

Thermo Scientific Integrated Informatics and Chromatography Software Solutions for the

Oil & Gas Industry

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Introduction

Professionals across all aspects of the oil and gas and petrochemicals industry – from lab and IT management and quality control to regulatory affairs and senior management – are more and more faced with data management challenges that span the scope of their organizations, from exploration and extraction to refining, rigorous testing and real-time monitoring.

To help our oil and gas and chemicals customers manage the most complex data management challenges, we're introducing the latest evolution of our integrated laboratory software platform – Thermo Scientific Integrated Informatics, the center of lab data acquisition, management and storage. Integrated Informatics represents an essential development in laboratory software designed to help lab managers and scientists move more efficiently through their workflow – from 'sample to knowledge' – delivering data integrity, compliance, productivity and enterprise-wide data sharing.

The foundation of Thermo Scientific Integrated Informatics is the SampleManager platform – with comprehensive lab and data management functionality for laboratory information management (LIMS), Chromeleon chromatography data system (CDS), scientific data management (SDMS) and procedural ELN/lab and method execution. This comprehensive informatics solution is further supported by mobile and web access. With Integrated Informatics, lab managers can consolidate their lab software investments, saving time and money in software licenses, implementation costs and ongoing service contracts.

Thermo Scientific Integrated Informatics can help today's oil and gas and petrochemicals companies deliver the safest products, using the most sustainable process, while delivering superior value to all stakeholders.



▲ **The Age of Informatics In and Out of the Lab**
David Leitham, Vice President & General Manager
Informatics and Chromatography Software, Thermo Fisher Scientific





Contents

The Power of Fully Integrated Informatics

By Ajith Kumar, Senior Business Analyst, Shell, Pearl GTL, Qatar
As seen in *The Analytical Scientist*

Shell's Pearl GTL brings in the big guns to tackle its vast data-handling requirements with an integrated laboratory information management system.

The Challenge

The unprecedented scale of the world's largest gas to liquids (GTL) plant in Qatar – Pearl GTL – creates a massive business and technology challenge: how can quality be maintained and productivity maximized while managing huge volumes of critical data?

Background

As a senior business analyst for Pearl GTL, I was responsible for managing the laboratory informatics components of a project of unprecedented scale, which required billions of investment dollars and created tens of thousands of jobs during peak construction.

Data management was a major priority. To maximize production and allow rapid decisions, we needed consolidated, accurate information available at our fingertips – at all times.

Established by Shell and Qatar Petroleum in 2006, and onstream at the beginning of 2011, Pearl GTL is the world's largest GTL plant and cements Qatar's position as the GTL capital of the world. The GTL process converts natural gas to liquid fuels and other products, including gasoil, naphtha, kerosene, normal-paraffin and lubricants. Pearl GTL captures the full value chain, from offshore development and onshore gas





processing to the refining of finished products in one project. The project provides the platform for the growth of an entirely new industry with GTL fuels, in particular by opening up opportunities for new markets.

When it comes to illustrating the enormous scale of the project to build the world's largest GTL plant, the statistics paint an impressive picture. Some two million tons of freight were shipped into a dedicated berth at Ras Laffan port adjacent to the plant site. More than 750,000 cubic meters of concrete were poured during construction. And enough steel was being used during the peak construction period to erect the equivalent of two and a half Eiffel Towers a month.

Initially, my major challenge was finding a resilient software solution that supported all of our stringent data and integration requirements – something that could help drive success from the very beginning.

The Solution

From the start, we knew that we needed a highly sophisticated software solution to manage the interface of a quality control system that receives a constant

stream of 34,000 transmitted measurements. These measurements, which include well content, volume, emissions, equipment condition and hundreds of other data points integral to the plant's operation, needed to be mapped onto the data generated by the laboratory operations. In addition to collection and storage, data also needed to be organized, integrated and analyzed constantly to ensure plant safety, product quality, environmental protection and production efficiency. Furthermore, our solution needed to ensure that Pearl GTL's labs remained in compliance with requirements such as ISO 17025, an accreditation that sets an international benchmark for running a testing laboratory. It lays out qualifications for suppliers, training, record-keeping, equipment calibration and much more. In the event of an audit, Pearl GTL would need to quickly retrieve and present data proving compliance.

With so many prerequisites for success, we needed a proven solution: a Laboratory Information Management System (LIMS). The right LIMS should present accurate, unbiased information necessary for maintaining the highest standards of safety, regulatory compliance and environmental commitment – all without sacrificing financial performance. But clearly, given the operation's complexity, not just any LIMS solution would do. In addition to organizing sample results, Pearl GTL's LIMS would need to be fully integrated with the ability to communicate with a variety of other systems, including operations management, batch tracking and enterprise resource tracking systems. Without such integration, it would be almost impossible to achieve success with a project of this size and scale.

We chose Thermo Scientific's SampleManager LIMS to manage our state-of-the-art testing laboratories, standardizing it across all laboratory equipment and production systems. SampleManager offered unparalleled support for all of Pearl GTL's stringent requirements.

Despite our complex quality, regulatory and interface requirements, we worked with a strong team of people from Thermo Fisher. Rolling out the solution across Pearl GTL was seamless, despite some of the LIMS interfaces that were implemented being the first of their kind in any Shell facility.

One of our principal reasons for choosing SampleManager was its ability to integrate with other systems. At Pearl GTL, the LIMS is integrated with an operations management system (known as OTTER), process historian (OSI PI), an oil movement and batch tracking system, laboratory instruments and other production systems. Now, communication between all systems is seamless and bi-directional. And all information necessary to manage complex sample scheduling and stringent safety, quality and regulatory requirements is readily accessible.

The way SampleManager integrates with PI delivers notable efficiencies for Shell and Qatar Petroleum at Pearl GTL. While some other labs manually send test results to operations, technologists and process engineers, the Pearl GTL laboratory results are available to all relevant parties within the PI system as soon as they are authorized in SampleManager. If high accuracy sampling data is important to your job, you can access it through the system in real time.



Other important consumers of lab data within Pearl GTL are users of the oil movement and batch tracking system. When panel operators need to move oil to new tanks in preparation for shipping, for example, they don't need to wait to be notified of test results, and this minimizes demurrage charges for loading delays. As soon as the results are available from the lab, the LIMS notifies operators through the oil movement system.

The LIMS has also enabled Pearl GTL to go paperless, helping us eliminate many human errors common in paper-based laboratories. Human beings can make an average of 3-6 mistakes for every 1,000 lab readings transcribed, so a sampling program the size of Pearl GTL's, could lead to hundreds of errors every day. SampleManager solves this problem by integrating lab instruments that automatically transmit data as soon as final results are produced.

SampleManager aggregates all this data and combines it with information collected from other sampling systems, including technicians in the field, enabling Pearl GTL to collate and present a vast array of data in a logical format for managers to analyze and make fast, effective decisions.



Using the OTTER system, all sample points in the field are marked with radio frequency identification tags. When field operators perform sample rounds, a handheld computer guides them to each sample point and then automatically records the required information, such as sampling time, and whether the sampling task is routine or non-routine. The LIMS also transmits safety related information, (such as the sample container to be used and special instructions for sampling) to the handheld computers to ensure the wellbeing of staff. As the LIMS is fully integrated with OTTER, the data collected is instantly transferred to SampleManager from the field for analysis by managers or technicians back in the lab, which also saves Pearl GTL an estimated 2,400 working hours per year.

It's interesting to note that all the benefits we achieved by implementing SampleManager are completely transferable to other industries.

Beyond the Solution

The implementation of SampleManager LIMS at Pearl GTL was an enormous accomplishment for both Shell and Thermo Fisher alike. Among the most important benefits of a fully integrated informatics solution is the agility gained in moving assets, reassigning personnel or streamlining production. In essence, the LIMS gives the business the ability to make more timely decisions.

The same principles are echoed in many other industries, for example, downstream of the oil refinery at modern chemical manufacturers. The need for agility is especially true in the production of fine and specialty chemicals, where plants may change over production lines weekly, sometimes even daily. Within these highly

flexible environments, laboratories responsible for quality, safety and efficacy of finished products must be equally flexible, which is no simple task.

In the chemical manufacturing lab, LIMS isn't just the first step, it's the most important step towards achieving the agility required to meet more precise customer demands and more stringent regulatory requirements. Once in place, the business isn't simply capturing and collecting data; it's making that data actionable across the enterprise. With the LIMS enabling this type of data mining, management can move more quickly to respond to market trends or new regulations or to recognize and capitalize on cost-saving or margin growing opportunities.

For businesses to compete in manufacturing, they need to liberate the insights that are too often kept in silos across the site or around the world. Opening up these vast stores of knowledge to the benefit of the enterprise can improve manufacturing technology in new ways. Your laboratories can become real growth drivers for business transformation and enable your business to rapidly capitalize on new growth opportunities and build lasting value, customer loyalty and security for employees.



If your lab is challenged by increasingly complex data management, let us show you the power of Integrated Informatics, the center of lab data acquisition, management and storage.



Modern Energy Industry Labs Must be Productivity Partners

By Trish Meek, Thermo Fisher Scientific

As seen in *Oil and Gas Technology*

Trish Meek, senior manager, product marketing informatics & chromatography software, Thermo Fisher Scientific and Jeanne Mensingh, president, Labtopia Solutions look at how avoiding everyday problems can make labs productive partners.

Even as energy prices fall globally, for labs serving this industry the show must go on. Consolidation, layoffs and belt-tightening are indeed stark realities, but seasoned energy executives know that now is hardly the time for complacency. In fact, this may be an ideal time to look inward for gaps across the enterprise that could derail exploration, production and distribution, especially as activity ramps up in the future, which, despite how it looks now, is inevitable.

