

Efficiënte laadoperaties van energiedragers

Bij het leveren en verkopen van energie is het meten van de hoeveelheid en de kwaliteit van de geleverde producten van essentieel belang, en onder invloed van regelgeving.

In deze presentatie wordt ingegaan op de mogelijkheden van een systeem met geautomatiseerde instrumentvalidatie en statistische procescontrole, volgens internationale normen. Dit maakt energieberekeningen, ladings-massabalans en factureringsrapporten over dampretours mogelijk.

KROHNE Nederland

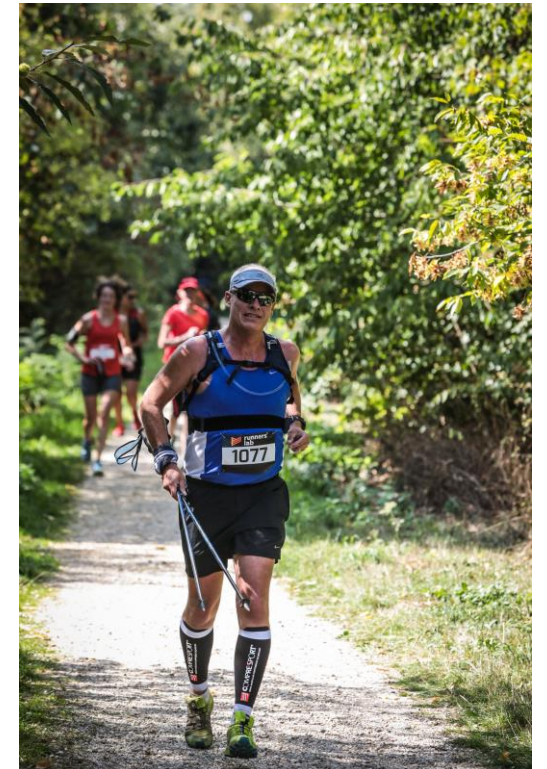


Productie Proces Automatisering

25 januari 2024 | Van der Valk Hotel, Vianen

Welcome

- **Tony van Weers**
- Product manager flow computer
- Hobbies:
 - Running
 - Trail running
 - Mountain biking



KROHNE

www.krohne.com

- Manufacturer of process instrumentation, such as flowmeter, pressure and temperature transmitters
- Metering systems
- Metering and monitoring software
 - Metering supervisory software
 - Pipeline leak detection
 - Analyzer Management (AMADAS)
 - LNG loading and quality release (LQRS)



Introduction

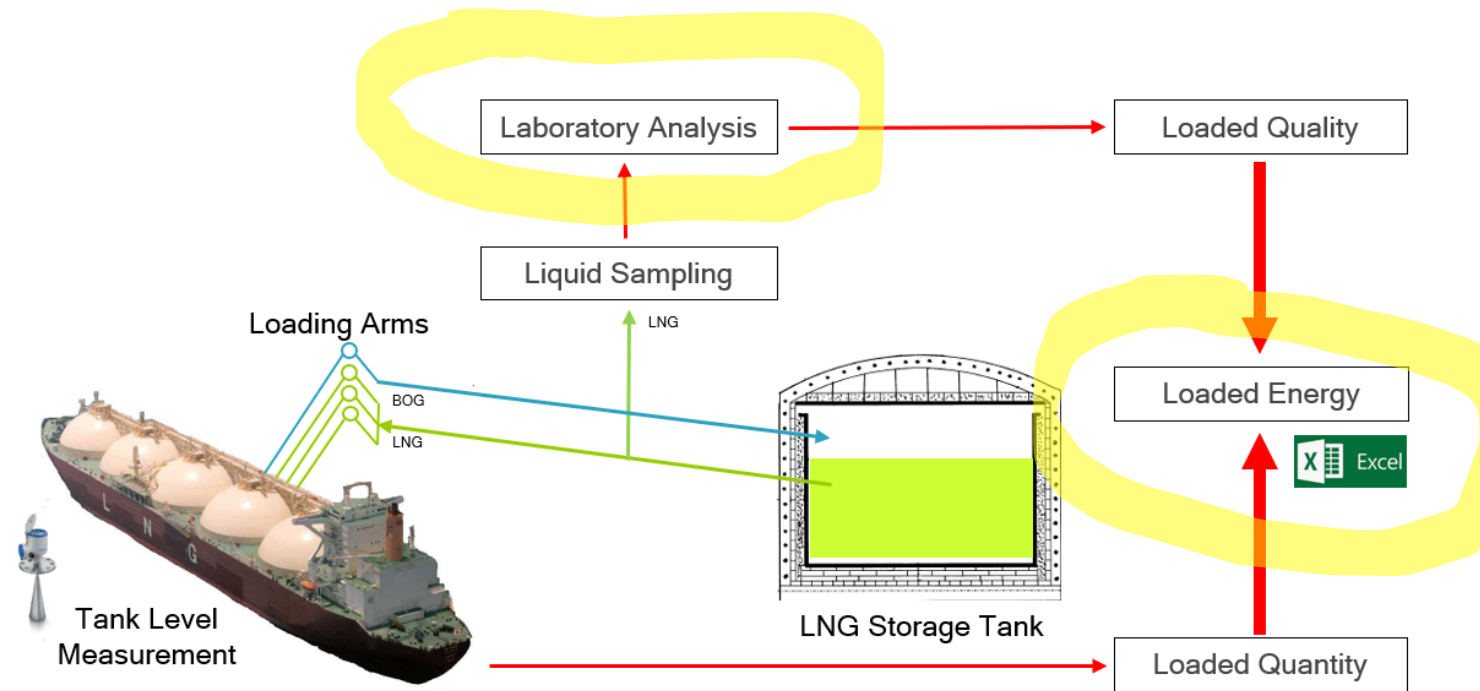
Current Situation and Associated Problems

