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CCUS OFFERINGS BY QUORUM

QUORUM SOFTWARE

SUMMARY

Quorum Software is a leading provider of energy software worldwide, serving more than 1,800 customers across the entire energy value chain in over 55 countries. Quorum's solutions power growth and profitability for energy businesses by connecting people, workflows, and systems with decision-ready data. Twenty years ago, we delivered the industry's first software for gas plant accountants, and today our solutions streamline business operations with industry-forward data standards and integrations. The global energy industry trusts Quorum's experts and applications to successfully navigate the energy transition while delivering value today and into the future.

For more information, visit **www.quorumsoftware.com.**

Quorum is developing solutions for the energy transition in many different areas including a) Carbon Capture, Utilization, and Sequestration b) Corporate Planning & Strategy c) Emissions Management d) Hydrogen & RNG, and e) Utility Scale Renewables. Below we outline a portion of our energy transition portfolio specific to CCUS. For a complete picture, please see our website:

https://www.quorumsoftware.com/solutions/energy-transition/

BENEFITS

- In-depth analysis to support decision-making
- Understand the value of your assets and unlock their hidden value
- Greater consistency across asset teams
- Spend less time compiling data and ensuring data quality
- Transparency and governance to your data and processes
- Future-proof your business as the energy transition accelerates

DESCRIPTION

CARBON STORAGE RESOURCES MANAGEMENT

In a low-carbon environment, underground CO_2 storage has the potential to be a cash-flow generating asset. This includes both mature, operational CCS projects as well as immature, future CCS projects. Like all corporate assets, CO_2 storage owners should track and estimate the value of all CO_2 storage assets. Quorum's Carbon Storage Resources Management solution enables CCS operators to analyze the capacity of their CO_2 storage assets and understand how that capacity is changing over time.

Benefits

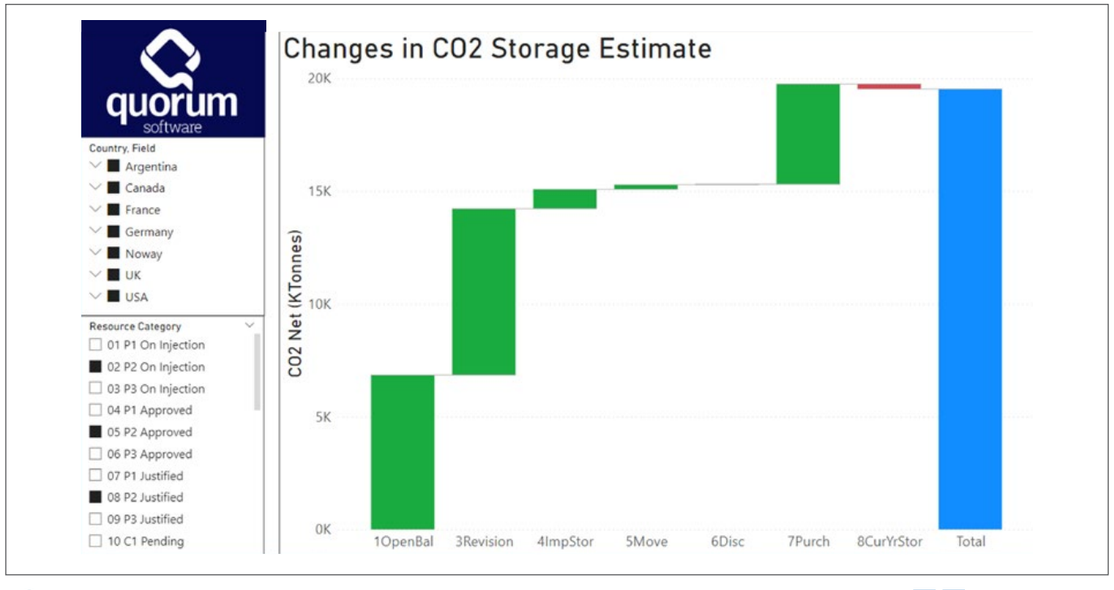
- Track and analyze the full portfolio of CO_2 storage assets – Quorum's Carbon Storage Resources Management application serves as a single source of truth for a full portfolio of CO_2 storage assets.
- Supports SPE's CO_2 Storage Resources Management System (SRMS) - align with the industry standard framework for managing and reporting CO_2 storage resources.
- Spend less time gathering data – engineers will have more time to analyze storage resources data and support decision-making.
- Reduce risk of data entry errors – company-specific data quality checks to identify errors early in the data gathering workflow.
- Scalable for companies of all sizes - from small independents to international supermajors, companies around the world can take advantage of our solution.
- Future proof your CO_2 storage business – capture and report CO_2 storage resource estimates in a structured manner in preparation for future regulatory requirements.

