



Imtech quality reporting module

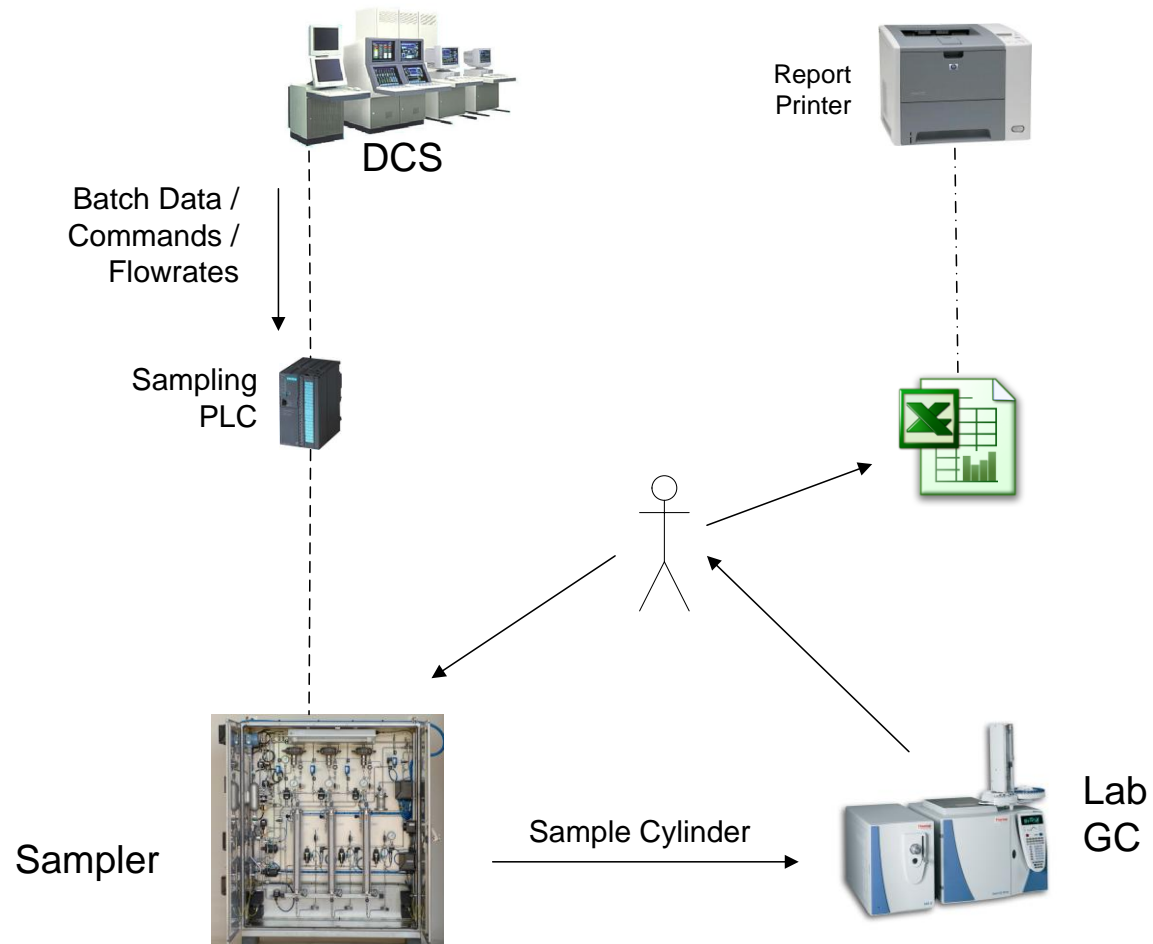
iQRM

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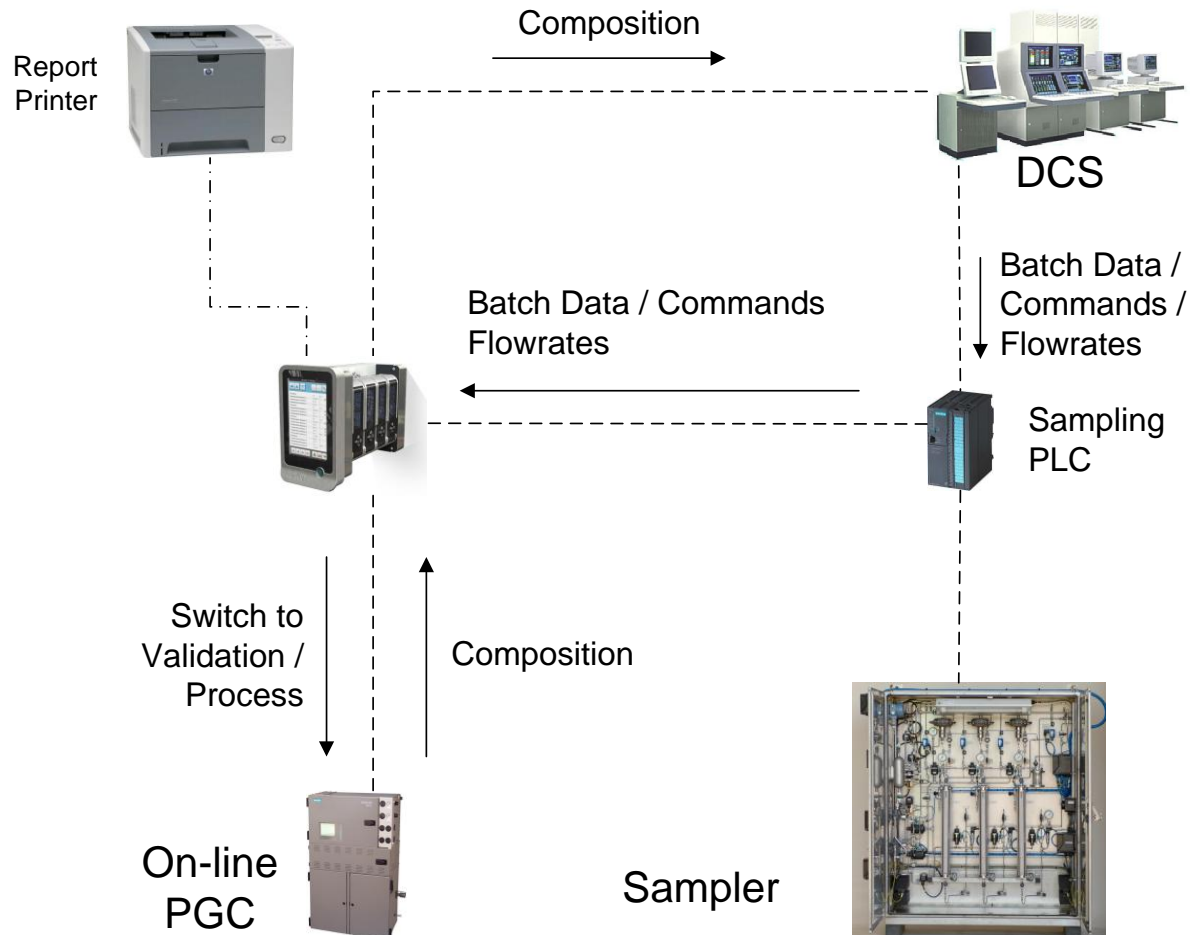


Current Situation





Situation with iQRM





iQRM Goal

Improve the determination and reporting of the average gas composition:

- Minimize human errors**
- Undisputable Certificates of Quality (CoQ)**
- Automated PGC Validation and statistical process control**



iQRM Main Features

- **Automated generation of a Certificate of Quality (CoQ).**
- **CoQ is based on-line PGC Measurements**
- **Certification by an independent notified body.**
- **Synchronization with the LNG Sampler in the field**
- **Automated PGC validation**
- **Statistical Process Control**



Platform

iQRM Hardware

FlowX/M flow computer module

- One module refers to one PGC.
- Multiple communication ports and I/O connections.
- Runs iQRM application.
- NMI Approved / Certified Module.