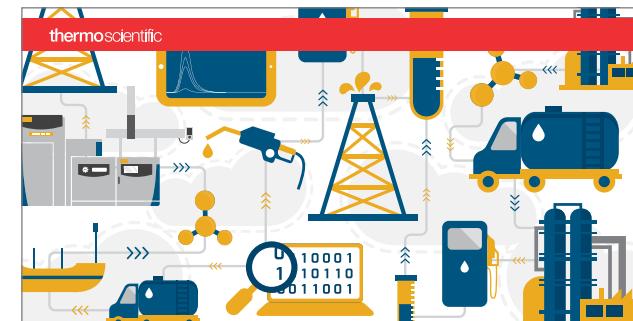
In a laboratory especially, gaps have a way of hiding in plain sight as small, everyday problems. It's not uncommon for labs in the energy industry to manage tens of thousands of transmitted measurements, everything from well content, volume, emissions and equipment status to soil sample data for upstream LNG exploration. All these data must be collected, stored, analyzed, packaged and repackaged, and even the smallest error has far-reaching implications. Failure to process a single sample according to standard operating procedures (SOPs) could lead to stranded investment or compliance penalty, neither of which is trivial.

The pressure is always on labs in the energy industry to achieve higher levels of productivity and efficiency, even when the industry is contracting. But industry executives are undoubtedly looking even more closely at operations now, scanning for little things that could make a difference in near-term profitability and prepare the business for longer-term success. So, it follows, labs would be wise to take stock of the little things that impact their productivity. To that end, we've identified some issues that often hide in plain sight, but that, if addressed, could make your lab more productive, efficient and compliant immediately.

Poor inventory management

Expediting shipments of out-of-stock consumables to a lab – perhaps overpaying as a result – is a symptom of laboratory mismanagement. Some call it ‘hot-shotting’. Since most energy industry labs run the same test over and over, with a certain cadence, inventory should be fairly predictable. The inability to anticipate future need is clearly an efficiency problem that stems from lack of visibility.

Tracking what has been used, when and by whom, is yet another critical, but often ignored, step. Gas chromatography (GC) vials are a great example. Since these are in such high demand, lab technicians often hoard them, and this can have downstream impacts on



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another technician's work, affecting productivity. The second technician, suddenly short of vials, will likely hot-shot them to minimize disruption. Neither outcome is good – one potentially disrupts production, the other affects overall margins.

The obvious answer is better budgeting and tracking, and this is where a laboratory information management system (LIMS) is highly effective. While it's not easy to manage inventory – even with software – spreadsheets are simply not dynamic enough to establish an inventory management system that supports proactive planning/budgeting and up-to-the-minute accuracy. With Thermo Scientific SampleManager LIMS, for example, labs can carefully track inventory as part of a comprehensive lab management program.

Better budgeting and tracking is an obvious remedy for inventory mismanagement. A laboratory information management system (LIMS) can enable labs to carefully track inventory as part of a comprehensive lab management program. It's even possible to create alerts about stock levels. The bottom line is that there IS a bottom line: manage it better and you'll not only avoid waste, you'll avoid costly production delays that poorly position the lab within the overall enterprise.

Inability to recognize analytical trends

Laboratory errors can be an early warning system. While many labs address errors after the fact, smart labs focus on predicting and preventing errors that mask QA/QC problems. But with analysts running hundreds of tests each week – many still using paper spreadsheets – this can be nearly impossible.

Today, more and more labs are turning to statistical quality control (SQC). SampleManager LIMS, for example, includes this capability, enabling technicians to detect non-conformance trending before it reaches pre-defined thresholds. This gives labs realtime monitoring capability that relies on statistical algorithms: the lab is observing data trends while the analysis is running, not weeks later.

One missed error can cost thousands or more in lost productivity, consumable waste and, much worse, batch issues that lead to loading delays and costly demurrage charges. Identifying minor errors as they occur – because an LIMS-enabled SOP requires you to spot check data at certain intervals – can mean the difference between profit and loss. And human beings alone simply cannot provide this analytical rigor.

Inconsistent procedures

Laboratories are at risk from inconsistent application of procedures, even innovative work-arounds that show promise as timesavers. There is only room for innovation in a lab if, and only if, it passes through the rigor of the SOP process.

Electronic SOPs (ESOPs) are the lab's defense against risk and the inevitable productivity declines that result from inconsistent procedures. With ESOPs defined in SampleManager LIMS, for example, there's a rigid workflow with clearly defined technical corrective actions to ensure consistency and adherence to protocol. Without this, it's too easy to make unintended errors.

Four considerations are important when developing ESOPs: thoroughness, standardization, distribution and compliance. Lab performance, defensibility and so much more depend on how successfully a lab addresses each of these imperatives. Fortunately, LIMS have evolved to make management of SOPs easier and more efficient. This brings consistency that not only keeps productivity on track but also helps with compliance with ISO 17025 and other requirements.



▲ Leading LIMS Solution Bridges the Lab and Enterprise

Katie Evans, Senior Product Manager, Thermo Fisher Scientific

Lack of traceability

A single laboratory may be responsible for hundreds or more tests each week. And a test is not simply a test, it's the sum of many parts. Where did a sample originate, what is the maintenance history of the instrument used, what are the reagents and standards used for the test, when was the analyst last certified and which vendor supplied the consumables? Answering these questions retrospectively can be time-consuming – and that time can sap productivity.

Analysts routinely spend a quarter of their productive time simply collecting data to defend a result. This can take away from time that should be spent contributing to productivity and profitability. But defending data isn't optional. And this is yet another area where data management software is about more than just data collection and reporting – it's about enabling productivity. It's about quickly returning to the job at hand – rapidly, efficiently and accurately delivering results across the business that enable production to continue uninterrupted.

Today, a LIMS can reach across an enterprise: it still sits in the lab, but it integrates with data in MRP, ERP and

other enterprise systems in ways that directly impact defensibility. No more searching in multiple places, often a combination of hand-written notes, spreadsheets and reports: everything required to defend a result is aggregated and organized for rapid analysis and reporting.

Missing maintenance

When many labs think of trend analysis, they don't often associate it with instrument maintenance, but that's a mistake. This reflects a misunderstanding of the importance of maintenance, especially preventive maintenance.

Data such as area counts, baseline conductivity and retention time provide valuable evidence that, if trended and analyzed, can reveal much about the health of an instrument. LIMS such as SampleManager actually offer capabilities that allow users to monitor instrument health so that work can be assigned more effectively on a regular maintenance schedule. Users are notified of upcoming maintenance – even of wear-part failure, so that maintenance can be scheduled before failure becomes an issue.

Analysts will tell you that they get to know their instruments, but sometimes signs are too subtle to sense the failure before it occurs and the instrument goes down. And with new grads, transfers and others who are unfamiliar with various instrument types cycling through a lab, there is simply too much margin for error. To understand what an instrument is telling them, it's much smarter for labs to rely on data: by simply setting a sample point and watching for deviation, labs can effectively give themselves an early warning system. And this can be easily done using a LIMS.

Does instrument downtime seem trivial? It better not, because when a GC goes down, for example, it can impact batch delivery and much more. And looking backward after a production stoppage or slowdown hardly solves the problem today. Now, it's more important than ever for labs to demonstrate that they can play a proactive role in driving productivity and profitability. But it's hard to make that case when instruments are down or poorly calibrated and your lab is what stands between a business being fully operational and standing still.

Small steps create big changes

Energy companies are more focused than ever on productivity and profitability. Across the enterprise, everything must be closely scrutinized, especially everyday problems that can seem trivial. Labs would be wise to look inward too, starting with the problems discussed in this article. Closing these gaps can have a demonstrable impact on productivity and profitability, not to mention easing the burdens associated with increasingly more onerous regulatory requirements.

A modern lab in the energy industry should be a productivity partner, capable of not only driving greater efficiency and profitability, but also of mitigating future risk. Interruptions during exploration, production and distribution are costly, and labs do not want to be the reason. Proactive management can help. Likewise, better data management can help with regulatory compliance, planning, R&D innovation and so much more. In this regard, the LIMS should be seen as a catalyst for an entire enterprise, not simply a tool for managing a lab. Then the lab can be positioned in a totally different light as a driver of – not an impediment to – productivity and profitability.

Preventing Production Problems in the Lab

Increasing biofuel demand will require next-generation laboratory software solutions.

By Trish Meek and Barbara Van Cann, Thermo Fisher Scientific
As seen in *Biomass Magazine*

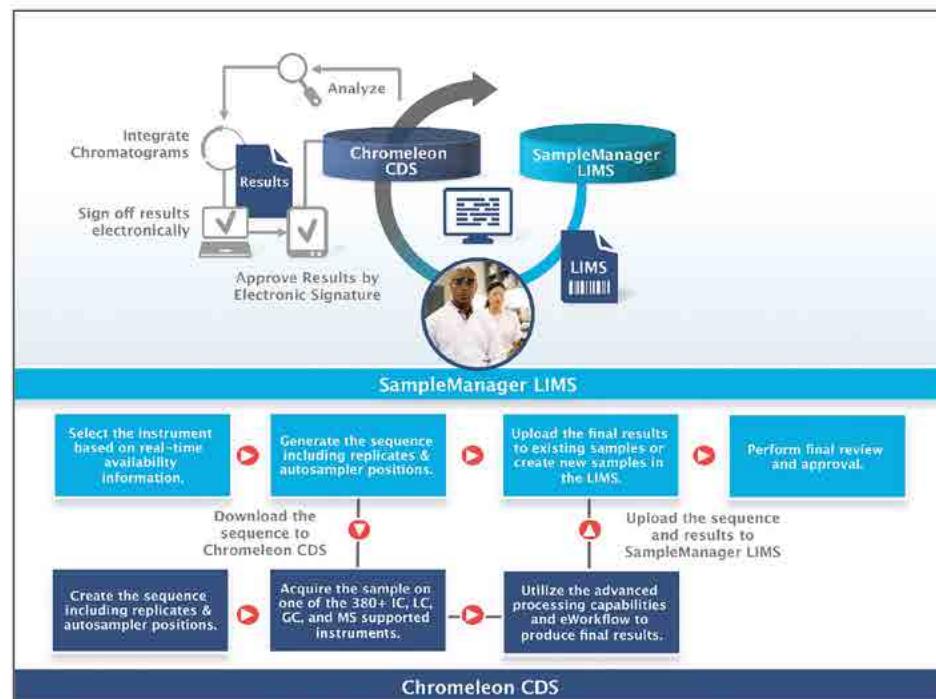
Reduced oil prices have been bad news for oil industry profits. It hasn't been easy for renewables, either. Despite dampened enthusiasm for renewables overall, innovation continues in areas such as biofuel production.

