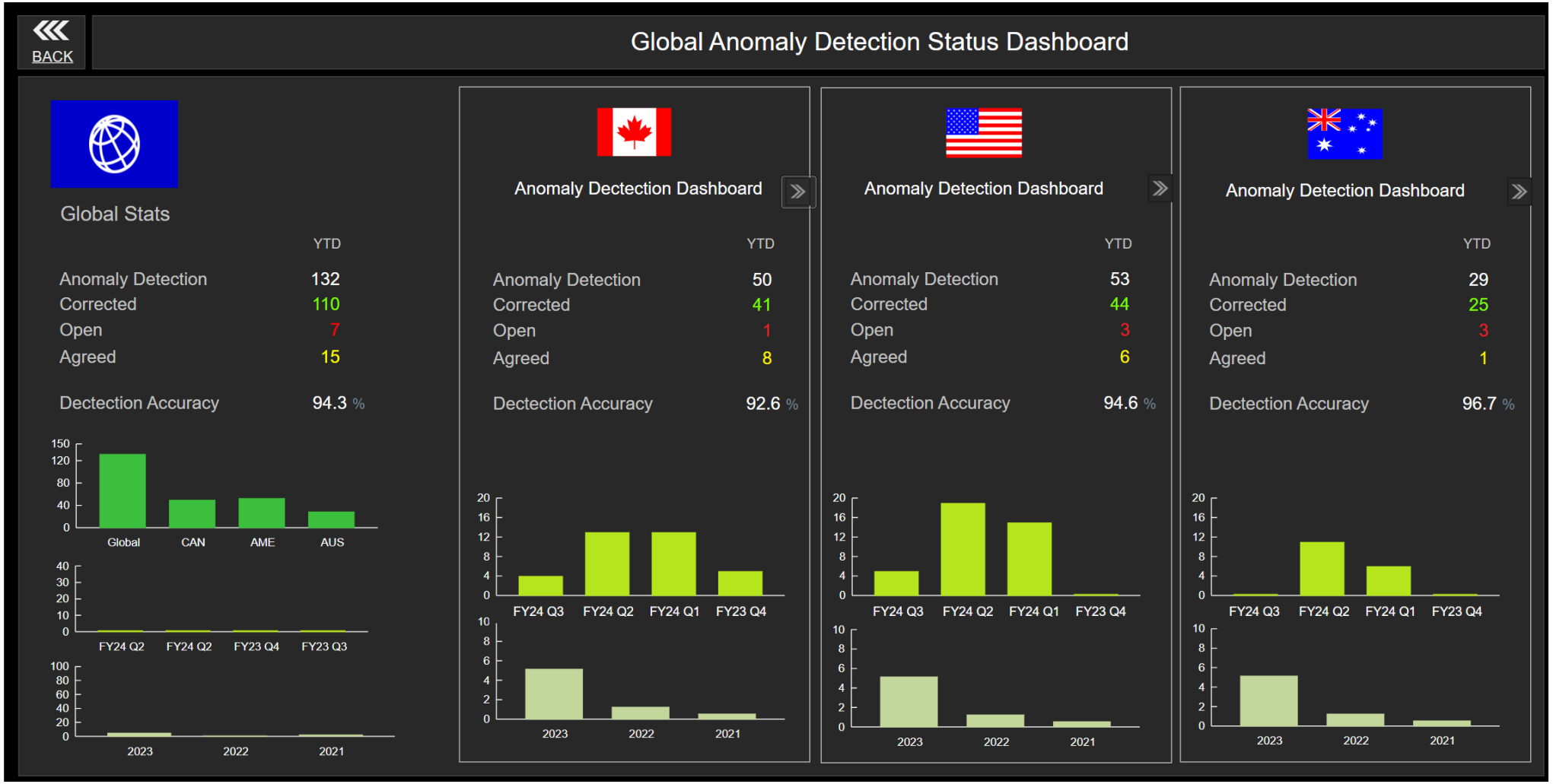
AVEVA

Anomaly Detection – AVEVA™ PI Vision KPI Dashboard



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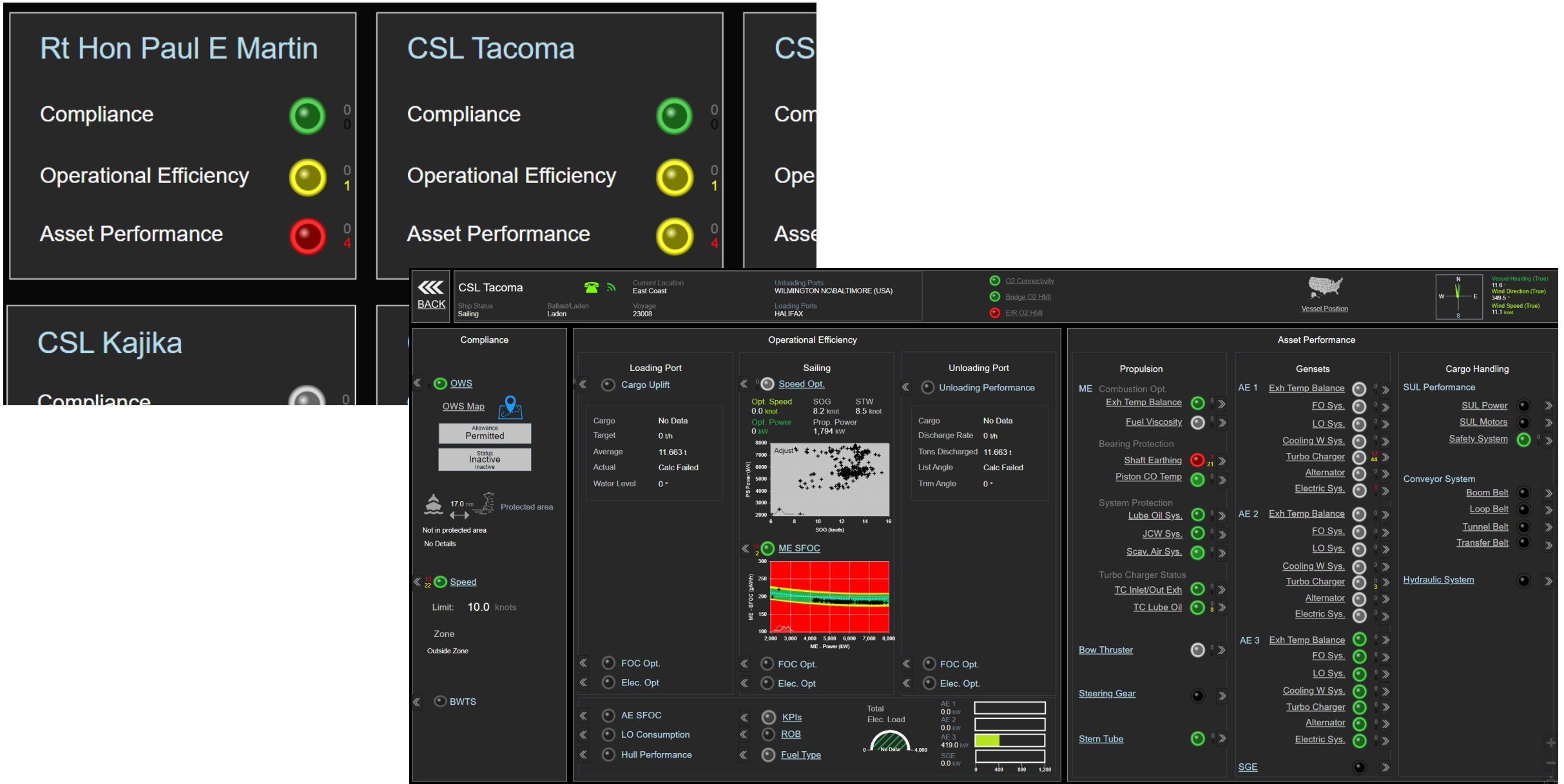
AVEVA

Anomaly Detection – Shaft Earthing Device



Anomaly Detection – Shaft Earthing Device

Good day,

O2 detected a below abnormal trend relating to ME shaft earthing device.
Please confirm the receipt of this notification and revert with the actual findings. If you have any questions, please feel free to contact S3C.