LNG (un)loading requires as per GSPA (Gas Sales Purchase Agreement) a quality certificate and a bill of lading as a minimum to determine the amount of energy transferred.

The input for these documents is currently derived from multiple instruments and independent operated systems.

- The **Quantity** is determined with the level measurements on the LNG vessel and these measurements are the input for the bill of lading.
- The **Quality** is determined in a laboratory using samples collected during. The results are the input for the quality certificate.

All this data is manually collected and processed in mostly Excel based worksheets without traceable references to instrument uncertainties, standards and no dynamic validation.



Scope Description

Current Situation and Associated Problems

Reviewing the existing situation the following potential problems can be listed:

- Current systems allow introduction of human errors.
- Certificates of Quality are produced using DCS historians or external plant information systems such as PI and MS Excel
- Quality Data transferred through multiple interfaces with possible loss of resolution or loss of data due to filtering (ISO demands upto 6th decimal point)
- Calculations not validated or certified by an independent body such as NMI.
- Quality data is not traceable, and measurements often not in compliance with ISO/GPA standards
- No dynamic validation of data, while LNG loading is in progress.
- Validation of data is often done after the shipload with no means to reconcile if equipment had developed faults during the loading.
- Contractual clauses (including calculations) differs from site to site which could lead to wrong interpretations and calculations.
- Overall loading system is difficult to audit by the authorities
- This can be applied to any transfer of energy in the form of liquid or gas.



Introduction

What can be improved?

- Instant availability of bill of lading and quality certificates avoids costly retrospective corrections once the vessel has departed
- Elimination of human errors in the data processing by automated information flows
- Reduction of maintenance costs by an average of >25% appears to be feasible using the benefits of automated validation software
- Avoids discussions over the amount of energy transferred as system is indisputable compliant to GSPA and certified by NMI.
- Increasing availability of critical instruments ensuring constant and reliable quality measurements, less give-away.