Description

Quorum's Carbon Storage Resources Management is a cloud-based solution that captures storage estimates across a resource owner's full portfolio of assets from mature, operational projects to less mature contingent or prospective storage resources. It is a best practice for a resource owner to gather estimates for all storage assets – to understand their value in the context of all corporate assets and prioritize investment accordingly.

The capacity of CO_2 storage assets changes year-over-year for a variety of reasons such as reservoir performance or economic conditions. Quorum's Carbon Storage Resources Management solution reconciles year-over-year changes allowing a CO_2 storage owner to understand which factors are driving fluctuations in estimated reservoir capacity. The diagram below illustrates the change in CO_2 storage estimates over the course of a year. The starting estimate is represented by the bar on the left side. The ending estimate is represented by the bar on the right side. The items in between reconcile the difference in starting and ending estimates due to technical or economic factors:

Quorum's Carbon Storage Resources Management application is an extension of one of Quorum's world-class software applications. Our application, Quorum Reserves, is used by oil and gas producers to track, estimate, and analyze oil and gas volumes in underground reservoirs. The same technology in Quorum Reserves has been used for Quorum's Carbon Storage Resources Management software application.



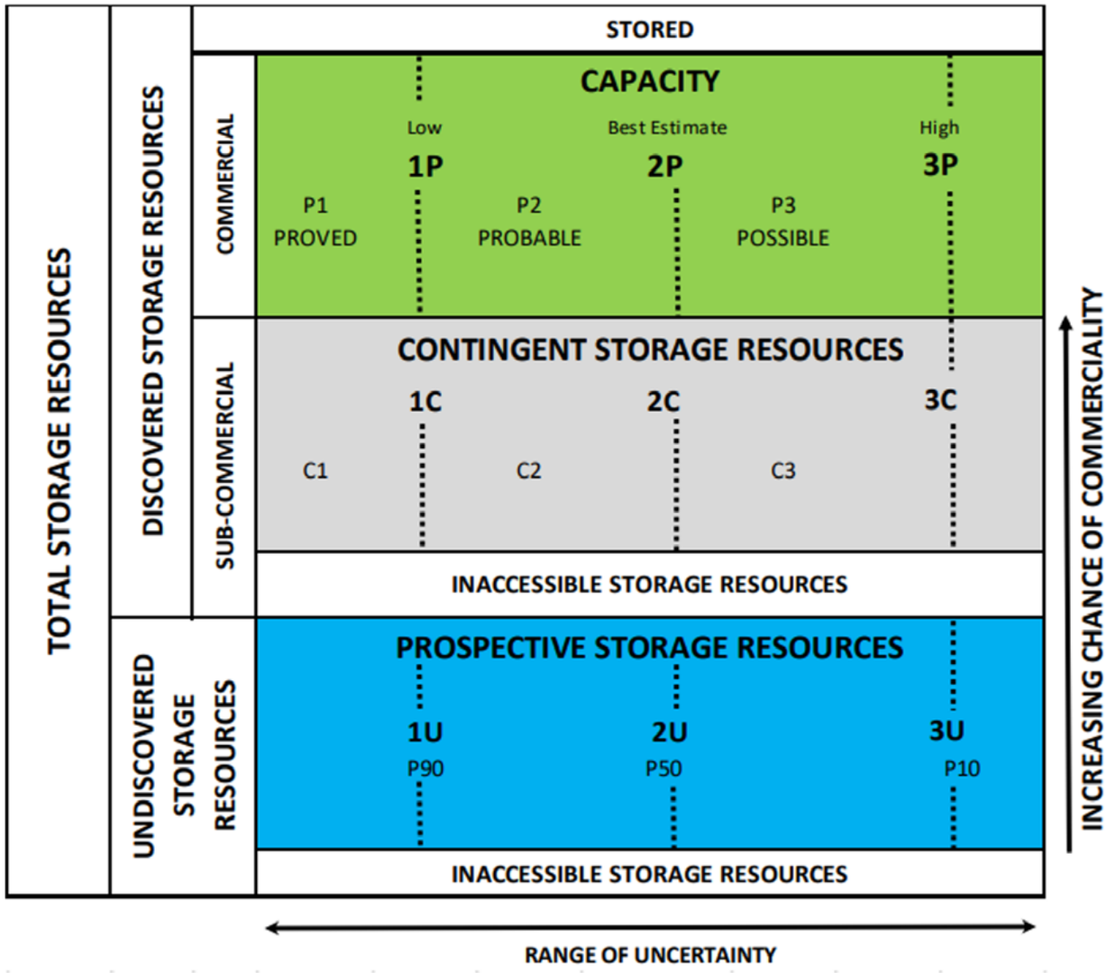
Storage Resources Management Standard (SRMS)