Platform

iQRM Hardware

Panel mounted FlowX/P

- 7" color touch screen.
- Sealed and secured system
- Multi-stream calculations
- Up to 4 FlowX/M modules per FlowX/P





Platform

iQRM Software

■ FlowX/P

- User interface
- Extended Communication features

■ FlowX/M

- Application software for one PGC
- Compliant to international standards

```
#include <stdio.h>

main()
{
    printf("hello, world\n");
}
```




Platform

iQRM Software Platform

- Certified standard application software
- Secured access
- Configurable to meet on site applications



iQRM Functions

iQRM Software

■ Loading

- Read PGC Measurements
- Evaluate measurement results
- Calculate flow weighted average composition
- Generate and print CoQ



iQRM Functions

iQRM Software

- Single Point Validation
 - Runs automatically
 - Starts automatically (time based) or Manually.
 - Evaluated validation results
 - Generate and print validation report



iQRM Functions

iQRM Software

- Perform a multi point validation session
 - Semi automatic
 - Not related to single point validations
 - Not related to loadings
 - Results can be uploaded for off-line PGC performance evaluation



Product

Liquefied Natural Gas (LNG)

- Composition measured by PGC:
C1, C2, C3, iC4, nC4, iC5, nC5, C6+, N2 and CO2,
with C6+ representing C6 and heavier fractions.
- Other components can be added. (e.g. Argon)
- iQRM focus is currently on LNG (un)loading systems.
- iQRM version for 24/7 systems under investigation.



Single Point Validation

Validation Session

- An ongoing loading postpones starting a new validation.
- Configurable Validation time interval
- Configurable Validation validity period
- iQRM performs the validation automatically
- Validation sessions may FAIL or PASS



Single Point Validation

Evaluation

- Calculate mean and standard deviation of PGC readings.
- Add results to Control Charts and apply Decision Rules to determine validation result.
- A result is either “**GOOD**” or “**BAD**”
- iQRM can calculate GHV and RD values acc. ISO6967 or GPA2172:1996 and cross check with PGC values.



Single Point Validation

Control Charts

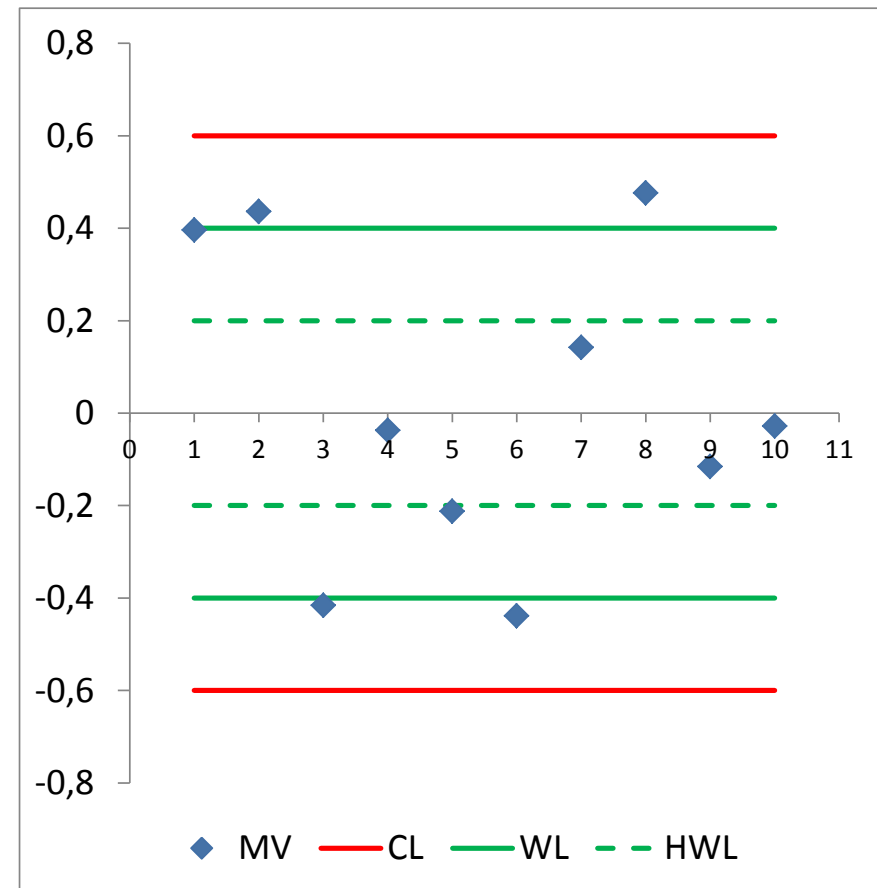
- Collection of mean and standard deviation results of the latest single point validations.
- Control Charts restarts when:
 - Validation gas changes
 - PGC is calibrated
 - Number of validation readings changes
 - Decision rules changes