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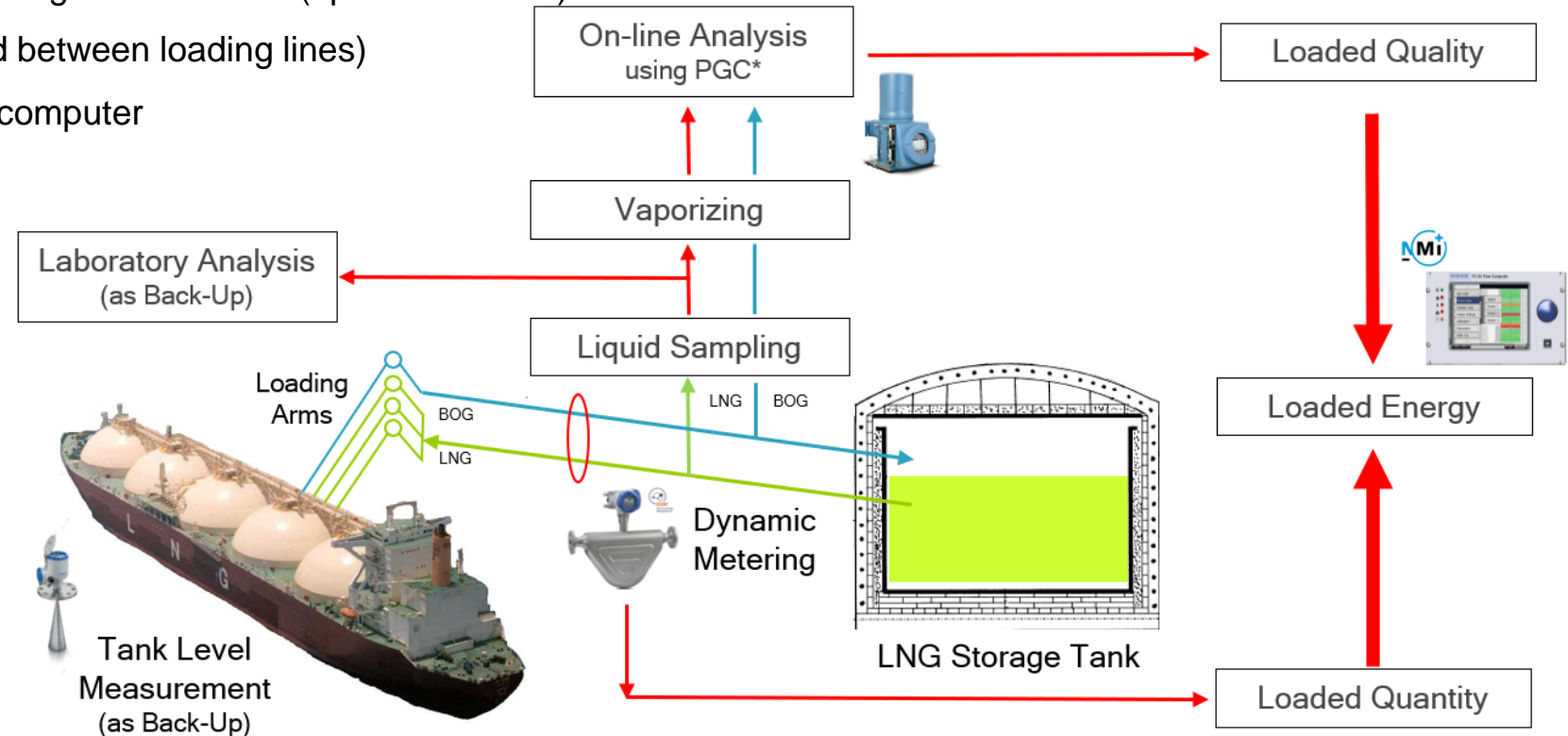
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Scope Description