Anomaly Detection Details

The ME shaft earthing device's mV trend has gradually increased and exceeded 100 mV for the last few days.
(Normal range: Within +/- 80 mV)

Possible Root Causes

- Poor contact or spring tension between the silver band and carbon brushes
- Dirty silver band and carbon brushes
- Poor cable connections
- Rust builds up behind the silver band

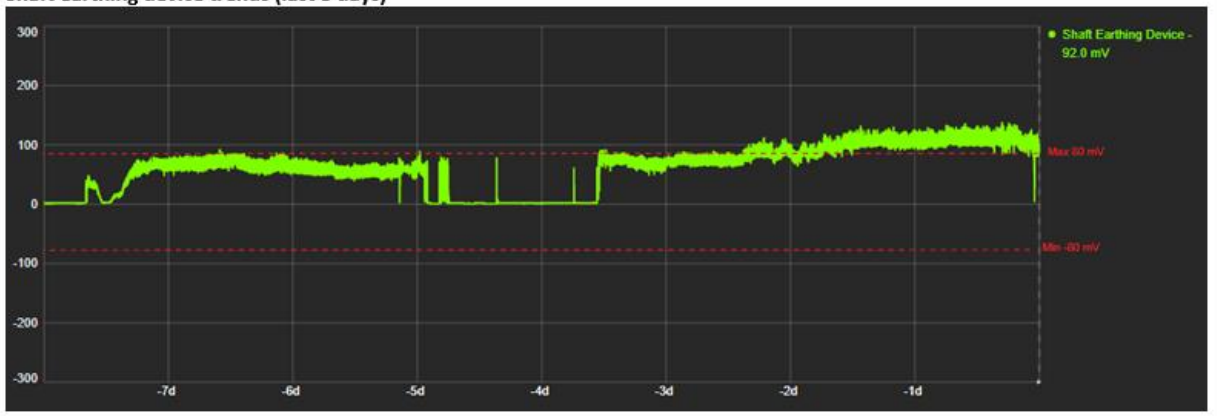
Attachment

- Shaft earthing device trends (last 8 days)
- Shaft earthing device trends (Last 2 months)

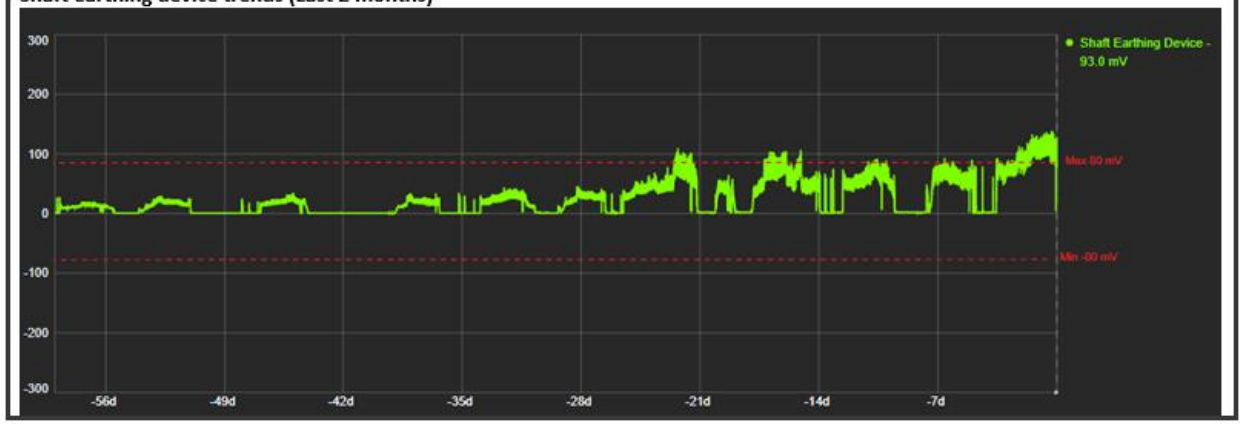
Thank You!

Standards, Systems, and Support Center

Shaft earthing device trends (last 8 days)



Shaft earthing device trends (Last 2 months)



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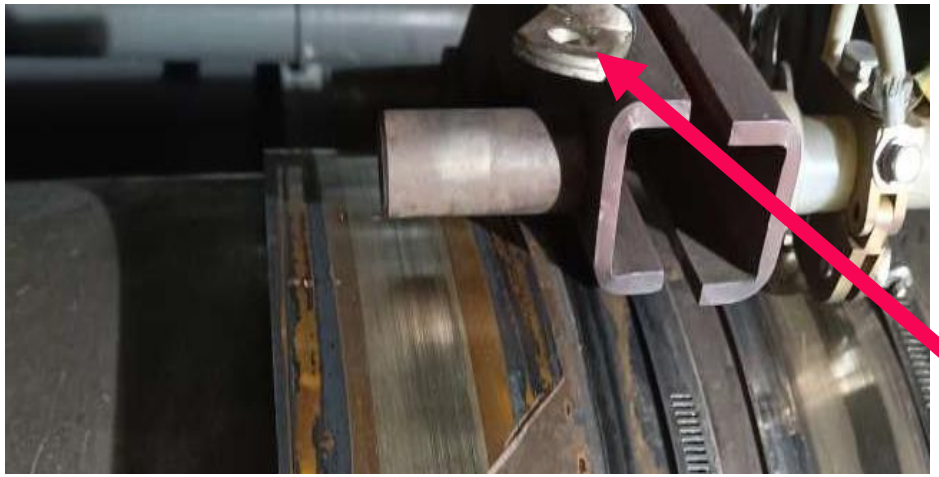
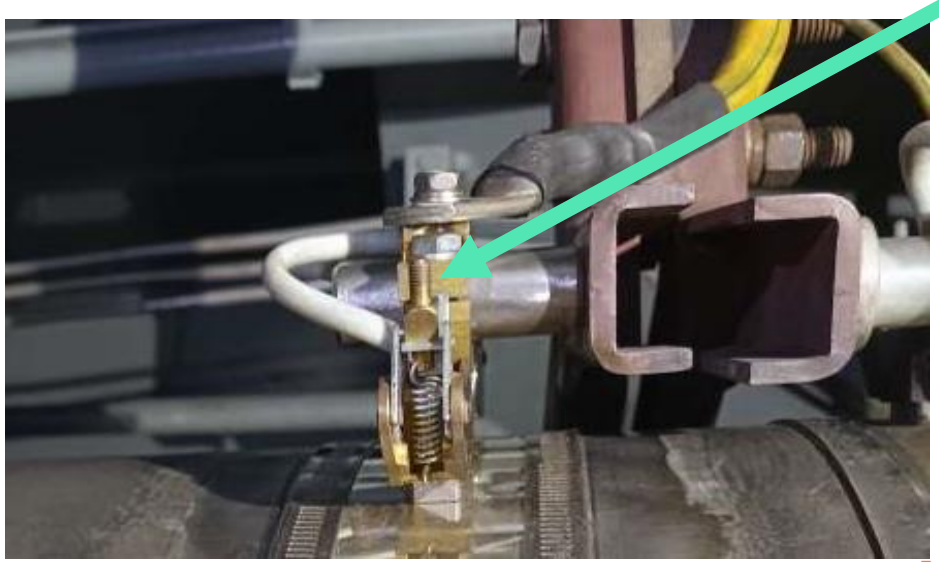
AVEVA