In late March, United Airlines announced that it will use biofuel to help power flights running between Los Angeles and San Francisco, with future plans to expand to all flights operating out of LAX. A small step indeed, but a positive sign that biofuel production remains viable for the future.

Now that United has publicly committed to biofuels, it must be able to rely on a steady supply. In this case, it will come from a Los Angeles refinery operated by AltAir Fuels. The total mixture will be 30 percent biofuel, sourced from feedstocks that include algae, and 70 percent traditional jet fuel.

The United announcement is part of a groundswell of activity across the transportation sector. From air to sea, to rail to over-the-road, major consumers of fuel are eyeing more affordable solutions that also comply with mandates related to clean air. The view

Integration = data integrity, quality and productivity



Integrating LIMS and CDS allows the lab to effectively remove eight manual processes, giving you one streamlined automated process – leaving only one manual process – putting the sample into the instrument and hitting the “GO” button.

appears positive, and the biofuels industry should be and is thinking about a future of higher production volume and greater quality. That means production efficiency and productivity, which puts biofuel labs back on the spot to demonstrate their critical enterprise value.

As biofuel producers refocus on a more optimistic future, they will turn their attention back to the complexity of their processes. With the potential for increased demand comes the increased risk of production failure. Batch failure is magnified when production accelerates, so labs will increasingly rely on new analytical technologies and new software solutions that enable them to more closely monitor, analyze and report. This ranges from gas chromatography (GC), ion chromatography and fourier transform infrared (FTIR) spectroscopy to inductively coupled plasma mass spectrometry (ICP-MS), all of which generate volumes of data.

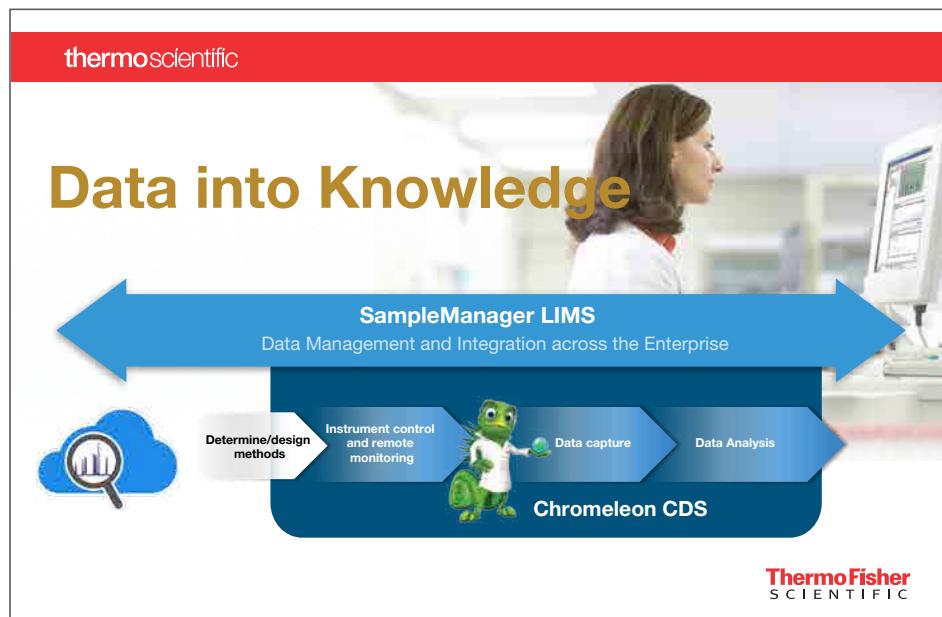
Volumes of data can soon lead to mountains of challenges, from daily lab operations to more complex pattern recognition that could expose risks, such as batch failure. Without a solution such as a laboratory information management system (LIMS), these mountains quickly become impossible to summit.

The LIMS brings discipline to an environment with many complex, moving parts. Enterprise-level LIMS, designed for integration across the lab and with other enterprise systems, can seamlessly connect with and work in harmony with other systems, such as a chromatography data system (CDS). In the next-generation biofuels lab, a CDS is critical to ensuring the quality of biofuels, which has everything to do with adherence to required gas and ion chromatographic methods.

As modern biofuel laboratories select equipment that is most suitable for specific analyses, they commonly choose from a variety of chromatography instruments from different manufacturers. Using a manufacturer-specific CDS for each instrument can lead to complications regarding efficiency, data handling, training, validation and compliance. The selection of a CDS with multi-vendor instrument control, including acquisition and data handling of MS instruments, overcomes these challenges. In addition, data storage and handling can be decoupled from instrument control and centralized, a so-called enterprise of the client-server system, increasing the security and accessibility of the data. With all data from instruments in the same format and one common report for results, regardless of the instrument that was used to generate them, the efficiency gains and productivity increases are considerable.

A major requirement in production laboratories is ensuring the highest instrument uptime to produce results at every time of day. Especially when running in a client-server system, keeping the laboratory fully up and running during a network outage, planned or not, is a big challenge. Therefore, a CDS should allow operation independent of the network, so that even when the network is down, the CDS keeps instruments running, data accessible for processing, and even allows creation and running of new sequences, ensuring 24/7 laboratory uptime.

By guiding technicians through the execution of analytical methods, the CDS drives the laboratory processes related to all aspects of a chromatographic analysis. Some CDS provide an even higher level of automation by encapsulating all of the unique aspects of a chromatography workflow, like instrument control and data processing parameters, correct injection order and reporting parameters, and guiding the operator



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through the minimal number of steps required to run it. The operator simply selects an instrument, specifies the number of samples and the starting vial position in the autosampler, and begins the analysis. The software then runs the chromatograph, processes the data, and produces final results.

Take, for example, ASTM D6584 and EN 14105, the main quantitative quality control methods for the determination of glycerol and glycerides in pure biodiesel by GC. When biodiesel (B100) is derived from vegetable oils, such as sunflower and palm oil, glycerol is created as a byproduct. Mono-, di- and triglycerides, created as intermediates or unreacted starting material, also occur. These methods test for the presence of glycerol and glycerides in the final product, which is important because of their negative impact on fuel efficiency and engine performance.

While both of these analyses differ in small ways, there are some common elements. Both methods require complex and time-consuming sample and calibration standard preparation. Samples are run in duplicate and compared to determine analytical

precision. With only a few clicks in the CDS, users can create and start a run and data analysis according to the requirements in the ASTM methods is automatically performed.

The next step in the chromatography process, data processing and evaluation, is the most time-consuming step. Even with all data processing parameters correctly set up in the automated chromatography workflow, technicians need to decide if a sample requires re-analyzing, based on the results. Advanced features, such as intelligent run control, allow users to setup system suitability tests with pass/fail criteria, testing for acceptance criteria of the calibrations, checks and samples. The software can then respond to the outcome of these tests, such as failed sample replicates or standards, and without user intervention, take predefined, immediate action, such as reinjecting the samples, performing a dilution or aborting the run. As this can even happen overnight, productivity is increased and a source for errors removed.

Final results can be sent directly to the LIMS. A seamless integration between the CDS and LIMS ensures a quick response to all quality results. Any samples that fail to meet the specifications established by ASTM and EN are appropriately flagged as out of specification in the LIMS and preventative action can be taken. This level of automation across the laboratory process ensures product quality and boosts laboratory productivity.

Conclusion

A LIMS is a proven workhorse in the biofuels industry, especially because it is uniquely suited to highly distributed lab environments with multiple instrument platforms, workflows and standard operating procedures. Although instruments perform discrete tasks and generate data for specific purposes, data integration is vital and a LIMS is critical to achieving an end-to-end flow of information across the lab and across all processes. To ensure efficient, safe and profitable biofuels production, labs must be able to support continuous process monitoring and manage the data outputs in a way that is useful to stakeholders across the enterprise when, where and how they need it.

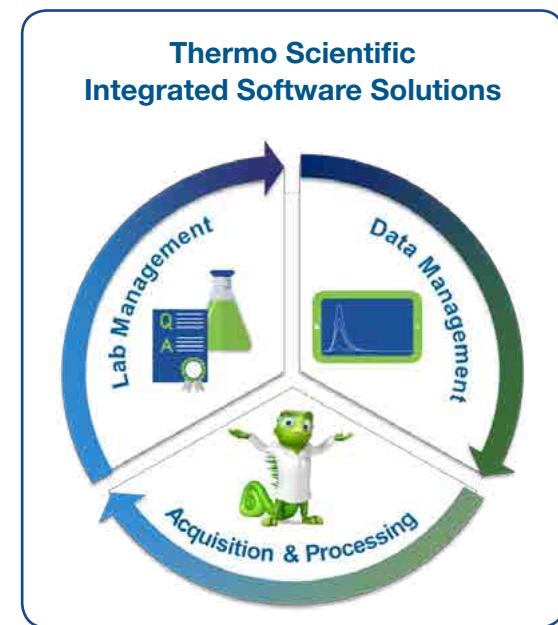
Third-generation biofuel production processes are dynamic and complex. It can take weeks for feedstock to break down, and finding a problem at the end is costly. Labs must be able to use even more sensitive analytical instruments and multilayer software infrastructure that enables instrument-, lab- and enterprise-level insight and decision-making across the production process.