Single Point Validation

Decision Rules

- Control Limit Check
- Warning Limit Check
- Half Warning Limit Check
- Offset Check
- Trend Check





Single Point Validation

Company Logo		Validation Report						Imtech					
Validation ID:	234	Start Validation:	1-jan-2012	6:00:00	Printed:	1-jan-2012	18:01:53						
		End Validation:	1-jan-2012	18:00:00									
Component	Reference Val Gas	Measured						Calculated				Result	
Gas Bottle ID:	123	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5	Cycle 6	Mean	Std. dev.	Error (Mean)			
	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	%		
Methane	90,00	90,014019	90,040389	90,056253	89,974085	89,982260	89,992988	90,009999	0,032948	0,009999	0,011	Good	
Ethane	6,00	5,999384	5,972665	5,958883	6,007577	5,998741	5,999207	5,989409	0,019104	-0,010591	0,177	Good	
Propane	2,00	1,996919	1,995163	1,988993	2,006902	2,016891	2,010590	2,002576	0,010576	0,002576	0,129	Good	
i-Butane	0,30	0,299023	0,299708	0,299681	0,302356	0,300220	0,299433	0,300070	0,001186	0,000070	0,023	Good	
n-Butane	0,30	0,298120	0,299658	0,298420	0,300162	0,300265	0,300941	0,299594	0,001108	-0,000406	0,135	Good	
i-Pentane	0,05	0,049825	0,049886	0,049639	0,050296	0,050412	0,049910	0,049995	0,000297	-0,000005	0,011	Good	
n-Pentane	0,02	0,020034	0,019850	0,019878	0,020135	0,020015	0,020068	0,019997	0,000111	-0,000003	0,017	Good	
Hexane plus	0,03	0,030007	0,030047	0,029966	0,030100	0,030233	0,030087	0,030073	0,000093	0,000073	0,245	Good	
Nitrogen	0,30	0,299223	0,297541	0,297945	0,301904	0,299986	0,299932	0,299422	0,001581	-0,000578	0,193	Good	
Carbon Dioxide	1,00	0,993446	0,995094	1,000343	1,006482	1,000978	0,996845	0,998865	0,004740	-0,001135	0,114	Good	
GHV	54,00	Measured by PGC (MJ/kg)						MJ/kg	MJ/kg	MJ/kg	%		
		54,154107	53,880900	54,211123	53,920227	53,852444	53,983906	54,000451	0,148930	0,000451	0,001	Good	
		iQRM calculation according ISO 6976 (MJ/kg)											
		54,046873	54,048233	54,029832	54,105031	53,874505	54,104843	54,034886	0,084716	0,034886	0,065	Good	
GHV Cross Check		0,107234	-0,167334	0,181290	-0,184804	-0,022061	-0,120937		0,151338	-0,034435	0,064	Good	
Relative Density	0,62	Measured by PGC									%		
		0,619784	0,619323	0,621693	0,622221	0,617830	0,620196	0,620175	0,001604	0,000175	0,028	Good	
		iQRM calculation according ISO 6976											
		0,619672	0,619985	0,619314	0,618569	0,619087	0,620401	0,619505	0,000655	-0,000495	0,080	Good	
RD Cross Check		0,000112	-0,000662	0,002379	0,003652	-0,001257	-0,000206		0,001917	0,000670	0,108	Good	
Validation Status:	GOOD												
Witnessed by	Name:						Witnessed by	Name:					
	Company:							Company:					
	Date:							Date:					
	Signature:							Signature:					