Anomaly Detection – Shaft Earthing Device: Potential Major Crankshaft Damages



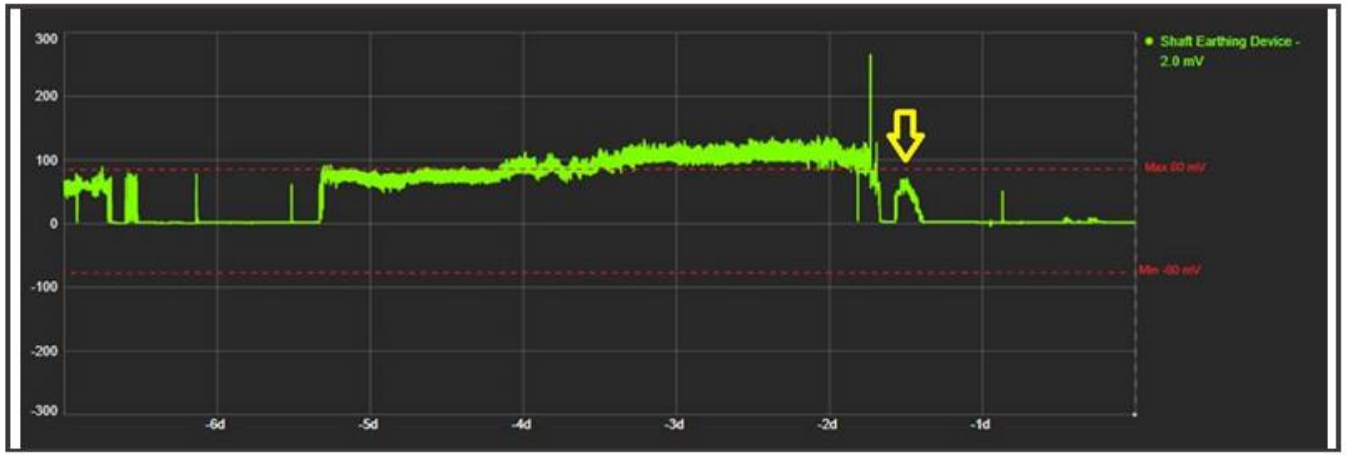


Good day,

Thanks for sharing the inspection results and pics.
As shown in the below, mV trends returned to normal after the repair. We will close this notification case.

Attachment

- Shaft earthing device trends (Last 7 days)



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AVEVA

Anomaly Detection – ME Exhaust Turbo High Temperature

Good day,

O2 detected a below abnormal trend relating to ME Exhaust Turbo inlet temperature on May 25th . Temperature keeps increasing at steady load
Please confirm the receipt of this notification and revert with the actual findings.
If you have any questions, please feel free to contact S3C.

Anomaly Detection Details

ME Exhaust Turbo inlet temperature has gradually increased and shown abnormal trends.

Possible Root Causes

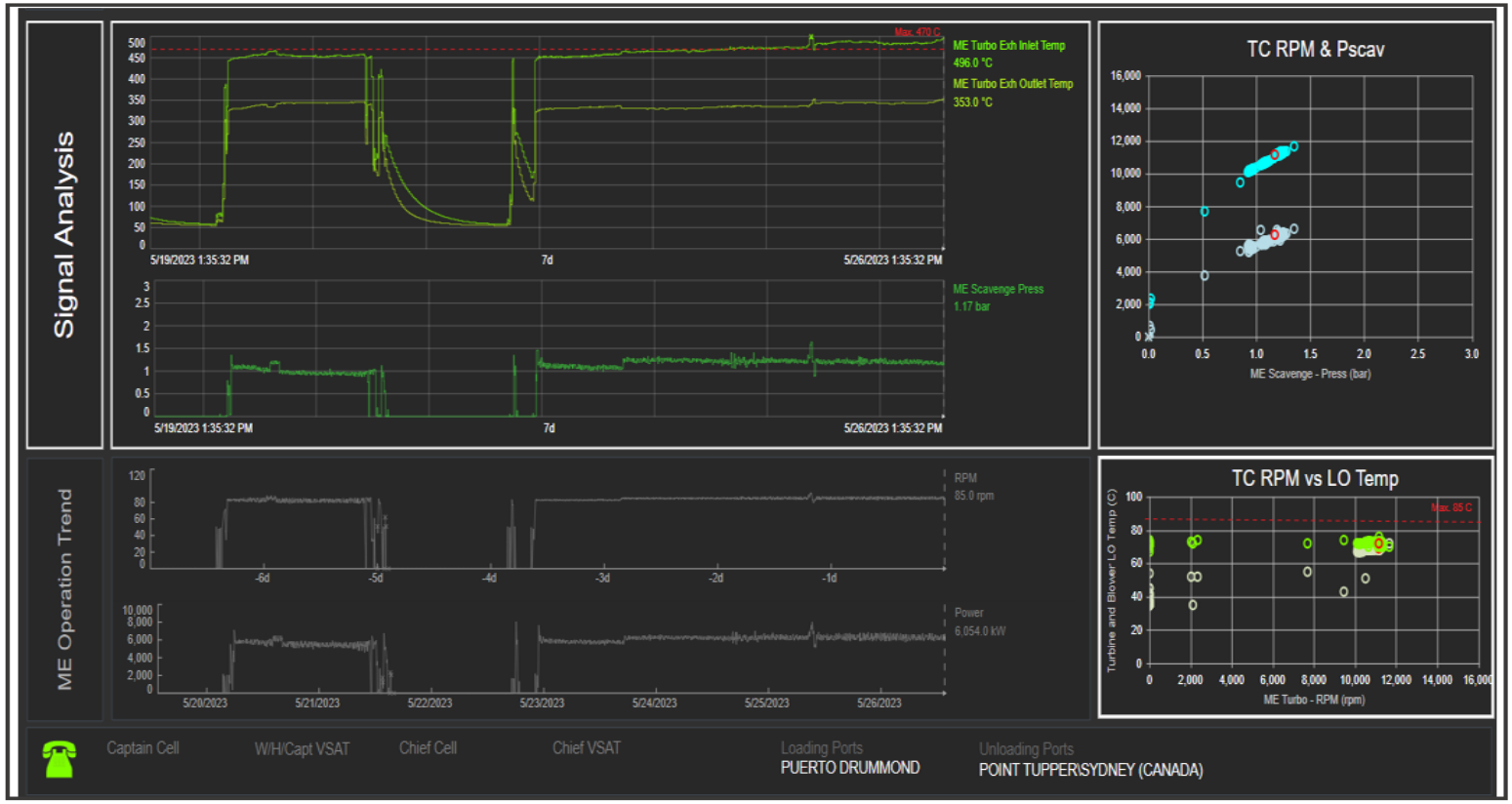
- Fuel type / quality
- Scavenge air too hot
- Faulty fuel injector(s)
- Fuel injection pump(s) malfunction (internal leakage, fuel rack position error)
- Exhaust valve(s) leakage
- Faulty sensor

Attachment

- Last 7 days trend

Thank You!