Take Your Lab Informatics to Another Level with SampleManager LIMS and Chromeleon™ CDS

With the SampleManager LIMS and Chromeleon CDS link built onto one platform, users will have complete control of all chromatography and/or mass spec instruments, combining two of the most common analytical techniques into a single system. SampleManager LIMS then allows you to turn that data into actionable knowledge by providing sophisticated data processing, visualization, search and data mining capabilities.

- Fully integrated LIMS, CDS, SDMS and LES/Procedural ELN
- Workflows to drive the laboratory process
- Comprehensive multi-vendor instrument support
- Centralized data management
- Advanced search and data mining with SDMS
- Monitor chromatography queue status and Instrument Health from the LIMS

With Chromeleon CDS linked to SampleManager LIMS, users have complete control of all chromatography and mass spec instruments, combining two of the most common analytical techniques into a single system. SampleManager LIMS then allows you to turn that data into actionable knowledge by providing sophisticated data processing, visualization, search and data mining capabilities.



Thermo Scientific Chromeleon CDS is a leading chromatography data system, unifying workflows for chromatography and routine quantitative MS analysis. Chromeleon CDS allows you to run your analyses in an enterprise environment – from method creation to quantitation and library-based compound identification and offers industry-leading multi-vendor control, supporting over 400 different instrument modules from over 15

manufacturers. With the SampleManager LIMS and Chromeleon CDS link built onto one platform, users will have complete control of all chromatography and/or mass spec instruments, combining two of the most common analytical techniques into a single system. SampleManager LIMS then allows you to turn that data into actionable knowledge by providing sophisticated data processing, visualization, search and data mining capabilities.

Addressing the Challenges of ISO 17025 Compliance

By Trish Meek, Thermo Fisher Scientific

A Laboratory Information Management System is more than a tool to ensure regulatory compliance: it is an instrument to improve quality.

What if ISO 17025 wasn't a standard, but instead was a technology that automated laboratory best practices? What if following the regulations to the letter – often without even thinking about it – actually led to better overall business performance? In that case, it's likely every business would aggressively deploy that technology.



That technology does indeed exist, and it's commonly known as LIMS, short for a Laboratory Information Management System, an essential data management and enterprise integration tool for managing laboratory workflow, samples, reporting and compliance requirements. And while many in the oil and gas industry think of LIMS as a way to manage important data, it is, in fact, much more than that.



Paula Hollywood of ARC Advisory recently wrote that "hydrocarbon processing laboratories are becoming almost like third-party service laboratories...this means that accreditation with standards such as ISO 17025 is no longer just nice to have, but a necessity to ensure conformance and customer satisfaction."

A "necessity for customer satisfaction" doesn't sound anything like onerous regulation. Instead it sounds like a catalyst that is part technology, part discipline and all-encompassing. In other words, when you think of ISO 17025, don't think compliance, think higher-quality product.

But certainly conforming to ISO 17025 standards is time-consuming, costly and technologically complex. It covers everything from contract review to method validation and quality assurance. One does not simply check a few boxes to stay in compliance; if it were that easy it wouldn't be so beneficial in the long run. But getting into compliance – and realizing the benefits of doing so – doesn't need to be overly costly or time-consuming. The rest of this article will explain how this is possible today.



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How a designed-for-purpose LIMS supports ISO 17025 compliance

Sections 4 and 5 of ISO 17025 are the primary areas of alignment between regulatory compliance and LIMS functionality. In fact, Thermo Scientific SampleManager is preconfigured for compliance; no additional programming or bolt-on modules are required. For an onsite or third-party laboratory in the oil and gas industry, built in functionality saves time, money and months of aggravation that can be associated with custom software development.

At a glance, sections 4 and 5 of ISO 17025 resemble a list of best practices for any lab. But what's spelled out in each section is more complex than many realize. With so many interdependencies and so much relational data, it's nearly impossible to manage without assistance from software. Sure, some have developed home-grown paper systems that seem intuitive, but ultimately they can't scale, often contain troublesome, burdensome processes, and can be slow to track down data, especially during an audit.

An integrated data management system, such as Thermo Scientific SampleManager LIMS, is designed to mitigate complexity, easing compliance within oil

and gas laboratories and, most important, exposing previously unrecognized opportunities for performance improvement. Next we'll look at several key ISO 17025 sections, specifically management requirements and technical requirements, and discuss how LIMS is purpose-built to align with each section.

Management requirements

4.1 Organization and management

Labs must not only meet standards within their own facilities, they are responsible for compliance at third-party facilities and temporary facilities – such as field-based labs – as well. This not only strengthens compliance, but also it establishes a quality benchmark to which all laboratory practices and data must conform. To manage this level of complexity without disrupting daily activity, a LIMS must use a web services architecture that is both secure and extensible.

Proper security controls are especially important for external laboratories – and those doing business with them – because proprietary, confidential data is continuously stored and accessible. A proven LIMS will address this by providing group security, which limits access to specific projects or clients, and by providing native browser encryption (SSL) for web access.

4.2 Quality system

Quality and consistency are merely concepts unless policies, systems and programs are documented and reinforced. ISO 17025 not only calls for documentation of quality systems and procedures, it requires that it be communicated to, understood by, available to



and implemented by appropriate personnel. The LIMS system can be the conduit for quality system documentation and reinforcement. Not only can relevant quality information be stored within the LIMS – or easily accessible through the LIMS via an intranet, but labs can also insert hyperlinks on landing pages and dashboards within the LIMS as just-in-time reminders to staff of quality system requirements.

4.3 Document control

Document control is an important component of a quality system. All documents generated internally or externally must be indexed and available on-demand. This includes any document type, including drawings, manuals and methods. The LIMS can store relevant documents in nearly any standard format as an attachment, making compliance with document control a natural extension of routine laboratory work.

4.4 Review of request, tender or contract

An oil and gas laboratory must demonstrate that it has

the requisite experience, capabilities and resources to meet the requirements of the client (whether internal or external). This ensures that the laboratory is actually capable of meeting its promise to provide quality results. Because the LIMS offers a system-wide view of resources, methods, instrument calibration, etc., it plays an important role in the contract review process. SampleManager LIMS, for example, pulls in data from operator loading reports to provide real-time insight into operator workload and possible resource conflicts. This avoids post-contract surprises that could trigger a compliance audit or, much worse, jeopardize a customer relationship.

Once work is complete, the LIMS also plays an important role in matching final delivery and pricing to scope of work. The LIMS tracks the handling of surface and subsurface oil and gas samples at all stages of the extraction and refining process from their delivery into the lab to the return of results to the customer. Everything is documented, ensuring full compliance and

providing a record trail useful in ongoing quality control and efficiency analysis.

4.5 Subcontracting of tests and calibrations

Testing overflow is common, but cannot be handled haphazardly. ISO 17025 requires that laboratories are able to demonstrate that any subcontractor is competent to perform the activities in question, and that it is also in compliance with the standards. A lab must therefore maintain an up-to-date register of all subcontractors, including its precise area of expertise and an assessment of past performance and testing results. When using a LIMS, all this information, including current certification statuses, is stored within comprehensive supplier tables for fast, universal access.

4.6 Purchasing services and supplies

Laboratories are responsible for the quality of all services and supplies that affect the quality of tests or calibrations. Specific procedures must be in place for the purchase, receiving and storage of all supplies and consumables, and failure to verify and document compliance with a stored consumable constitutes non-compliance. Using a paper-based process, compliance is nearly impossible. With a LIMS, however, all supplier statuses, including reagents and other consumables, are easily managed using supplier management entry screens that feed into real-time reports and dashboards.

4.8 Complaints

ISO 17025 requires that laboratories have policies and procedures in place to resolve complaints. This includes a full record of investigations and corrective actions taken, if necessary. With a LIMS, all this information is easily captured and stored within an incident summary, ensuring compliance and providing an historical record



for avoiding such issues in the future. In SampleManager LIMS, this incident management capability can also be used to assign and track actions due to non-conforming work, which is addressed in section 4.9 of ISO 17025.

4.11 Preventative action

ISO 17025 includes provisions for prevention as well as complaint resolution. This is one of the places where the regulations align with the LIMS best practices capabilities. Several tools within SampleManager, for example, help proactively identify issues before they become serious or systemic. In addition, Analytical Quality Control functionality can detect problems with running analyses, and the data feeds into a built-in Statistical Quality Control (SQC) package to proactively monitor analyses, identify trends and highlight potential issues.

Technical requirements

The technical requirements section addresses the myriad of factors that influence the correctness and reliability of laboratory tests and calibrations. These factors range from personnel to equipment and handling.



▲ Thermo Scientific Lab Execution System/Procedural ELN Helps Scientists Go Paperless

Trish Meek, Director of Product Strategy, Thermo Fisher Scientific

5.2 Personnel

ISO 17025 requires that laboratory management take full responsibility for the ongoing competency of all staff at all stages of testing and analysis. For this, a LIMS is particularly useful, not only for compliance, but also for ensuring that staff remain properly trained and certified. In SampleManager LIMS, for example, the system's operator training functionality sets specific user input restrictions so that only personnel who are certified on particular instruments, analyses or preparations can enter or modify data associated with these items. These rules and requirements can change as staff turnover, as requirements change or based on updated training results.

5.4 Test and calibration methods including sampling

Using appropriate methods and procedures for tests and calibration is as much about best practices as it is compliance. ISO 17025 requires that labs have easily accessible instructions for operation and handling of instruments and test samples, that all methods are appropriate and compliant/current and that personnel have the requisite experience to use the method.