The Society of Petroleum Engineers (SPE) has developed a common framework for resource owners to account for CO_2 storage resources called the Storage Resources Management Standard (SRMS). Quorum's Carbon Storage Resources Management application aligns with the SRMS framework.

The above diagram illustrates the structure of the SRMS framework. It has two axes. The vertical axis indicates the maturity of a CCS project which is measured by the chance of commerciality. The most mature projects are accounted for as "capacity", followed by 'contingent storage resources' and finally the least mature "prospective storage resources." The horizontal axis indicates the range of uncertainty of CO_2 storage capacity in a resource. As a project matures toward commerciality there is typically a narrower range of uncertainty. Resource owners usually capture three deterministic estimates of a CO_2 storage resource: a low estimate, a best estimate, and a high estimate.

A standardized framework such as the SRMS empowers CCS operators to have a common basis of understanding to describe CO_2 storage resources in different jurisdictions across different companies. Quorum's Carbon Storage Resource Management application aligns with the SRMS framework. Like other resource-based industries, Quorum foresees a regulatory environment that requires CCS operators to publicly disclose their CO_2 storage resources using a framework such as the SRMS. Quorum recommends that operators future-proof their CO_2 storage business by adopting a standardized, auditable application to capture storage resource estimates.

Please see our website: *https://www.quorumsoftware.com/solutions/energy-transition/carbon-capture-utilization-and-sequestration/carbon-storage-resources-management/*



PETROVR

Planning and developing Carbon Capture, Utilization and Storage projects necessitates the integration of the input of many technical and commercial functions. The quality of this integration, together with the ability to assess effectively and transparently all alternative development options, is essential to maximising the value of these projects. Furthermore, these projects are fraught with uncertainties, from the storage capacity, the costs and performance of all the wells and facilities involved as well as scheduling of the execution and operational activities. Throughout the maturation of these projects, storage owners are faced with decisions such as how many CO_2 injection wells are needed, what should the capacity of transmission pipelines and/or processing facilities be, and how to manage risks associated with the development? Each of these decisions will impact the success of the project both in terms of financial success and amount of CO_2 that can be captured and safely stored. Quorum's PetroVR application empowers engineers and planners to assess and compare all the development alternatives available, factoring in the impact of the risks and uncertainties into the decision-making process throughout the maturation process of these large and complex CCUS projects.