Standards, Systems, and Support Center



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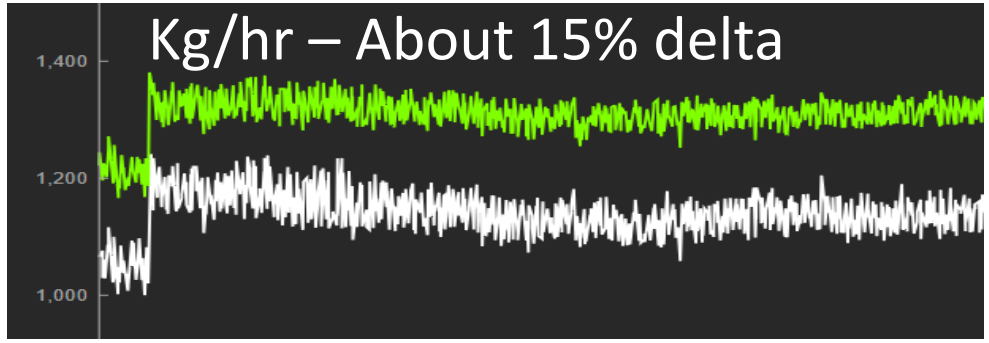
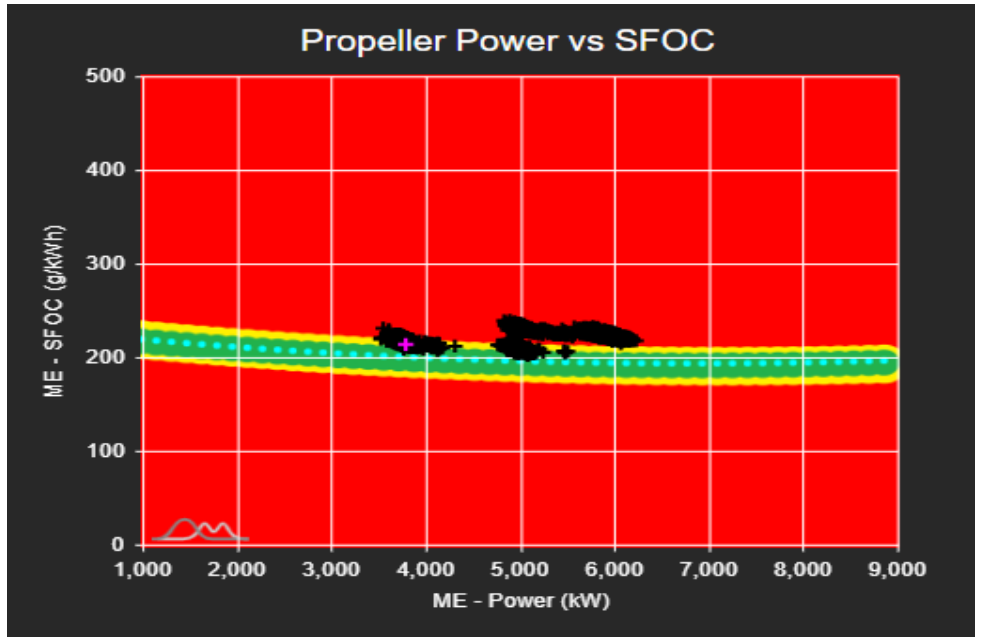
AVEVA

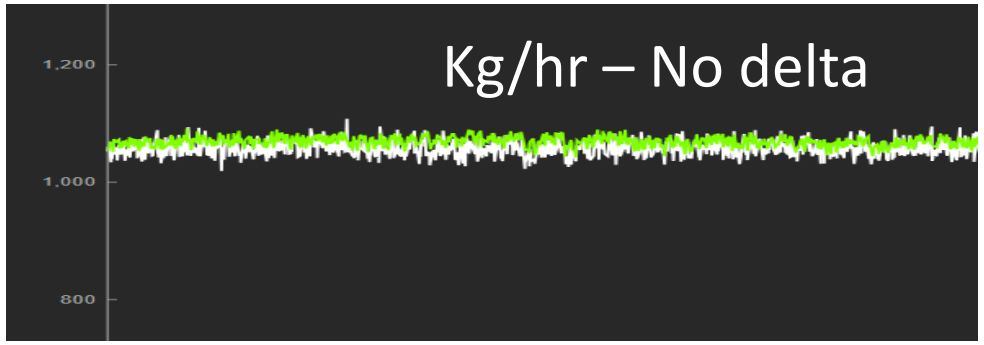
Anomaly Detection – ME Exhaust Turbo High Temperature – 1,000 MT of CO_2 Saved