Calibration standards need to be fully tracked throughout their lifetime, so the LIMS stores up-to-date inventory and preparation records, usage and expiry data. The system also stores a full audit trail of any modifications, and labs can implement electronic signature controls for added security when standards are authorized for use.

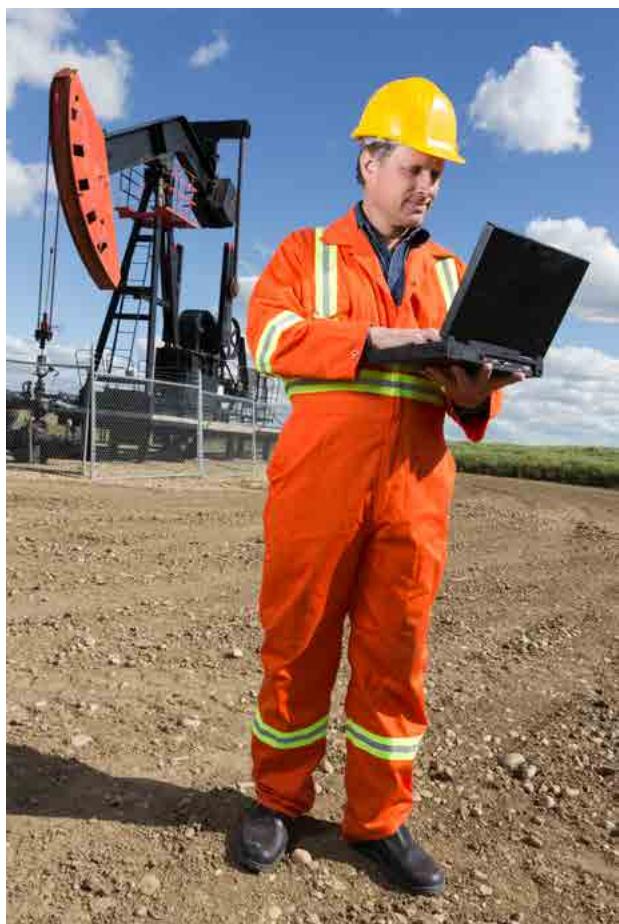
SampleManager LIMS also supports validation of methods, required under section 5.4.5. This critical function for any oil and gas laboratory is addressed through AQC worksheets that enable analytical QA/QC support. This is done through a batch system that augments QA operations by including spiked samples, recoveries and surrogate support in the analytical sequence. Once the lab determines analysis parameters, the results for both analytical and standard samples are stored in the LIMS for future compliance reporting.

5.5 Equipment

ISO 17025 makes it clear that all equipment must meet the required performance parameters for its stated use. The requirements relate to sample preparation, testing, processing and analysis, and this also extends to equipment that is outside the lab's permanent control.

Thermo Scientific Lab Execution System/Procedural ELN Helps Scientists Go Paperless

Analytical and QA/QC labs, under ever-increasing pressure to improve time to market, ensure compliance and realize cost savings, now have an all-inclusive informatics solution that gives them complete control over their methods and standard operating procedures (SOPs) without having to purchase, integrate and validate software from multiple vendors. Trish Meek, Director of Product Strategy for Informatics at Thermo Fisher Scientific, explains how the new solution helps get scientists closer to the paperless lab.



To accomplish this, the LIMS maintains comprehensive records for each instrument as well as each of its components and complete calibration history and status. Having this information in hand means that it is possible to identify the exact instrument configuration deployed at any point in time to test a particular sample.

And with systems such as SampleManager LIMS pre-configured for the industry, getting up-and-running on the road to compliance and higher performance is only a log-in screen away.

5.7 - 5.9 Sampling plan, handling and transport, assuring the quality of test and calibration results

ISO 17025 requires that labs have defined procedures for sampling plans, handling and transportation of samples, as well as the management of calibration items and for ensuring the quality of results. Although these procedures can be complex and time-consuming without a system of record, with LIMS it's possible to create a sampling plan from a template that automates many of the necessary steps. To address handling requirements, for example, each laboratory sample has a unique identifier, which is combined with a full lifecycle – from receipt to disposal – that can be tracked through the LIMS. Hierarchical definitions allow real-life physical locations to be mapped, and the assignment of materials, samples and equipment to be tracked and audited. For monitoring the quality of results for tests and/or calibrations, the LIMS automates established statistical Analytical Quality Control techniques to ensure the reliability of the process and equipment being deployed.

5.10 Reporting the results

No laboratory would dispute the ISO 17025 requirement that each test or calibration it carries out should be reported accurately, clearly, unambiguously and objectively. That would be a best practice. But this is easier said than done, and nearly impossible without software. A LIMS provides a powerful and flexible

reporting tool that generates multiple reports from data stored within the system (in the case of SampleManager LIMS, data stored in external databases is accessible too). The reports, which can be customized as needed, are designed with oil and gas laboratories in mind. The system is preconfigured for rapid, cost-effective implementation.

Conclusion

ISO 17025 compliance in the oil and gas industry isn't easy, especially in labs still using paper-based processes, but for those labs that take a comprehensive approach the benefits are significant. Compliance processes can be part of an integrated program that improves overall multi-facility performance and profitability. ARC Advisory is more direct, stating that "Compliance with ISO 17025 demonstrates a commitment to quality and provides customers the assurance that the laboratory's management and technical requirements adhere to globally accepted best practices."

So whether an oil and gas laboratory starts with regulation as its impetus or simply wants to improve quality, the end result with LIMS is the same: an integrated system that can deliver the best of both worlds. And, with systems such as SampleManager LIMS pre-configured for the industry, getting up-and-running on the road to compliance and higher performance is only a log-in screen away.



Engineering Defensibility

By Jeanne Mensingh, Thermo Fisher Scientific Partner

Jeanne Mensingh, president and founder of Labtopia Solutions, a Thermo Fisher Scientific Partner, explains how LNG labs can use data management tools to improve the reliability of their results and strengthen the business they serve.

Laboratory data is critical to every part of the LNG industry. From soil sample data for upstream exploration to purity data used downstream to ensure product quality, LNG professionals rely heavily on timely, accurate and well-organized sample data.

These data must be reliable and defensible. Fortunately, many laboratories adhere to strict protocols to ensure data accuracy – they can ill afford to have decision-makers question what they're seeing. The real challenge for these labs isn't data quality; instead, it's the ability to prove data quality as efficiently as possible. In a word, the lab's findings must be defensible: based on proven processes and robust supporting data.

This data-driven approach to lab data reliability is nothing new: ISO 17025, the international standard for testing and calibration laboratory competence, has mandated comprehensive data collection and management for

15 years. What has changed are the software solutions that labs can deploy to meet this challenge.

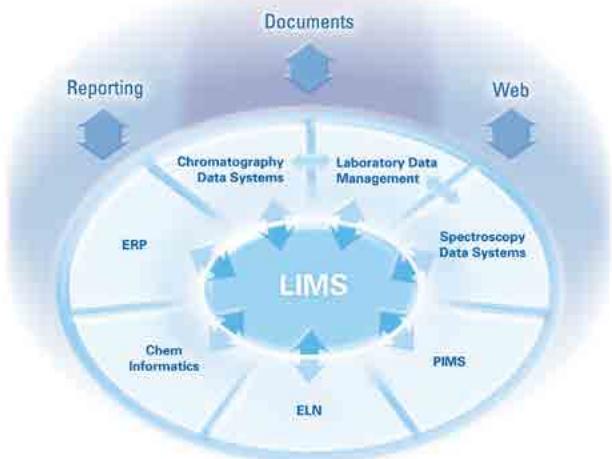
The importance of data management

A laboratory test result doesn't exist in a vacuum: even a common gas chromatography result is the sum of many complementary parts, from supplier shipment data and staff training records to carrier gas and reagent quality checks. Ideally, all of these data work together to prevent errors and make results more defensible.

Historically, defending data has been a time- and labor-intensive process. Lab employees had to collect data from dozens of different sources – including handwritten notes – to build a case in support of a disputed result. Even today, many labs spend as many as ten hours a week manually collecting and managing data. This represents a lot of time spent on manual and labor intensive tasks that could be better spent on more important or revenue-generating activities. Time spent

on these manual tasks represents a significant opportunity cost.

Fortunately, comprehensive data management software makes it much easier for today's labs to defend their data. Laboratory Information Management Systems (LIMS),





Multi Sample Login

first introduced in the 1980s as basic sample management and data reporting tools, have today grown into comprehensive platforms that gather, monitor and manage all laboratory data and records. They also serve as the integration point for all lab instrumentation and can also link to enterprise systems such as PIMS, MES and SAP. Having all these data well-organized and readily available makes the process of defending lab results much easier, allowing lab employees to focus on productive work and assuring management that the data they're relying on for key business metrics are defensible.

Gas chromatography, a common analytical technique in LNG laboratories, serves as a useful example of the sheer volume of data necessary to support the validity

of a single lab result. A LIMS allows lab employees to easily access these data when and how they need them, ensuring the reliability and defensibility of all test results.



Case study: Gas Chromatography

Gas Chromatography (GC) is used to determine the composition of a liquid or gaseous sample. It works by vaporizing a sample and then sending the resulting gas through a coiled tube, called a column, filled with an inert carrier gas. The sample's constituent gases are slowed down by the carrier gas as they pass through the column; each constituent gas is slowed to a different degree depending on its molecular structure. By measuring the time it takes each constituent molecule to reach a detector at the other end of the column as well as the volume of each constituent, lab professionals can determine the composition of the sample as a whole.