Benefits

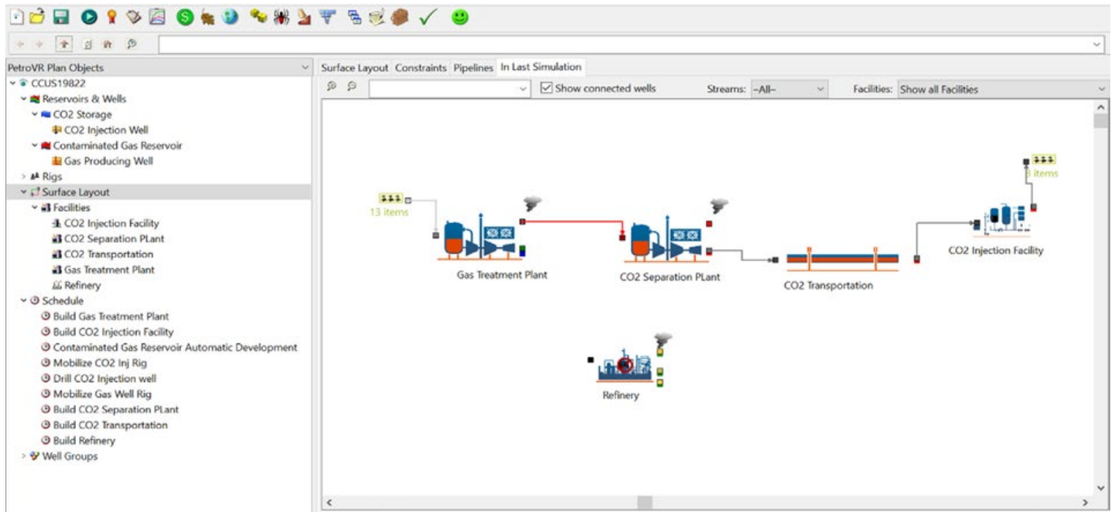
- Enhance CCUS project evaluation through integrating simulation covering all technical and commercial aspects in one single application.
- Streamline CCUS project evaluation by integrating simulation of all technical and commercial aspects into a single, comprehensive application.
- Improve the quality of the CCUS project development decisions throughout the project maturation process with the ability to assess and compare transparently and consistently the various development alternatives available, understand the trade-offs between these, and select the one that fits best your corporate strategic objectives. Understand the impact of the project risks and uncertainties and factor this into the decision-making process.
- Simulate the development of your CCUS project under uncertainties through Monte Carlo analysis.
- Manage production goals and net-zero commitments – actualize the challenges of net-zero development with easily configurable tooling to enable development planning and production optimization.

Description

Quorum's PetroVR application is a comprehensive full-cycle, integrated simulation software for exploration and development projects including specific functionalities to cover the CCUS use-case.

PetroVR is built on more than 20 years of oil & gas field development experience. It permits engineers and planners to configure the model of their asset as necessary to reflect specific areas of complexity. It has an integrated simulation capability where users can specify any object and associated activities necessary to model their project throughout its life cycle. This includes reservoirs, wells, and facilities but also specific CO_2 storage: CO_2 injection wells and CO_2 injection facilities. An illustration is provided in the figure below.

The application simulates the project execution and operation in a time step fashion covering the entire life of the project, consistently applying inputs, constraints and rules as specified by the user and thereby computing the expected production and injection volumes as well as the associated costs incurred through time, allowing the assessment of the economic viability of the project.