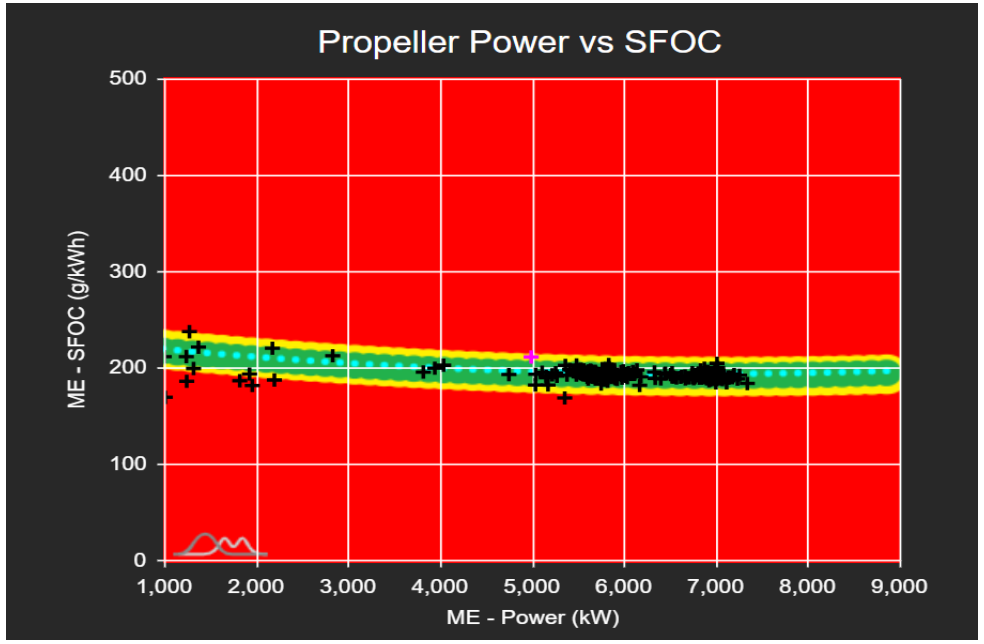
Sheila Ann - Before





Sheila Ann - After





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Compliance

Effluents Management

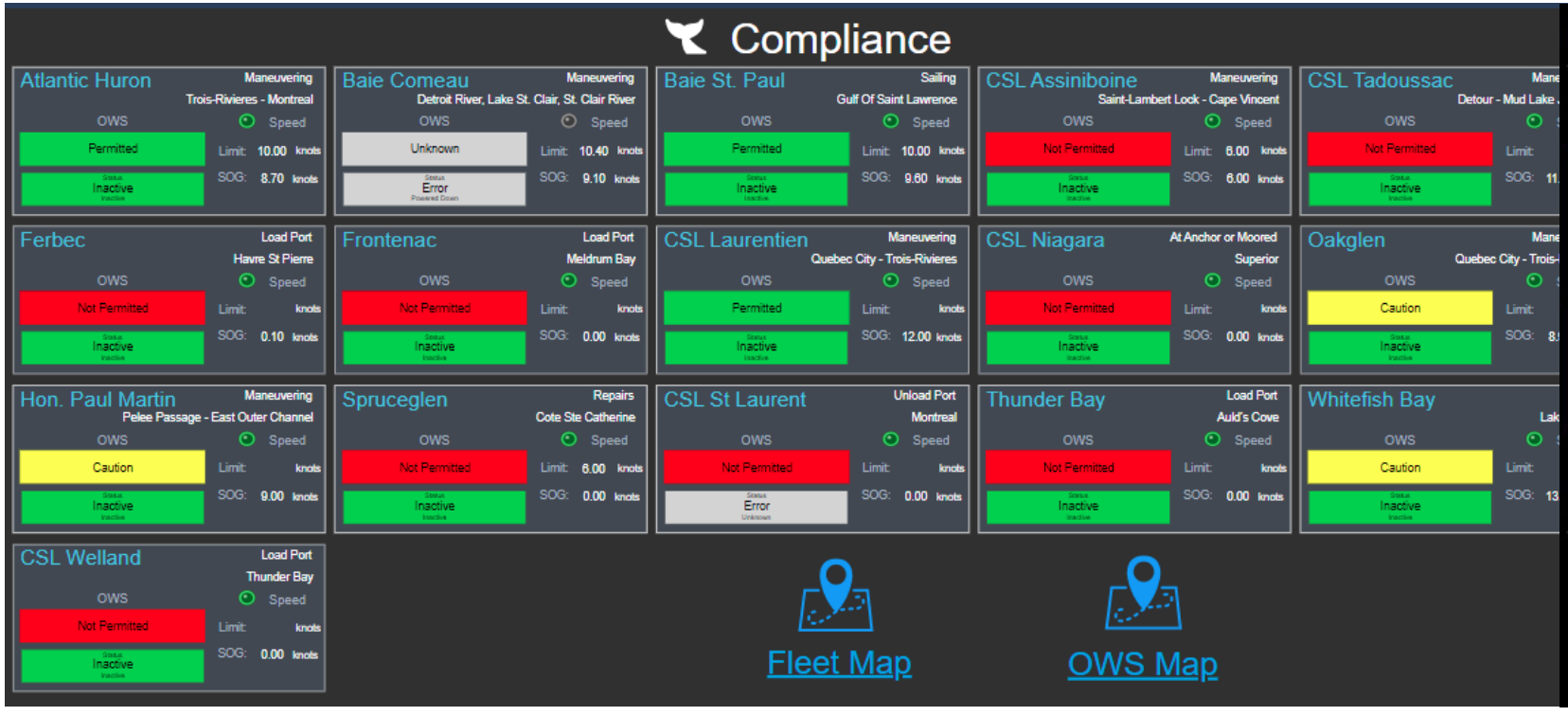
Using the power of geofencing and business logic, the complex environmental rules were coded in O2, making it easy and reliable for the crew and office.

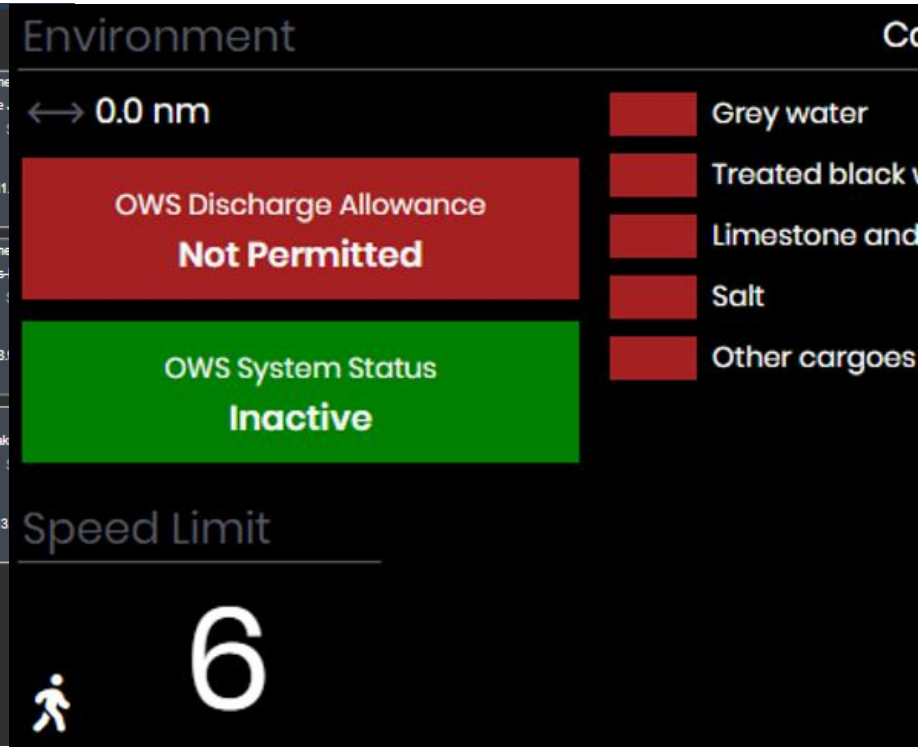
Reporting

O2 data, stamped with time and geolocations, automates reports with high quality information.

Speed Limits

A simple problem, yet complex to solve. O2 displays actual speed limits, even the dynamic ones that vary with water levels and marine protected areas.





Compliance – Template for Auto-Generated E-Mail with PI Notification

Dear Officers,

OWS discharge allowance **is not permitted based on Regulatory or mandatory Company Best Practices.**

The OWS System **is currently discharging overboard.**

Kindly take action as per the SMS procedures.

Vessel information:

Current Regulatory Area: Vessel Outside Prohibited Area
Country - State: Canada - Ontario
Vessel Distance to shore: 18.63 nm
Vessel Speed: 5.9 knot

Do not hesitate to contact your O2 Fleet Support Center if you need assistance.