Loading

Starting a Loading

- Trigger from DCS or other system.
- A loading prevails over a validation.
- A loading does not start when validation result is “**BAD**”.
- A loading starts when validation result is “**GOOD**”, even when the validation is expired.



Loading

Procedure

- Collect PGC from start to end of loading.

- PGC readings are marked as “Invalid” when:
 - Loading is paused.
 - LNG inlet vaporizer temperature too high.
 - Sample temperature at accumulator too low.



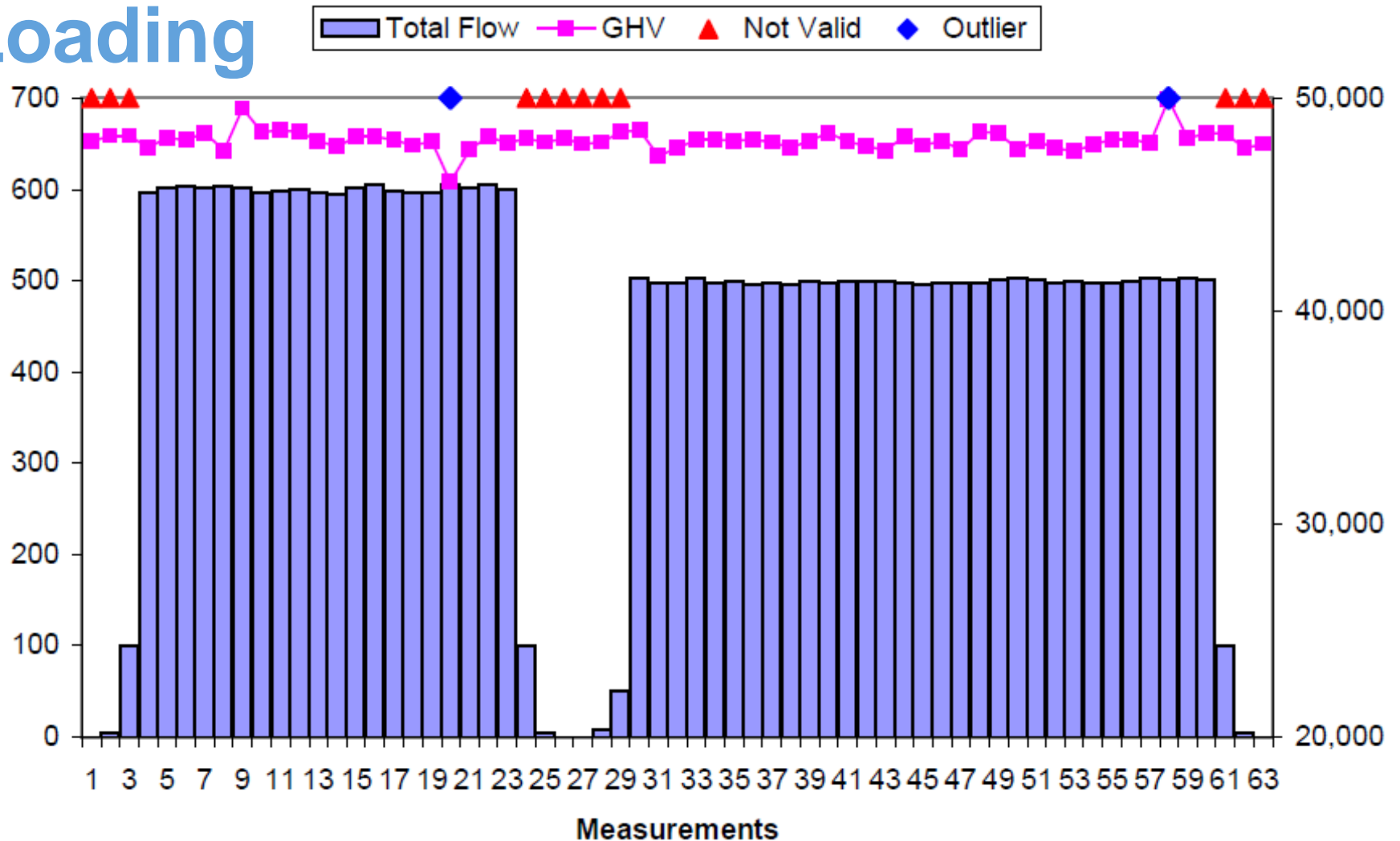
Loading

Measurement Analysis

- Valid measurements undergo Grubbs outlier checks on GHV.
- Average composition will be determined based on valid measurements without outliers.
- Average calculation can be Time proportional and Flow weighted.