quorum software

GLOBAL CCS INSTITUTE

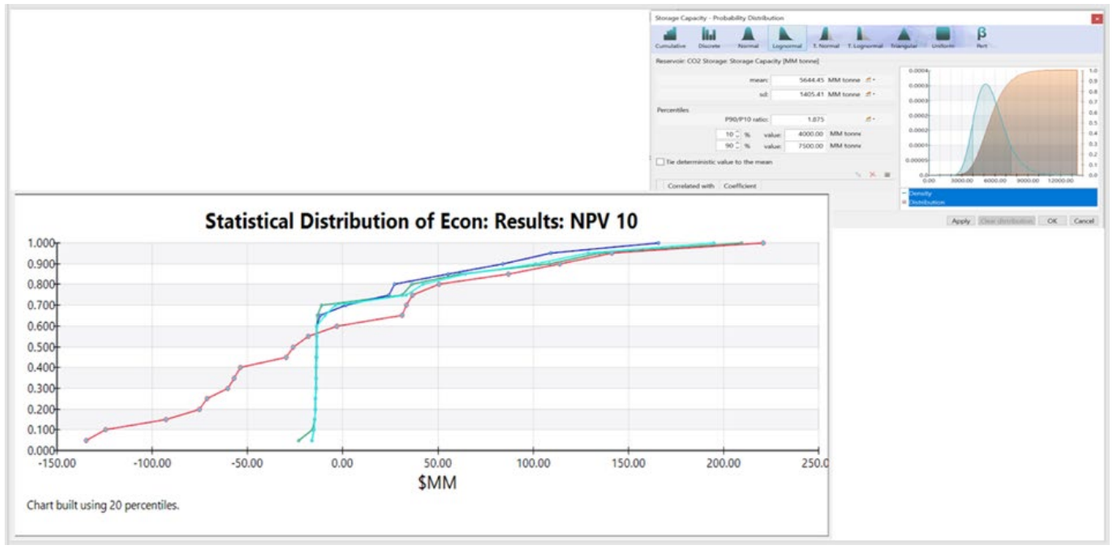
In addition to simulation capabilities, PetroVR has an advanced scenario manager enabling the easy and transparent generation of alternative development scenario models. This functionality facilitates the comparison of the development alternatives identified by the user making the "what if" analysis easy, transparent, and greatly enhancing the ability to generate insights into the trade-offs between decisions.

Many project engineers and planners rely on aggregating inputs from various spreadsheets to model their field development plan and possible alternatives. While spreadsheets are flexible, they are prone to errors. The approach is often cumbersome, time-consuming and does not offer any standardization across asset teams. PetroVR permits companies to replace spreadsheet modelling with a powerful business simulation approach that integrates all the elements of their project.

The PetroVR application facilitates probabilistic analysis through its easy-to-use Monte Carlo functionality. Users can specify the range of uncertainty for every input variable that they need to consider in the evaluation of the project and generate the full range of expected outcome for any selected value measure reflecting all the uncertainties specified (see example below). CCUS are large and complex projects with many technical uncertainties as well as commercial. Factoring these uncertainties in the decision-making process is essential.

Quorum's PetroVR application has a long-standing track record of adding value and reducing risks associated with field development. CCUS operators can take advantage of this application's powerful simulation, scenario analysis and probabilistic evaluation capabilities to guide and support their project development decision-making.

Please see our website: *https://www.quorumsoftware.com/solutions/planning-economics-reserves/asset-development-planning/petrovr/*



FLOWCAL

The Carbon Capture and Storage (CCS) process involves collecting (capture) CO_2 from industrial processes or from the atmosphere, transporting the CO_2 via pipelines and injecting it into underground geologic formations. During this highly technical process, CO_2 is handled in both gas and liquids (supercritical) phases making accurate measurement data management both a challenge and a requirement for successful and ongoing profitability of CCS projects.

The responsibility of custody transfer measurement points means CO_2 must be measured and correctly accounted for at the capture point, pipeline inlets, pipeline outlets, pipeline linepack/inventory, storage injection points, and finally, the storage inventory must also be tracked and balanced. A CCS operator must have a strong toolset to consolidate, review, correct and distribute an immense amount of measurement data across the organization. In addition, the CCS operator must perform this with the knowledge that the measured CO_2 and inventory are accurate to minimize legal and financial exposure and maximize revenue.

FLOWCAL by Quorum is the tool that enables CCS operators manage CO_2 measurement data.