O2 Sea Keeper

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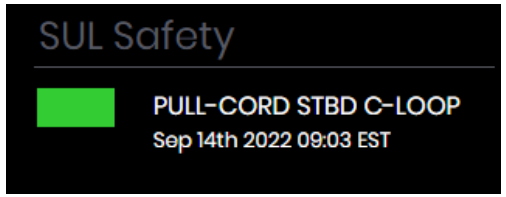
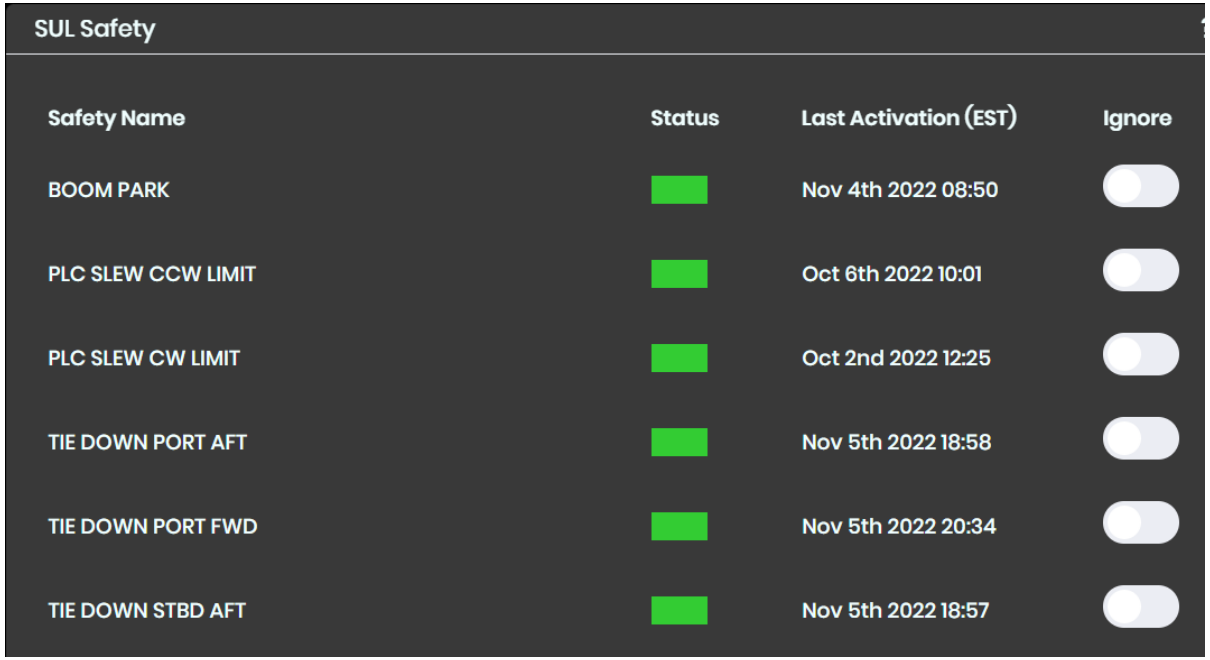
SUL Safety Alarms Feature

- O2 SUL Safety alarms feature aims to assist the crew in automatically recoding each time a safety switch, emergency stop or shutdown is activated.

- O2 displays the latest activation date and consequently the appropriate color with the longest standing alarm activation by default on the main dashboard.

- The color of an indicator displays the elapsed period since its activation:
  - Green < 60 days
  - Yellow > 60 days
  - Red > 90 days
  - Gray – Unavailable or ignored





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SUL SAFETY

Sept 2022

Nov 2022

260 Safeties - 4 Trillium SUL
- Sep 2022: 119 red
- Nov 2022: 0 red (waiting parts, RA in place)
- 4 Forebodies ECD April 2023

788 Safeties - 9 vessels
- Commissioning in progress, ECD April 2023
- Metis ECD June 2023

291 Safeties - Adelie, Elanora, Reliance, Donnacona
- Commissioning in progress, ECD April 2023
- Cement ships safeties – not many - lower priority

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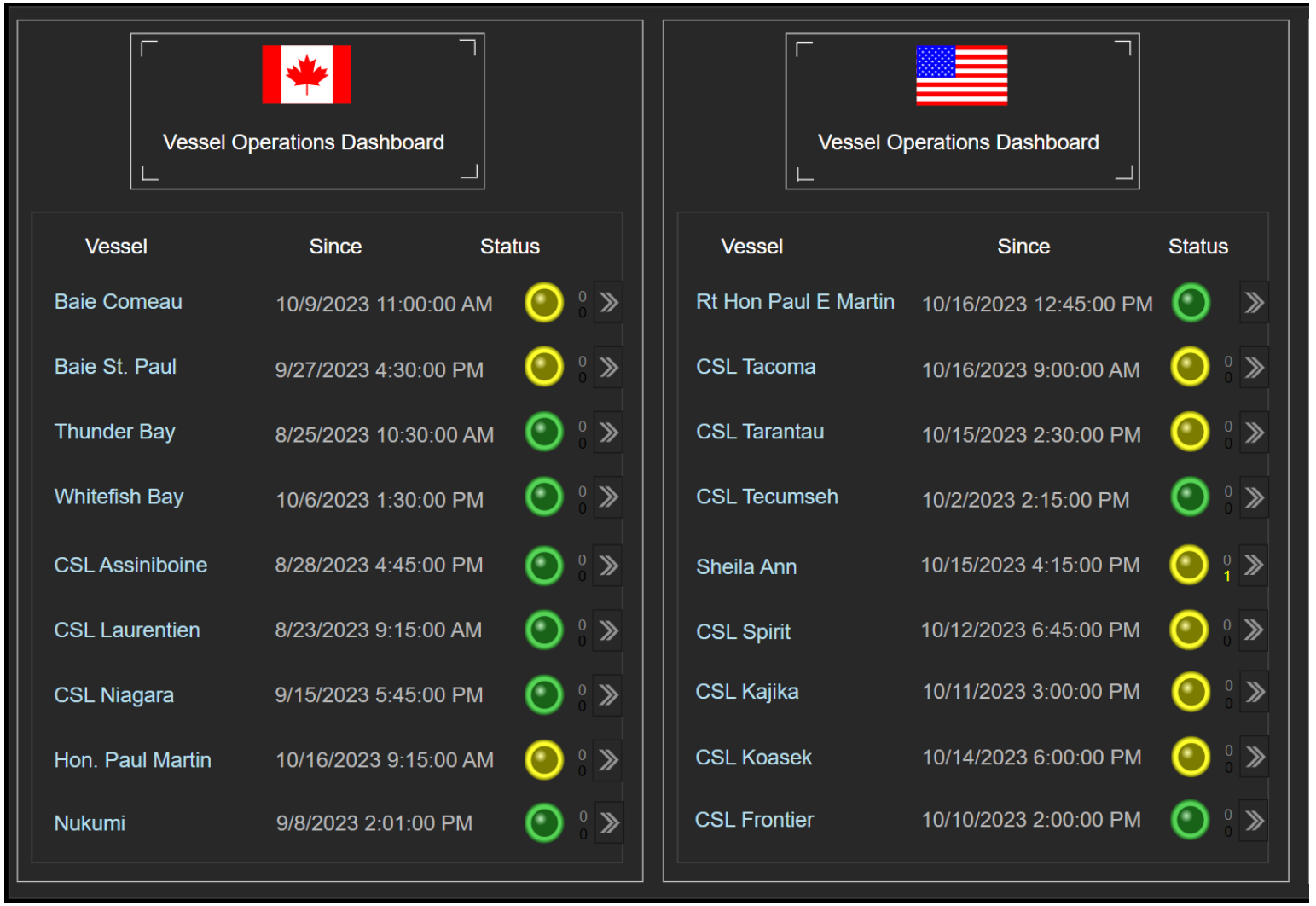
SUL SAFETY - NOW



