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CO₂-MONITORING

Compliance by Design – how data-centric platforms ensure life-cycle documentation in CCS projects

Carbon capture and storage (CCS) facilities are complex, and the documentation requirements for operators are often even more so. Safety reports, test records, and verification documents for CO₂ monitoring – anyone who loses track of these risks delays, fines, or even operational shutdowns. A data-centric life-cycle approach provides a solution: It brings together planning, operations, and documentation into a single, consistent model – making compliance more efficient than ever before.

Normal operations at a state-of-the-art waste-to-energy plant in central Germany: the furnaces, flue gas cleaning systems, and CO₂ scrubbers are running smoothly – and yet the plant manager is growing increasingly anxious. The regulatory authority has announced an inspection. The requirements include: up-to-date flow diagrams, a current safety report, conformity and test documentation for pressure vessels, and measurement chains for CO₂ monitoring. In practice, the data is scattered across Excel files, CAD models, Share-Point folders, and emails. Under time

pressure, the documentation becomes a risk.

For operators of facilities that capture, transport, and store CO₂, these documents are not merely a “nice-to-have” but the legal basis for their operations. The Hazardous Incidents Ordinance (Seveso Directive) requires, depending on the quantity threshold, a safety report including a facility layout, risk analysis, protective measures, and emergency planning; this report must be kept up to date and is reviewed by the regulatory authority. For “upper-tier” areas – which apply when defined

quantity thresholds are exceeded – internal alarm and emergency response plans are also required.

For the capture and storage of carbon dioxide, EU ETS MRV rules (Regulation 2018/2066) apply for monitoring, reporting, and verification, as well as the CCS Directive 2009/31/EC, which sets out monitoring, reporting, inspection, and post-closure obligations for storage sites. The standard for the pipeline transport of CO₂ is described in ISO 27913. For pressure systems, the Industrial Safety Regulation (BetrSichV) requires inspections prior to commissioning and on a

recurring basis; TRBS 1201 specifies the scope and documentation of the inspections, including deadlines and responsibilities (ZÜS/qualified person).

Fragmented data, high risk

What can cause plant managers sleepless nights is the fact that technical departments often operate in silos. A minor change in the R&I flowchart does not automatically appear in isometric drawings, bills of materials, or test plans; versions drift, and responsibilities are unclear. Just when regulatory agencies require a consistent record, there is no single, definitive account of the plant's condition.

Data-centric life-cycle approach as a solution

To avoid the issues described above, a data-centric approach has proven effective in practice. With Cadison, the “document puzzle” is transformed into a single, consistent plant model – and thus into a “single source of truth” – from permitting and planning through construction and operation to decommissioning. All object and document information is linked to tags (objects such as equipment, piping, measurement points, and safety functions). Changes to an object are automatically updated in the P&ID, 3D layouts, bills of materials, isometrics, and reports. Revisions are versioned with timestamps and approval statuses; workflows map out the management of change. Reports – from safety report appendices to Ex zone sheets and PED compliance lists – are generated directly from the model without media breaks. Interfaces to ERP/



„Single source of truth“

If a minor change in the R&I flowchart does not automatically appear in isometric drawings, bills of materials, or test plans, consistent data will be missing when it matters most. This concept solves precisely this problem by consolidating all object and document information and updating it automatically. As a result, a reliable record is available at all times for planning, operation, and decommissioning.

DMS/IFC or via the API ensure seamless exchange with purchasing, document control, and BIM/permit files.

How to make compliance manageable

An example illustrates the benefits: MRV chains play a key role in the capture, transport, and storage of carbon dioxide (CCS). The acronym MRV stands for Monitoring, Reporting, and Verification – a central requirement of EU emissions trading and CCS regulations. They describe the end-to-end verification path for how emissions or CO₂ streams are recorded, documented, reported, and verified in

a facility. MRV chains are represented in the model as measurement and balance boundaries; each measurement device (flow, quality, condition) can be stored as a tag with calibration and test history. This facilitates ETS-compliant annual reports and regulatory verification. For CO₂ pipelines, the model-based documentation supports traceability in accordance with ISO 27913: from specification checks to inspection planning. Monitoring and decommissioning plans under the CCS Directive can be linked to the plant model as reusable document sets. Conclusion: Instead of treating compliance as an afterthought, data-centric systems build it in by design: The approval file is drawn from the same database as construction and operational documents. Audit requests become targeted queries, and changes remain fully traceable. For the operator, this means: shorter turnaround times, less rework, lower legal and deadline risks – and a robust database that grows with the plant. All in all: Whoever establishes the single source of truth for plant data also obtains the single, reliable record for the entire lifecycle.

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