The goal here is not to provide an in-depth explanation of GC, but rather to make clear the enormous number of variables that can influence a GC result. Everything from technical errors, such as using the wrong column or improperly calibrating an instrument, to staff management errors, like improper training or manual data entry inaccuracies, can render a lab result indefensible.

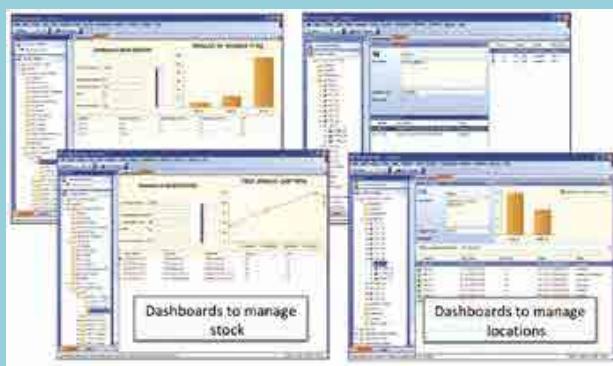
To defend their results, labs must account for all the variables and provide evidence that they were executed properly. A LIMS makes this much easier by automating the entire data collection and reporting process.

Technical quality

Technical quality data include all variables involved in producing an accurate result from an instrument. These data are different than those related to employee performance, which primarily concern the lab staff's competency and adherence to Standard Operating Procedures (SOPs).

For GC analysis for the LNG industry, relevant technical quality data would include reference material certificates, records of approved suppliers, maintenance records and more. A LIMS provides an entire suite of capabilities for managing these data.





Standard Dashboards

Suppliers

Labs require many consumables to operate GC analyzers. Rather than retest all of these consumables as they arrive at the facility, most labs find it easier to build a network of trusted suppliers. These suppliers likely have a well-earned reputation for quality which they can support with their own laboratory data.

A LIMS can automate supplier data management by associating materials with a supplier as they enter the facility. If a technician needs to defend the results from a test, they can reference the LIMS database to verify that all consumables used were from approved suppliers. If they are, they can partially rule out consumables as a fail point.

Consumable quality

Verifying that a consumable comes from an approved vendor is only part of the equation. Consumables can also go out of specification during storage or use. Fortunately, a LIMS can help solve this problem as well: lab administrators can configure the LIMS to trigger periodic consumable quality checks. Together with



verification of supplier data, this capability can help labs avoid the inadvertent use of out-of-specification consumables.

Instrument maintenance and calibration

GC analyzers must be regularly maintained and calibrated to deliver accurate results. To defend their results, labs must also be able to demonstrate adherence to proper maintenance procedures. This is another area where a LIMS excels. Lab managers can organize and retrieve records by instrument, time period and even staff member, allowing them to demonstrate that the instrument in question is adhering to a pre-defined schedule. Verifying this would be much more time-consuming and error-prone in a paper-based environment.

A LIMS adds additional value for calibrations that require certified reference materials. In addition to tracking the calibration itself, the LIMS can store reference material certificates that demonstrate the quality of the materials used.

Staff performance

In addition to instrument error, lab results can also be invalidated by human error. Human errors in the lab originate from issues in one of three broad categories: training, process and data management. A defensible lab result must be able to demonstrate that the lab staff that produced it did not inadvertently make errors in any of these areas.

Staff training

New lab staff typically undergo initial training on the unique processes within their new work environment. Regular retraining is necessary as processes change. Training for each employee must be closely monitored to ensure that they're up-to-date; otherwise, results from any part of an analytical process in which they participate could be questioned. Maintaining these accurate and up-to-date staff competency records is an onerous process that can be simplified by storing all personnel training records within the LIMS.



Process quality assurance

Human error is one of the most common causes of failure in any process: small errors in the execution of a GC analysis can render a result invalid. To prevent this, labs must be able to comprehensively monitor the execution of laboratory processes and reference them to individual results.

A LIMS achieves this by storing and automating SOPs to walk staff members through each process. As staff progress through the steps of an SOP they mark their progress in the system, creating records to document that they executed everything correctly. Process errors can be reported to a lab manager in real-time, allowing them to correct problems before erroneous results are even reported. In fact, multiple SOPs and workflows can

be stored in the LIMS so that changeover for production can be done in the most efficient manner possible.

Data entry and transcription

Manual data entry errors made by staff can significantly affect lab results. Even if a process is nearly entirely automated, a single manual data entry error can make the result indefensible. A LIMS helps alleviate data entry concerns by automatically collecting and aggregating lab instrument data. A vendor-agnostic LIMS is particularly important, as it's capable of interfacing with a broad range of instruments from multiple vendors.

Conclusion: complete traceability

The areas covered here are not an exhaustive list of variables involved in GC analyses. But they do

demonstrate the point – there are many ways for a single experiment to go astray and lead to a disputed result. Defending results is about more than simply verifying inputs and outputs; it's about documenting complicated processes rigorously at every step.

A LIMS can provide complete visibility into processes and the staff that execute them. Moreover, it can direct processes in a manner consistent with SOP. This complete traceability – from materials supplied to training and instrument calibration – significantly streamlines laboratory operations and provides critical data defensibility.



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Christoph Nickel, Senior Director for Informatics and Chromatography Software, Thermo Fisher Scientific



ISO 14001 and LIMS: Combining Laboratory Environmental Management with Operational Efficiency

Many expect there to be a conflict between meeting environmental targets and improving a company's bottom line, but managed carefully they can both improve operational efficiency.

By Trish Meek, Thermo Fisher Scientific



Businesses around the world are realizing that environmental responsibility and profitability don't have to be at odds: in fact, effective environmental management can often encourage operational efficiency.

This is true in laboratories as well, but some laboratory managers still believe that practicing environmental stewardship automatically means higher costs. Experience has shown otherwise: labs that choose to take a rigorous, disciplined approach to environmental management usually realize efficiency gains in the form of reduced energy use, more efficient use of consumables, diminished waste production, disposal costs and more. This makes sense: waste – including the environmental externalities of running a lab – is almost always a sign that inefficiency exists somewhere in an operation.



The family of ISO 14000 standards have been in place across many industries for more than 15 years, and for laboratories they provide a useful non-technical framework for successfully reducing waste and environmental impact. ISO 14001, the primary standard in the 14000 family, outlines a set of guidelines for establishing an effective Environmental Management System (EMS). An EMS is a management framework that helps decision-makers, including those attached to a lab or labs, establish environmental goals and set up a positive feedback loop that enables ever-improving environmental performance and, by extension, greater laboratory efficiency.

The feedback loop is at the heart of the ISO 14001 standard. At its core is a five-step process: first, lab management must commit to environmental goals that are reasonable for their organization. Next, they must plan how to achieve those goals over a set period of time (often a quarter or a fiscal year). Step three is implementation: once a specific plan has been made, management must present it to staff and ensure that they're capable of executing their new workflows.

After the plan is in place, the final two steps begin. In the evaluation phase, the lab must continuously monitor all operations and collect data on the performance of its plan. Finally, the review phase is a chance for lab management to go over the data collected in the evaluation step and look for ways to improve upon their original plan for the next operating period – which, naturally, leads back to the policy step. Environmental management improvement in terms of laboratory operations can have a number of targets, such as instrument running costs, waste solvent disposal,

and may have their root cause in long established working practices.

The importance of information management

An effective, fully-compliant EMS is built on being able to measure the effects of changes – essentially being able to compare the before and after stages of each five step iteration. In fact, it requires labs to manage additional, more granular, data so that the lab environmental performance can be appropriately measured allowing management to evaluate the success of implemented changes. This creates new complexities that make better information management a priority for any lab in the process of establishing an EMS.

For many labs, the ideal solution for managing all this information is already in place: the Laboratory Information Management System (LIMS). Among many other things, a LIMS is commonly used for management and reporting of sample data; however, it can be equally effective for the collecting, organizing and reporting of performance data, which are all critical aspects of a successful EMS. As the LIMS tracks the lifecycle of



▲ **Chromeleon Combines LC, GC, MS Instrument Control as well as Method and Data Management**
Shane Trombley, Product Specialist, Thermo Fisher Scientific



a sample as it passes through the lab, it also gathers metrics about the laboratory operations, for example, the usage of stock solvent for a preparation, the time taken to analyze the sample using an instrument and so on. This data can be used to collate actionable information as we shall see later.

Planning

Once a lab commits to establishing an EMS, it must identify and catalogue the environmental aspects of its operations, which ISO 14001 defines as any items or processes that can have negative impacts on the environment. Once all impacts are catalogued, management sets what are called objectives and targets. Objectives establish what must be accomplished, such as “reduce the usage of hazardous solvents,” while targets are measurable outcomes that are related to an objective. For the objective to reduce solvent use, for example, a lab might set a target such as “reduce total solvent waste for disposal by 15 percent before June 2015.”

A LIMS makes EMS planning easier by enabling lab management to build a map of the lab, which includes all instruments and testing protocols having a proportionately higher environmental impact. This allows the lab to identify the low hanging fruit for process improvements or protocol changes to meet the environmental targets that have been set.

Implementation

Once the plan is set and the lab is working towards its new environmental goals, new processes and methods must be rolled out to relevant lab workers. Implementation comprises three important steps: providing training to employees on their new environmentally friendly protocols, instituting data capture processes for environmental metrics, and management review of the results of the new process. LIMS provides critical support for each of these steps.

The first step, employee training, benefits from the way a LIMS can fully automate the assignment of Standard Operating Procedures (SOPs) for lab technicians, creating a paperless training environment. New workflows and procedures are clearly outlined based on roles and responsibilities, ensuring that each technician knows precisely what they must do as a part of the lab achieving its EMS goals. Additionally, the LIMS can enforce that users must have completed a specific training course prior to being able to access protocols stored within the LIMS. And, during any audit to demonstrate ISO 14001 compliance, the LIMS has automatically captured the employee training progress and history.