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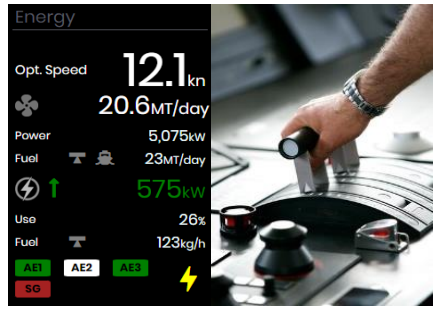
ENERGY MANAGEMENT

Speed Optimization Trial Results

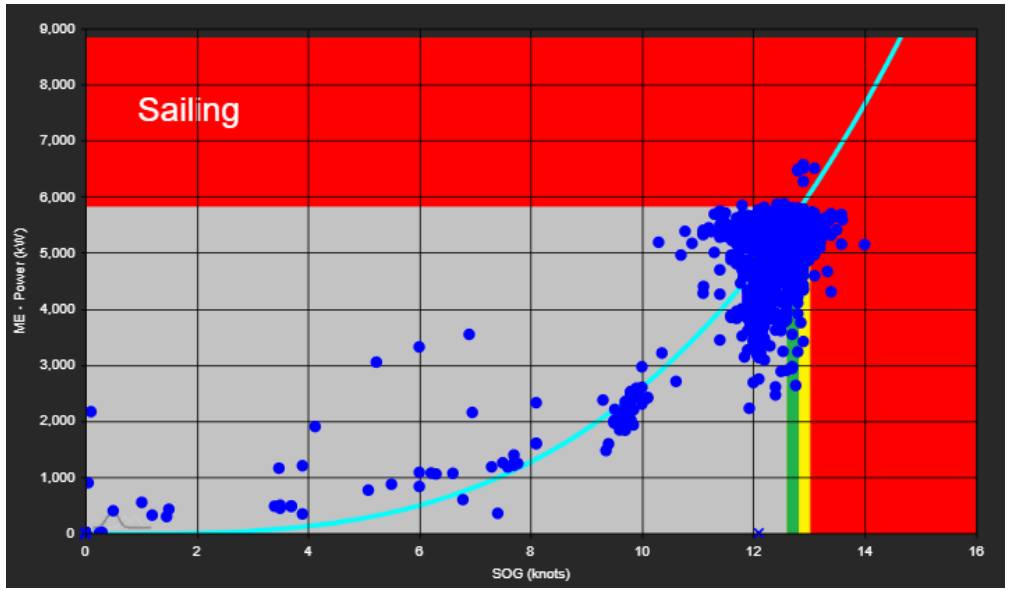
In 2022, 8 Canadian vessels trialed and sailed 219 days in open water

299 MT of fuel was saved, equivalent to 956 MT of CO_2 reduction

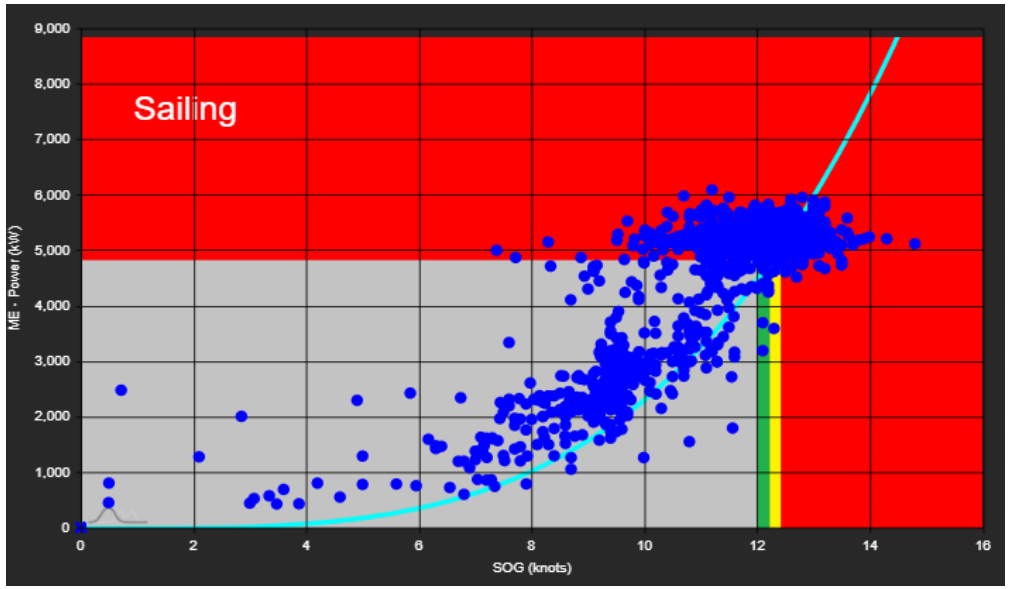
No negative side impact on the business due to fuel savings



Speed Optimization



No Speed Optimization



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Office Interfaces using the Power of AVEVA™ PI Vision

Vessel Operations Dashboard (VOD)