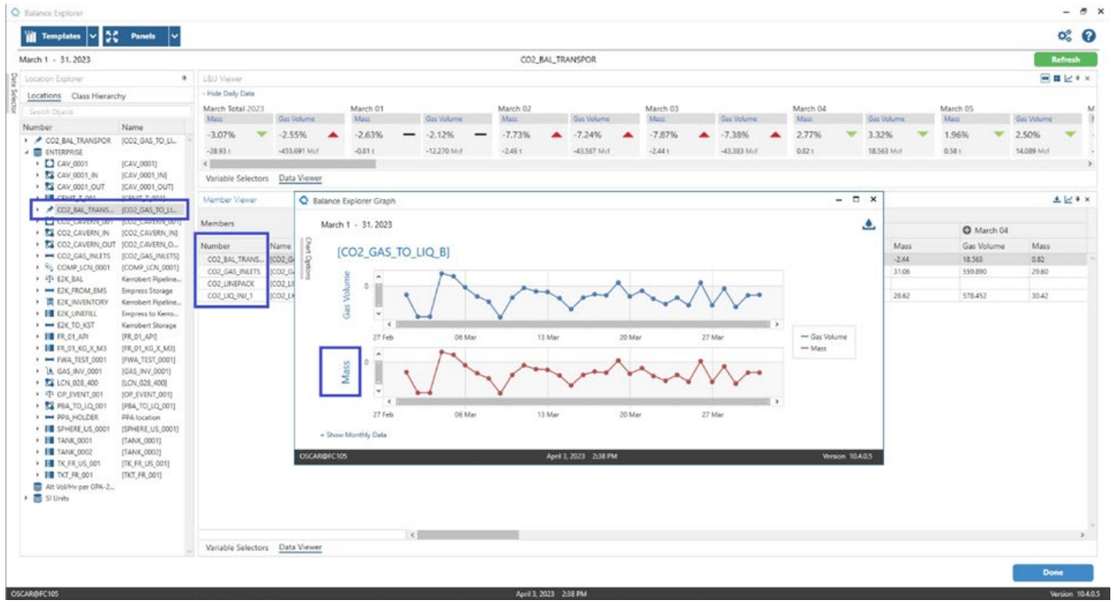
Benefits

- Support for CO_2 measurement in both gas and liquids (dense) phase
    - Support for a wide range of metering technologies such as coriolis, ultrasonic, orifice, linepack/linefill, caverns, etc.
- Compliance with measurement industry standards and regulations
- Physical balancing by volume and mass
- Meet internal and external audit requirements.
- Financial risk reduction/elimination

Description

FLOWCAL by Quorum Software is one of the most robust measurement data management systems available, streamlining the measurement process and optimizing data integrity. Designed to operate as a data warehouse capable of serving the needs of an entire organization, FLOWCAL provides a corporate solution for the most demanding system requirements. It can be applied to CO_2 measurement, hydrocarbon measurement (gas and liquids), helium and hydrogen measurement.

FLOWCAL is used by the largest energy producers and midstream operators to ensure every drop of hydrocarbon is reviewed and accounted for. New CCS operators are starting to rely on FLOWCAL to ensure their stringent measurement needs are met in support of their financial goals. FLOWCAL has an extensive toolset to avoid costly errors by using validation routines that flag erroneous data and identify issues in the field, reduce measurement uncertainty, identify 'Lost And Unaccounted For', physical system balance, and minimize risk by ensuring compliance, data transparency and a complete secure audit trail.



CO_2 Transportation and Injection Balance

Liquid Volume Statement - By Product
March 2023

Meter #: CO2_LIQ_INJ_1
Meter Name: [CO2_LIQ_INJ_1]
Product: CO2 - CSS
Table: NIST 23 V9.0

Contract Hour: Midnight
Contract Day: 1
Pressure Base: 14.696
Temperature Base: 60.0
DMF: 1.0000
K-Factor: 1.0000
Meter Type: Coriolis
Calc. Method: API (Direct Mass)

	CO2	N2	C1	C2	C2H4	C3	C3H6	IC4	NC4	C4H8	IC5	NC5	neo	C6+
Mass %:	99.739	0.166	0.095											
Liq Vol %:	99.531	0.168	0.259											