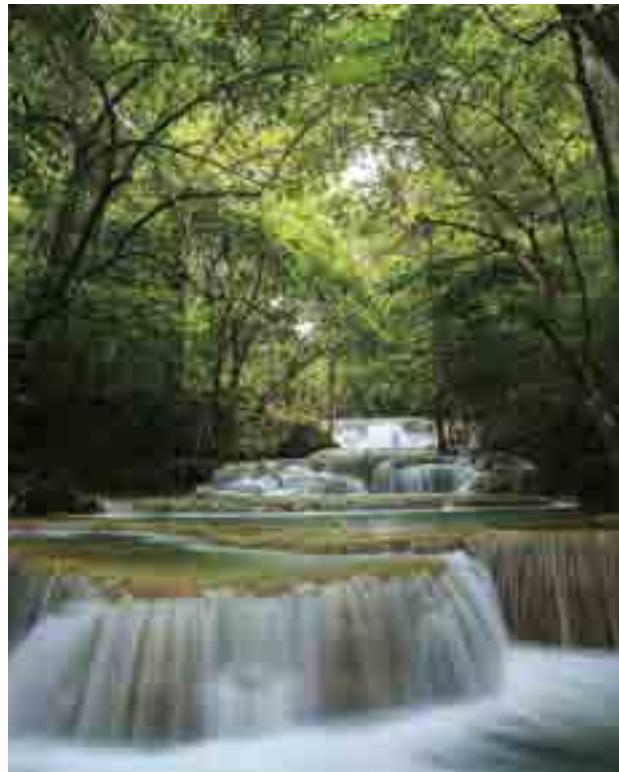
A LIMS also plays a vital role in communicating environmental management parameters to staff. Real time dashboards can be used to display environmental quality parameters, alerts based upon critical parameter levels can be sent to relevant decision-makers inside and outside the lab. This dramatically reduces response times and improves EMS performance. What's more, early response can also mitigate damage to instruments, equipment or product if an environmental impact rises to the level of hazard.

When environmental incidents are surfaced, the LIMS is designed to help employees solve them. The LIMS stores Incident Protocols that detail exactly what employees must do if problems occur. Little time is wasted between notification and response because the LIMS notifies each employee precisely what to do and when.

Evaluation

Evaluation is the longest and most data-intensive step in the EMS process: a compliant lab must continuously monitor all affected lab operations throughout the operating period. Once again, this is where LIMS can play a significant role. It is, after all, designed to automatically collect and manage large, diversified sets of data and make them easily usable for laboratory decision-makers.

A LIMS can serve as a central repository for collecting data from all instruments in the lab (a LIMS such as Thermo Scientific SampleManager can collect data from any manufacturer's instrument). Having a single place to store and retrieve information enables analysis



Combining the environmental management capabilities of an ISO 14001-compliant EMS with the operational efficiency power of a LIMS has the potential to transform laboratory operations to be more environmentally friendly.

of performance trends, monitoring of key performance indicators defined by the EMS and periodic internal audits to ensure that goals are being met.

The ability to securely store, recall and analyze such a volume of data, including digital information in high-resolution formats, is critical to the next step of the process: management review.

Management review

At the end of a predefined operational period (often a quarter or fiscal year), ISO 14001 requires that lab management meet to review the progress of their EMS goals. A LIMS can simplify this review significantly. Because all data is organized within the LIMS and preconfigured for streamlined access and review, lab management can quickly assess progress against previously defined goals. Management can drill down into details – all the way to the instrument configuration, solvent usage, etc. – as necessary.

As EMS goals are met, management can set new goals, further improving environmental performance based on hard data gathered from the prior period. A flexible LIMS allows management to easily update the system for new objectives and targets, including revising SOPs and other automated procedures to guide employees through what's required of them in the forthcoming period.

(Re)commitment

After each period, management must reaffirm its commitment to ISO 14001 compliance by reviewing the results of their EMS with an independent (ISO) or governmental (EPA) auditing body. Just as a LIMS simplifies EMS performance review for management, so too does it streamline external reporting of the laboratory's environmental performance. The LIMS can generate reports for each period that are tailored to the requirements of external auditors. This not only ensures a thorough, well-documented review, it also shows auditors that a rigorous system is in place for achieving results over the next period.

Conclusion

Combining the environmental management capabilities of an ISO 14001-compliant EMS with the operational efficiency power of a LIMS has the potential to transform laboratory operations to be more environmentally friendly. By simultaneously reducing process waste, identifying improvement opportunities and implementing a lab-wide data management system, labs can significantly enhance their productivity and environmental responsibility. As more and more companies realize the benefits of ISO 14001 compliance and institute their own environmental management systems, the role of the LIMS in ensuring EMS excellence in the laboratory will only increase.

LIMS Compliance for Better Quality and Performance

By Trish Meek, Thermo Fisher Scientific



Too often, businesses think of government regulation, standards and oversight as burdensome, onerous and, some would say, even gratuitous. If businesses can instead think of standards, such as ISO 17025, as checklists for running a credible, high-quality lab, tremendous benefits are possible. This article explores how an integrated data management solution, such as a Laboratory Information Management System (LIMS) can help oil and gas companies adhere to ISO 17025 standards and how that can actually be a catalyst for better overall performance.

According to a recent “ARC View” piece by ARC Advisory Group, “hydrocarbon processing laboratories are becoming almost like third-party service laboratories.” The author of the piece, Paula Hollywood, goes on to say that “this means that accreditation with standards such as ISO 17025 is no longer just nice to have, but a necessity to ensure conformance and customer satisfaction.” The key here is customer satisfaction, whether that customer is internal or external, in the case of a true third-party laboratory. Compliance, in other words, is not the ultimate goal of LIMS; delivering higher quality product and customer satisfaction are.



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So how do LIMS and regulations such as ISO 17025 align and or complement one another? Fundamentally, ISO 17025 overlaps with LIMS in 12 key areas, outlined in the following sections of the standard:

- 4.4. Review of requests and contracts
- 4.6 Purchasing services and supplies
- 4.8. Complaints
- 4.9. Control of non-conforming testing
- 4.10. Corrective action
- 4.11. Preventative action
- 4.12. Records
- 5.2.5. Training and authorization of personnel
- 5.4.5. Validation of methods
- 5.5. Equipment
- 5.9. Assuring the quality of test results
- 5.10. Reporting results

At quick glance, you'll see that each of these areas touches on an aspect of lab business that should already have best practices to which all staff adhere. But hewing to best practices philosophically is much different – and infinitely less complex – than capturing, managing and reporting on the “hows, whens, whos and whats” related to following the standards.

A proven integrated data management system, such as Thermo Scientific SampleManager LIMS, is designed to mitigate complexity by automatically connecting those pieces, easing compliance within oil and gas laboratories and, most important, exposing previously unrecognized opportunities for performance improvement. Let's explore how LIMS can help turn compliance into opportunity.

Getting on the same page

Sections 4.4 and 4.6 of ISO 17025 address a fundamental best practice in any business, getting on the same page with the client, whether that client is internal or external. Which tests are being performed, how samples must be handled, what supplies must be used, which suppliers are approved, etc. vary greatly from client to client and situation to situation, and loose adherence has potentially costly consequences, especially when it comes to resolving any disputes. The requirement to track this information and produce proof during an audit may seem onerous, but in reality it's simply good business. So the fact that a LIMS removes the “it's too time-consuming” objection, all that remains are the business benefits.

Rooting out inefficiency

In a complex industry such as oil and gas, we learn to expect the unexpected. Sections 4.8 through 4.10 address formal processes for managing incidents, not to simply assign blame, but instead to rapidly fix the issue and avoid future occurrence. The “Incident Management” functionality in LIMS includes templates for different incident types, defines required actions and documents the response through successful closure. Through LIMS, the laboratory can not only accelerate response to incidents and resulting complaints, but it has an always-learning database that is constantly rooting out inefficiency and risk.

An ounce of prevention

Section 4.11 requires laboratories to identify potential sources of non-conformance. This can expose analytical processes that are “heading out of control,” even those that are still technically “in spec.” Without a system to

identify this, such as LIMS Statistical Quality Control (SQC) and Analytical Quality Control (AQC) worksheets and charts, it's nearly impossible for laboratory personnel to spot possible issues.

A proactive oil and gas laboratory can spot data trends related to nitrogen, methane or propane content, for example, using LIMS as a tool to monitor for quality and possible environmental or safety impact.

SQC/AQC charts are also valuable tools for validating methods (see section 5.4.5) and ensuring the quality of test results. Many believe that section 5.4.5 is actually one of the strongest parts of ISO 17025. Having access to at-a-glance charts to use as early warning systems and visual performance monitors provides benefits far beyond compliance.

A proactive oil and gas laboratory can spot data trends related to nitrogen, methane or propane content, for example, using LIMS as a tool to monitor for quality and possible environmental or safety impact. AQC worksheets cover initialization checks, calibration checks, interference checks, matrix spikes, duplications and other information that can expose patterns, including specific patterns for which the laboratory requires warning.



Sakhalin II

Sakhalin II, the world's largest integrated oil and gas development project, proves that no requirements – or environmental conditions – are too harsh for LIMS. The project also shows how ISO 17025 compliance and the pursuit of product quality go hand-in-hand.

The ultra-modern laboratory onsite at Sakhalin II provides round-the-clock testing of both onshore and offshore feeds, environmental and safety monitoring and water quality control and analysis. While ISO 17025 regulations require steps such as validation of analytical methods, instrument calibration and security controls, with LIMS there is so much more the laboratory can do.

The Sakhalin II laboratory manages a rigorous daily sample schedule within LIMS, including analysis of gases for nitrogen, methane, ethane, propane and butane, as well as quantification of hydrogen sulphide, CO₂, mercaptans, carbonyl sulphide (COS) and total sulphur content. The same system that ensures real-time compliance also drives quality control, from

calculating the density and gross heating value of each cargo to issue certificates of quality.