VOD L1

VOD L2

VOD L3

Fleet Overview Dashboards

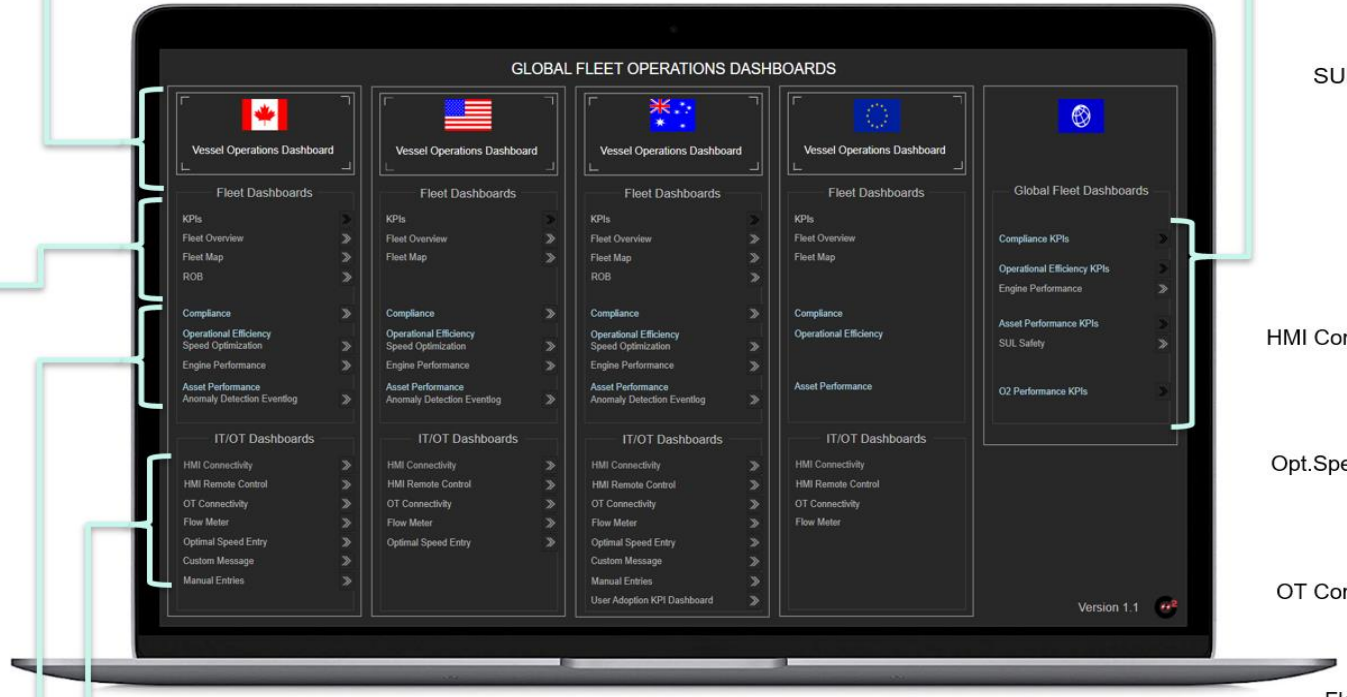
Overview

Fleet Map

Fuel ROB

Global Fleet Operations Dashboard

One-stop link page to access all O2 dashboards.



Global Fleet Overview & KPI Dashboards

Engine SFOC

SUL Safety

HMI Connectivity

Opt.Speed Entry

OT Connectivity

Flow Meter

Key Initiatives Fleet Dashboards

Compliance | Speed Optimization | Engine SFOC | Anomaly Detection

IT/OT Dashboards

Manual Entries | Custom Message | HMI Remote Ctrl

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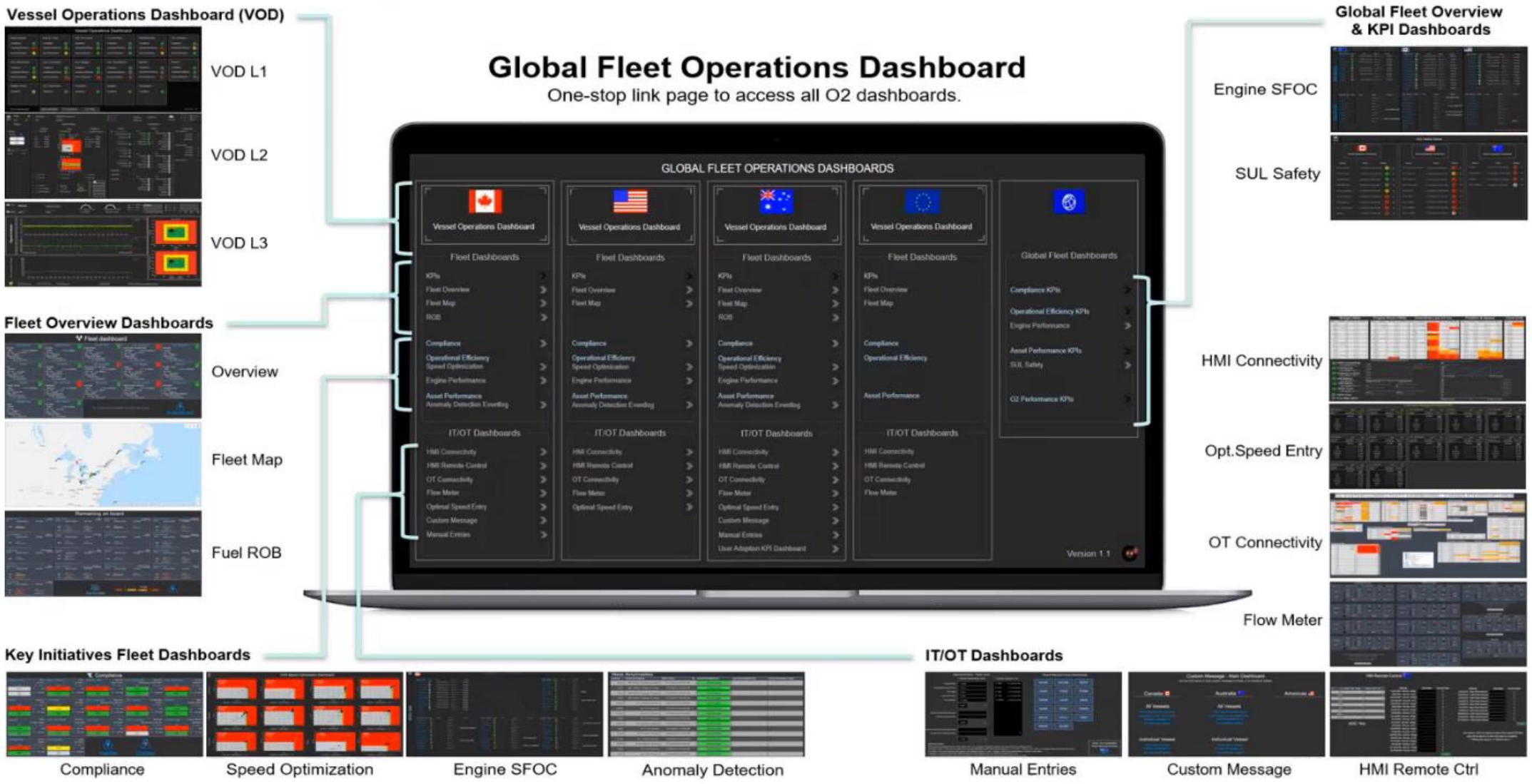
Office Interfaces



MARINE | CANADA & WORLDWIDE

CSL Reduces fuel consumption by ~3-5% per trial vessel per year & achieves asset failure avoidance goals

Challenge

- Improving operations has always been a Primary Drive of CSL, and remains a Key Business Priority
- Regulations are complex (there are no street signs on waterways)
- Lots of manual entries & paperwork for the crew
- Vessels are operating worldwide

Solution

- Deployed AVEVA™ PI System™ to streamline data collection, access, analysis, and reporting

Results

- **Estimated 3-5% fuel saved & 120 MT of CO2 per vessel per year – validated with trial on 8 vessels**
- **Equipment failure avoidance by applying 133+ preventive corrective actions thus far**
- **Countless automated reports**

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IIoT, AI & Big Data

Q&A

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ABOUT AVEVA

AVEVA is a world leader in industrial software, providing engineering and operational solutions across multiple industries, including oil and gas, chemical, pharmaceutical, power and utilities, marine, renewables, and food and beverage. Our agnostic and open architecture helps organizations design, build, operate, maintain and optimize the complete lifecycle of complex industrial assets, from production plants and offshore platforms to manufactured consumer goods.

Over 20,000 enterprises in over 100 countries rely on AVEVA to help them deliver life's essentials: safe and reliable energy, food, medicines, infrastructure and more. By connecting people with trusted information and AI-enriched insights, AVEVA enables teams to engineer efficiently and optimize operations, driving growth and sustainability.

Named as one of the world's most innovative companies, AVEVA supports customers with open solutions and the expertise of more than 6,400 employees, 5,000 partners and 5,700 certified developers. The company is headquartered in Cambridge, UK.

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