Design Criteria

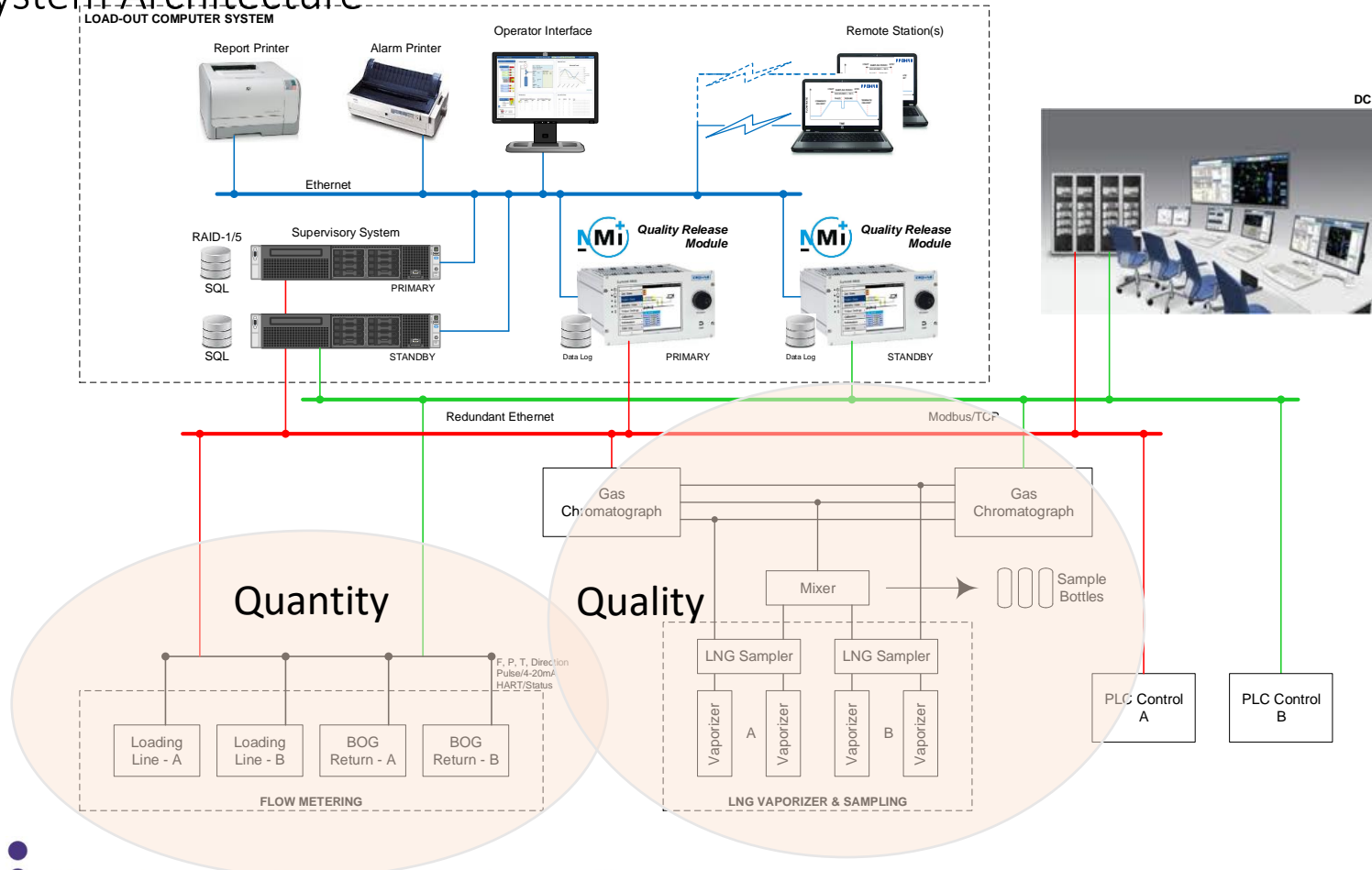
To benefit from the L-QRS the following is additionally required:

- Flow Measurement (incl P&T) on each loading and BOG line (optional for BoL)
- Quality Measurement (individual or shared between loading lines)
- L-QRS system with the Summit 8800 flowcomputer