Day	Meter Temp (°F)	Meter Pressure (psi)	Flowing Density (REL)	Pulses	Meter Factor	Mass (tonnes)	Base Density (REL)	Net Std.Vol (NSV) (bbl)	Summed Volume (bbl)	Net Allowable (bbl)
1	53.7	1244	0.8897	65,644	1.0025	29.850	0.8099	232.04	230.37	230.37
2	59.6	1248	0.8671	64,566	1.0025	29.360	0.8099	228.23	226.58	226.58
3	59.7	1248	0.8668	62,939	1.0025	28.620	0.8099	222.48	220.87	220.87
4	56.8	1250	0.8785	66,897	1.0025	30.420	0.8099	236.47	234.77	234.77
5	57.4	1248	0.8758	66,919	1.0025	30.430	0.8099	236.55	234.84	234.84
6	55.2	1249	0.8843	65,644	1.0025	29.850	0.8099	232.04	230.37	230.37
7	53.4	1244	0.8908	64,192	1.0025	29.190	0.8099	226.91	225.27	225.27
8	57.9	1249	0.8739	63,511	1.0025	28.880	0.8099	224.50	222.88	222.88
9	58.7	1242	0.8703	63,467	1.0025	28.860	0.8099	224.35	222.73	222.73
10	59.7	1245	0.8665	63,379	1.0025	28.820	0.8099	224.03	222.42	222.42
11	59.1	1244	0.8688	64,874	1.0025	29.500	0.8099	229.32	227.67	227.67
12	55.0	1244	0.8849	66,897	1.0025	30.420	0.8099	236.47	234.77	234.77
13	59.5	1246	0.8674	66,436	1.0025	30.210	0.8099	234.84	233.14	233.14
14	52.3	1250	0.8953	64,258	1.0025	29.220	0.8099	227.14	225.50	225.50
15	51.4	1245	0.8982	63,423	1.0025	28.840	0.8099	224.19	222.57	222.57
16	51.4	1243	0.8980	63,335	1.0025	28.800	0.8099	223.88	222.26	222.26
17	51.0	1250	0.8998	63,885	1.0025	29.050	0.8099	225.82	224.19	224.19
18	59.7	1250	0.8669	66,897	1.0025	30.420	0.8099	236.47	234.77	234.77
19	52.1	1245	0.8956	65,270	1.0025	29.680	0.8099	230.72	229.05	229.05
20	54.7	1246	0.8861	65,754	1.0025	29.900	0.8099	232.43	230.75	230.75
21	51.9	1241	0.8960	64,324	1.0025	29.250	0.8099	227.38	225.74	225.74
22	52.8	1244	0.8929	64,192	1.0025	29.190	0.8099	226.91	225.27	225.27
23	55.7	1245	0.8823	64,104	1.0025	29.150	0.8099	226.60	224.96	224.96
24	54.8	1246	0.8856	63,181	1.0025	28.730	0.8099	223.34	221.72	221.72
25	54.5	1247	0.8871	65,864	1.0025	29.950	0.8099	232.82	231.14	231.14
26	56.2	1241	0.8800	64,676	1.0025	29.410	0.8099	228.62	226.97	226.97
27	56.0	1241	0.8808	65,754	1.0025	29.900	0.8099	232.43	230.75	230.75
28	59.1	1248	0.8693	66,567	1.0025	30.270	0.8099	235.31	233.61	233.61
29	55.0	1244	0.8846	65,578	1.0025	29.820	0.8099	231.81	230.13	230.13
30	57.0	1243	0.8772	64,742	1.0025	29.440	0.8099	228.85	227.20	227.20
31	55.3	1246	0.8838	65,160	1.0025	29.630	0.8099	230.33	228.67	228.67
Total	55.7	1246	0.8820	2,012,331	1.0025	915.060	0.8099	7,113.30	7,061.94	7,061.94

FLOWCAL by Quorum Software Print Date: 04/03/2023 15:10 Page 1

Dense phase CO_2 volume statement

In summary, FLOWCAL enables CCS operators to review, correct, and account each CO_2 molecule whether it is in gas or dense phase, in the pipeline or in underground storage. FLOWCAL can manage CO_2 custody transfer data, balance the captured versus the injected CO_2, keep track of CO_2 inventories in the pipe and underground, and provide a holistic view of the CO_2 moved across the CCS operation. System balancing can be managed from gas volume balance, liquids volume balance, and mass balance perspective providing a bird's eye view of the entire CCS system. Please see our website: *https://www.quorumsoftware.com/solutions/measurement/gas-liquid-measurement/*