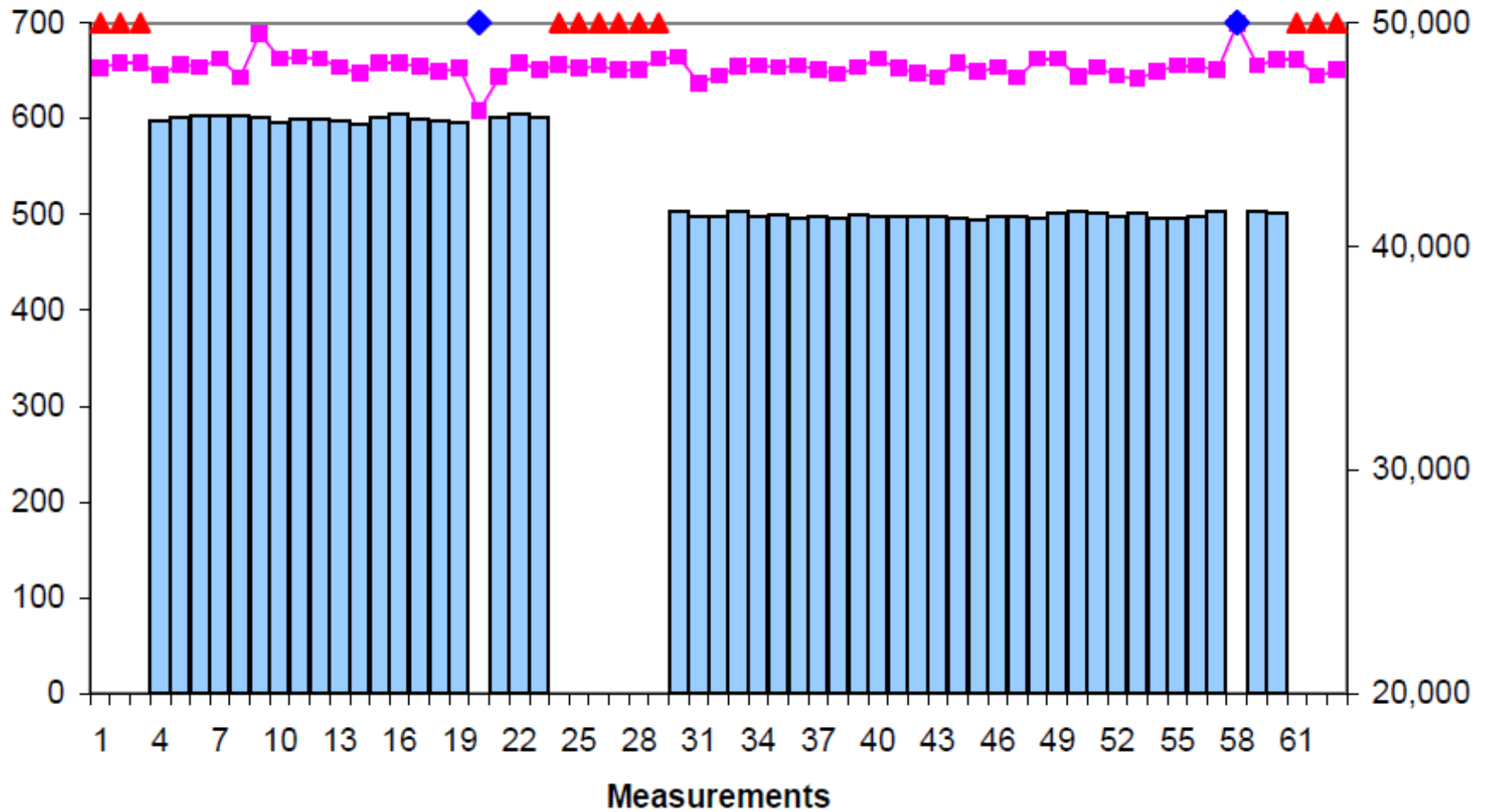


Loading





Loading





Loading

Typical Certificate of Quality (CoQ) contains:

- Unique loading ID
- Reference to Last Validation
- Start and End loading date and time
- PGC measurement coverage of loading
- Average Composition, GHV and RD
- Number of used measurements, invalid measurements, found outliers



CoQ, printed automatically

Company Logo												Certificate of Quality															
Loading ID:		2345		Start Loading:		1-jan-2012		6:00:00		Total Registered Loading Flow				34362		m ³											
Last Validation ID:		234		End Loading:		1-jan-2012		18:00:00		Flow covered by PGC Measurements				31795		m ³											
				Printed:		1-jan-2012		18:01:53		Percentage covered by PGC measurements				92,53		%											
Average Composition																											
C1	C2	C3	iC4	nC4	iC5	nC5	C6+	N2	CO2	GHV	RD	Number of measurements used				53											
mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	MJ/Sm ³		Number of invalid measurements				8											
90,00119	5,99951	1,99882	0,30007	0,30024	0,04999	0,02000	0,03001	0,30056	0,99961	47,934	0,623	Number of rejected outliers				2											
Witnessed by						Witnessed by						Witnessed by															
Name:						Name:						Name:															
Company:						Company:						Company:															
Date:						Date:						Date:															
Signature:						Signature:						Signature:															



Multi Point Validation

Purpose

- Off-line PGC performance evaluation over a certain measurement range carried out by an independent third party. (e.g. acc ISO-10723)
- iQRM supports up to 7 validation gas mixtures
- Results can be uploaded for off-line evaluation
- Results are not used within the iQRM



Reports

Main Reports

- Single Point Validation report
- Certificate of Quality

Additional Reports

- Measurement table of loading
- Multipoint Validation report
- Controls Charts
- Alarm and Event Log
- Parameter Change report
- Snapshot report



Security

Sealed off Hardware Switch

User levels secured with passwords

- Guest
- Operator
- Engineer
- Administrator



Benefits

- CoQ printed immediately after loading.
- No human interference.
- Standardized CoQ reports with uniform performance evaluation.
- Traceability to validation report and SI standards.
- Secured platform with certified application.
- Parameter change traceability.
- Scheduled automatic validation.
- Uniform evaluation using control charts.
- Less laboratory resources required.



Contact details

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