System Architecture & Functions

Typical Plant System Architecture



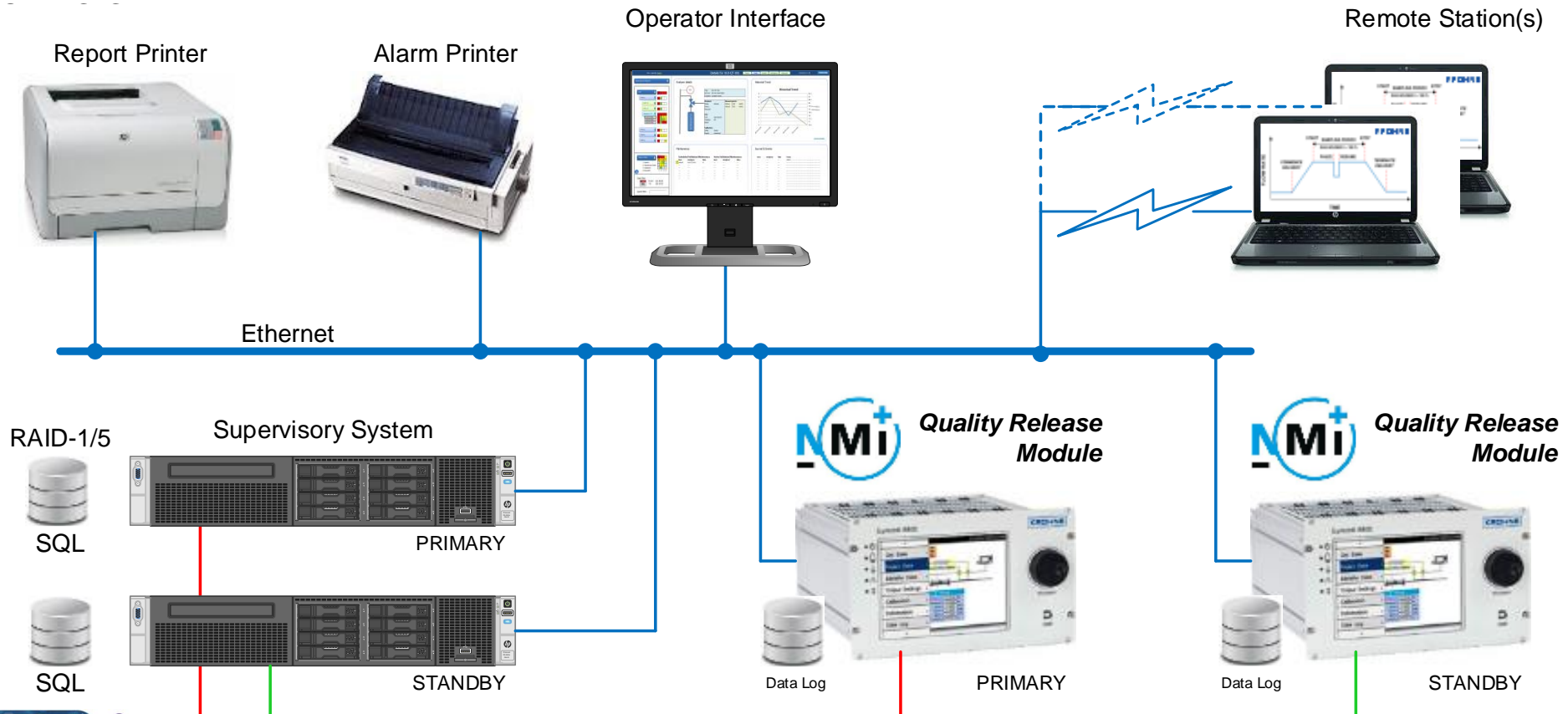
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System Architecture & Functions

System Architecture Redundant KROHNE L-QRS



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System Architecture & Functions

Summit 8800 Flowcomputer Functionality & SynEnergy®



Data Validation and Outlier Detection:

- Outlier detection on mass-based heating value as per ASTM E-178 (2000)
- Two-tailed testing (lowest and highest values), confidence 98%
- Repetitive test until all outliers excluded / outlier replaced with last good value
- Flow Weight Average (FWA) mass-based heating value is recalculated with outliers removed & replaced
- If more than x% outliers, data set is considered invalid

Note: All calculations certified by NMI

Reporting:

- Report calculations for
 - Total volume
 - Flow-weighted average for gas composition
 - Combined FWA for multiple loading lines
 - Total Energy based on L-QRS measured volume
 - Total Energy based on CTMS
 - PGC Coverage
- Certificate of Quality
- LNG Batch Report

Certificate of Quality
Gorgon LQCS
LNG LOADING LINES

Batch ID:	28May2023 26-40119
Shipment No:	Contract Delivery: 28May2023 05-0103
Vessel Name:	Terminal Delivery: 28May2023 29-40119
Gas Offer Name:	Sampling Start: 28May2023 05-0103
Target Cargo Size: 0	Sampling Stop: 28May2023 05-0306
LQCS System:	400 LQCS-0VCS / 400 LQCS-0VMS
	Sampling Rate: 2 / (Loading Line 1)

LOADING TESTS			
LNG Line	Batch Time 1	Batch Time 2	Unit
LNG Line 1	05:04:00	05:11:00	m³
Total	05:04:00	05:11:00	m³
Average WFA	794.0	794.0	kg/m³
WFA Coverage	100.00	100.00	%
WFA Temp. Dev.	0.00	0.00	kg/m³
WFA W. Sample	0.00	0.00	kg/m³
WFA Heating	0.00	0.00	kg/m³
LNG Line 2	05:11:00	05:18:00	m³
Total	05:11:00	05:18:00	m³
Average WFA	794.0	794.0	kg/m³
WFA Coverage	100.00	100.00	%
WFA Temp. Dev.	0.00	0.00	kg/m³
WFA W. Sample	0.00	0.00	kg/m³
WFA Heating	0.00	0.00	kg/m³

LOADING TESTS		TOTAL LOADING TESTS	
WFA Heating	WFA Temp. Dev.	WFA Heating	WFA Temp. Dev.
794.0	0.00	794.0	0.00
100.00	0.00	100.00	0.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

LOADING TESTS		TOTAL LOADING TESTS	
Total Volume	Total Energy	Total Volume	Total Energy
111.00	88.00	111.00	88.00
111.00	88.00	111.00	88.00
111.00	88.00	111.00	88.00
111.00	88.00	111.00	88.00



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System Architecture & Functions

SVC Instrument Management



Analyser Management (AMADAS)

- Gas chromatograph validation (prior to each ship load)
- Long term evaluation using control charts
- Gas chromatograph Calibration and Round Robin testing
- Pressure- and Temperature transmitter validation
- Vaporizer system validation (repeatability check)
- Instrument Availability Monitoring & Availability calculations
- Instrument Maintainability

Using the statistical benefits significant benefits can be achieved with regards to availability of critical analysers and instrumentation, auditable and traceable maintenance and calibration records and cost saving on maintenance.



System Architecture & Functions

HMI-Instrument Management

User: administrator
 Access Level: 9999
 Server Name: KOG-LOCS-SVC1

INSTRUMENT MANAGEMENT

21.01.07 28-May-2015 **KROHNE**

	Instrument	Description	OPERATION STATE				VALIDATION STATE				RESULT	Maint. Switch
			Not Operational	Disabled	Fault	Routine Maint	In Progress	Halted	Completed	Aborted		
			Non Routine Maint	Failed	Good	Satisfactory	Bad					
LNG Loading - Common	Gas Chromatograph A		●	●	●	●	●	●	●	●	●	●
	Gas Chromatograph B		●	●	●	●	●	●	●	●	●	●
LNG Loading - Line A	LNG Vaporiser A		●	●	●	●	●	●	●	●	●	●
	LNG Vaporiser B		●	●	●	●	●	●	●	●	●	●
	Pressure Transmitter											●
	Temperature Transmitter											●
	Flow Meter											●
	Vapo A Outlet											●
	Vapo B Outlet											●
	Vapo A Outlet											●
	Vapo B Outlet											●
LNG Loading - Line B	LNG Vaporiser A		●	●	●	●	●	●	●	●	●	●
	LNG Vaporiser B		●	●	●	●	●	●	●	●	●	●
	Pressure Transmitter											●
	Temperature Transmitter											●
	Flow Meter											●
	Vapo B Outlet											●
	Vapo A Outlet											●
	Vapo B Outlet											●
	Vapo A Outlet											●
Boil Off Gas - Common	Gas Chromatograph		●	●	●	●	●	●	●	●	●	●
Boil Off Gas - Return Line 1	Pressure Transmitter											●
	Temperature Transmitter											●
	Flow Meter											●
Boil Off Gas - Return Line 2	Pressure Transmitter											●
	Temperature Transmitter											●
	Flow Meter											●
Bypass Line 1	Pressure Transmitter											●
	Temperature Transmitter											●
Bypass Line 2	Pressure Transmitter											●
	Temperature Transmitter											●

Date	Time	State	Tag	Group	Alarm description
28 May 2015	16:59:31	UNACK	LOC_QFC_S4_TE_ACC_SNR_1_INVALID	QFC	BOG Return Line 2 - Temperature sensor 1 invalid alarm
28 May 2015	16:59:31	UNACK	LOC_QFC_S4_TE_ACC_SNR_1_MIN	QFC	BOG Return Line 2 - Temperature sensor 1 minimum alarm
28 May 2015	16:59:31	UNACK	LOC_QFC_S2_TE_ACC_SNR_1_MIN	QFC	LNG Loading Line 2 - Temperature sensor 1 minimum alarm
28 May 2015	16:59:31	UNACK	LOC_QFC_S2_PR_ACC_SNR_1_MIN	QFC	LNG Loading Line 2 - Pressure sensor 1 minimum alarm
28 May 2015	16:59:31	UNACK	LOC_QFC_S2_PR_ACC_SNR_1_INVALID	QFC	LNG Loading Line 2 - Pressure sensor 1 invalid alarm
28 May 2015	16:59:31	UNACK	LOC_QFC_S2_USC_ACC_RATIO_HF	QFC	LNG Loading Line 2 - Pulse ratio HF alarm
28 May 2015	16:59:31	UNACK	LOC_QFC_S3_TE_ACC_SNR_1_INVALID	QFC	BOG Return Line 1 - Temperature sensor 1 invalid alarm

Validate	Validate
Validate	Validate
Maintenance Log	Maintenance Log
Report	Report
Manufacturer Docs	Manufacturer Docs
Analysis Entry Tool	Analysis Entry Tool
References	References
Parameters	Parameters
Activate MON2020	Activate MON2020
Activate Daniel FM	Activate Daniel FM

Instrument Mgt.	Sampling System
Line 1	BOG 1
Line 2	BOG 2
LNG Loading	BOG Return

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System Architecture & Functions

HMI-Instrument Management

Instrument	Description	OPERATION					VALIDATION					Maint. Switch				
		STATE					STATE			RESULT						
		Not Operational	Utilised	Fault	Routine Maint	Non Routine Maint	In Progress	Halted	Completed	Aborted	Failed		Good	Satisfactory	Bad	
Gas Chromatograph A		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Gas Chromatograph B		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
LNG Vaporiser A		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
LNG Vaporiser B		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pressure Transmitter		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Temperature Transmitter		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Instrument	Description	OPERATION					VALIDATION								
		Not Operational	Utilised	Fault	Routine Maint	Non Routine Maint	In Progress	Halted	Completed	Aborted	Failed	Good	Satisfactory	Bad	Maint. Switch
Gas Chromatograph A		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Gas Chromatograph B		●	●	●	●	●	●	●	●	●	●	●	●	●	●
LNG Vaporiser A		●	●	●	●	●	●	●	●	●	●	●	●	●	●
LNG Vaporiser B		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pressure Transmitter		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Temperature Transmitter		●	●	●	●	●	●	●	●	●	●	●	●	●	●



Customer Benefits

Basic Number Crunching

Typical key figures for LNG loading operation:

- Annual number of (un)loadings: 50
 - Average amount of LNG per batch: 65 – 80 M Euro
 - Typical uncertainty level: 0.5 – 0.7%
 - Annual costs for disputes: 0.65 MEUR
 - Annual maintenance costs: 0.24 MEUR
- => 3,250 – 4,000 M Eur / year
(@95% confidence acc. GIIGNL)
(1% of cargo value every 1 out of 50 loadings)

Once L-QRS is installed and operational improvement is expected in the maintenance costs, amount of disputes and availability resulting in less product give-away.

- Increased QMI availability reduces the uncertainty (subject to location): 0.01% (?) * 3,250 M EUR = 325 kEUR
 - No more disputes as all data is traceable and available real-time: 650 kEUR
 - 25% on annual maintenance costs: 60 kEUR
- Total annual saving for LNG operator / train: 1,035 kEUR**



More info

<https://krohne.com/en/solutions/monitoring-solutions/supervisory-validation-software>



LNG-Quality Release System (L-QRS)

Software solution for efficient LNG loading operations

- Instant availability of both certificate of quality & bill of lading, based on real-time quality measurement
- Certified by NMI and compliant with ISO 8943, GPA 2172, ASTM 4784, GIIGNL
- Automated instrument validation and statistical process control according to international standards...

> View solution details



SynEnergy Supervisory and visualisation software

Solution for continuous process monitoring and reporting

- HMI/SCADA software for measurement solutions
- State of the art HTML5 secure web technology
- Optimisation of operation results due to predictive maintenance
- Easy integration into existing DCS and ERP networks

> View solution details



CalSys Analyser Management software

Solution for analyser management and data acquisition (AMADAS)

- Effective performance monitoring of quality measurement instruments (QMI)
- Automated analyser validation, statistical process control and increased availability of critical process analysers
- Complies with international standards and methods (ASTM D3764, ASTM D6299, OP 97-30425 etc.)...

> View solution details

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Conclusion

- Even in our highly automated world we still can improve automation
- Elimination of human actions give trust in a system
- Reduction of maintenance costs by an average of >25% possible
- Avoids discussions due to certified systems for the amount of energy transferred
- Increasing availability of critical instruments results in less give-away.



Questions & Answers

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Thank you for your attention!



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