In such a complex operation, the LIMS becomes more than a compliance tool. In a facility such as the Sakhalin II laboratory, LIMS can replace inefficient and risky paper-based processes with highly integrated automatic data capture and transfer that eliminates errors caused by manual processes. Not only is data available to regulators in a timely fashion, it's available to decision-makers making data-driven business decisions that impact product quality and overall profitability.

SampleManager LIMS is used to manage Sakhalin's lab workflow and reporting on samples, as well as data management of environmental monitoring throughout operations.





Good news to report

The most burdensome part of reporting is compiling the data. With a LIMS, however, access controls ensure that each step, each access is authorized, documented and stored. Appropriate files, notes and external links accompany each instance of access, creating an audit trail that is easily accessed and reviewed. Once again, ISO 17025 compliance may dictate the institution of access controls and accompanying documentation, but the wisdom of capturing this information for performance assessment is undeniable. Without LIMS it would be a burden for sure; with LIMS it's a best practice.



Well equipped

A complex oil and gas laboratory maintains a technology inventory comprised of instrumentation, spare parts, consumables and complementary lab equipment. ISO 17025 requires that labs maintain comprehensive records for each piece of equipment and that proper calibration must be documented. This can be especially burdensome, especially in larger labs and/or labs that have relationships with satellite or partner labs upstream and downstream. But with LIMS as a system of record, burden becomes benefit and stakeholders in the business can begin accessing information that informs efficiency, performance and capital equipment decisions for the laboratory enterprise-wide.

Oil and gas laboratories must address difficult analytical challenges as the industry seeks to deploy new exploration, extraction and processing technologies. ISO 17025 addresses the use of new or non-standard methods and provides a framework for capturing all related information. This means that the consumer of the results can be sure that best practices were used in generating that information and the lab can be confident that new methods can be developed and reproduced successfully.

Thermo Scientific Integrated Informatics can help today's oil and gas and petrochemicals companies deliver the safest products, using the most sustainable process, while delivering superior value to all stakeholders.

Conclusion

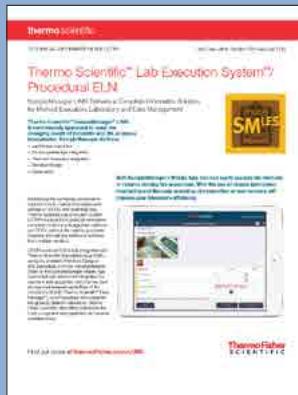
Oil and gas companies can think of regulations such as ISO 17025 as burdens or catalysts. Before LIMS – before it was possible to run a paperless lab – compliance was indeed time-consuming and costly. Now, however, compliance processes can be part of an integrated program that improves overall multi-facility and performance and profitability. As the ARC View suggests, "Compliance with ISO 17025 demonstrates a commitment to quality and provides customers the assurance that the laboratory's management and technical requirements adhere to globally accepted best practices. The documentation produced by SampleManager LIMS confers credibility in testing practices and data quality to customers and regulatory authorities." So whether a laboratory in the oil and gas industry starts with the regulation as impetus or simply wants to improve quality, the end result with LIMS is the same: an integrated system that can deliver the best of both worlds.

The Resource Center

Technical Bulletins: LIMS, LES, SDMS, and CDS



Thermo Scientific
SampleManager LIMS



Thermo Scientific
Lab Execution System/
Procedural ELN



Thermo Scientific
SDMS – Data Manager



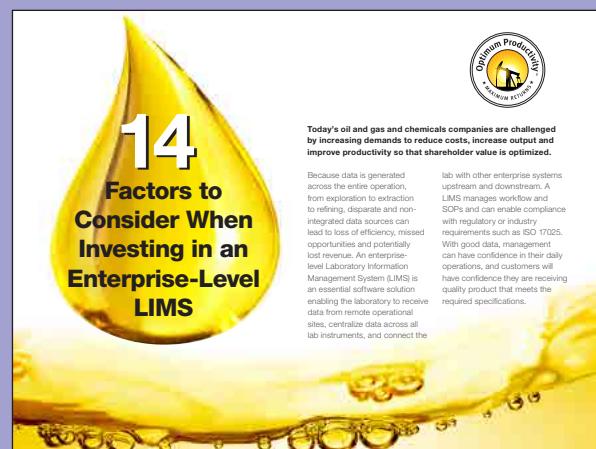
**Thermo Scientific
SampleManager LIMS and
Chromeleon CDS Link**



Thermo Scientific
Integration Manager



Infographic



Today's oil and gas and chemicals companies are challenged by increasing demands to reduce costs, increase output and improve productivity so that shareholder value is optimized.

Because data is generated across the entire operation, from exploration to extraction to refining, despatch and non-interesting waste management, it leads to loss of efficiency, missed opportunities and potentially lost revenue. An enterprise-wide Laboratory Information Management System (LIMS) is an essential enabling solution enabling the laboratory to receive data from remote operational sites, centralise data across all lab with other enterprise systems upstream and downstream. A LIMS manages workflow and SOPs and can enforce compliance with industry-specific requirements such as ISO 17025. With good data, management can have confidence in their data operations, and customers will have confidence in the quality product that meets the required specifications.

- # 14 Factors to Consider When Investing in an Enterprise-Level LIMS

Here are fourteen reasons to invest in an enterprise-level LIMS.

- 1 IMPROVED PRODUCTIVITY**
Improve laboratory productivity, testing and sample traceability via a centralized, searchable database integrated with lab instruments, remote field collection sites and downstream facilities.
 - 2 COMPLIANCE**
Ensure compliance with regulatory or industry standards through the use of standardized processes. ISO-compliant workflow and SOPs, with standard reports built into the LIMS.
 - 3 INTEGRATION**
Achieve tighter integration between lab-generated information, remote sites, downstream facilities and existing systems by consolidating data available where and when it is needed.
 - 4 DEPENDABLE RESULTS**
Deliver accurate, consistent and traceable results upstream or downstream by having access to all data related to sample testing securely stored in a centralized database.
 - 5 DATA TRANSCRIPTION**
Data transcription errors, saving time and personnel cost.
 - 6 BETTER DECISION MAKING**
Collaborate and share information for faster, more informed decisions, improving operational efficiency product quality and customer satisfaction.
 - 7 LIFE CYCLE MANAGEMENT**
Manage the entire sample life cycle from receipt to certificate of analysis to report generation.
 - 8 DATA VISUALIZATION**
Access powerful and intuitive data visualization capabilities by having raw instrument data stored in the LIMS and archived for any future need.
 - 9 TRACKING**
Track field collection or environmental data points to monitor the compliance of the facility and have regulatory documentation available for audit or management review.
 - 10 INTEGRATION**
Integrate with other systems, such as EHRs, for better patient care and operational efficiency.
 - 11 FASTER PROBLEM SOLVING**
Identify and solve problems faster, and even anticipate them before they occur by having access to real-time information across the organization.
 - 12 REDUCED DOWNTIME**
Reduce downtime and production time through the use of automated maintenance, built-in ISO 17025 SOPs, increasing efficiency and reducing impact on revenue.
 - 13 IMPROVED PURCHASING POWER**
Streamline vendor relationships and improve purchasing power with centralized requirements stored in the LIMS.
 - 14 QUALITY CONTROL**
Improve quality control process with SOPs and workflow built into the LIMS, alerting management to out-of-spec

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Chromeleon CDS Brochures

Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) Software Combining Separation (GC/IC/LC) and Mass Spectrometry (MS) in an Enterprise (client/server) Environment

Thermo Scientific™ Chromeleon™ 7 Chromatography Data System Intelligent LC: Advanced Control for Thermo Scientific LC Systems

Thermo Scientific™ Chromeleon™ 7.2 Chromatography Data System Designed for Mass Spectrometry (MS) Instrument Control and Data Processing

Chromeleon CDS Specification Sheets

Thermo Scientific™ Chromeleon™ 7.2 Chromatography Data System (CDS) New Import and Export Options for Transferring CDS Data Between Multiple Systems

Thermo Scientific™ Chromeleon™ 7.2 Chromatography Data System (CDS) New Intelligent Run Control (IRC) for Complete Control Over Your Running Sequence

Chromeleon CDS Handy Web Links

AppsLab Library: Find your Methods, eWorkflows and more

The AppsLab Library of Analytical Applications is a fully searchable online, analytical method repository where you can find applications with detailed method information, chromatograms and related compound information.

Discover the latest applications from Thermo Fisher Scientific for LC, IC, GC, GC-MS and LC-MS instruments. Search by compound, column, instrument or any other method parameter and view key method parameters.

Download one-click eWorkflows, created and tested by Thermo Fisher Scientific application scientists, which can be directly executed in your chromatography data system.



All the information needed to run, process and report the analysis is available in ready-to-use eWorkflows.

Thermo Scientific AppsLab Library of Analytical Applications – Methods, eWorkflows and more

Videos



The Age of Informatics In and Out of the Lab

David Leitham, VP/GM Informatics & Chromatography Software, highlights the need for robust software and LIMS solutions to harness the power of data in and out of the lab and how Thermo Fisher Scientific can be a partner to customers. Learn about our leading LIMS and other software solutions, including Chromeleon CDS, and unleash the power of your data across your enterprise.



Thermo Scientific Lab Execution System Helps Scientists Go Paperless

Analytical and QA/QC labs, under ever-increasing pressure to improve time to market, ensure compliance and realize cost savings, now have an all-inclusive informatics solution that gives them complete control over their methods and standard operating procedures (SOPs) without having to purchase, integrate and validate software from multiple vendors. Trish Meek, Director of Product Strategy for informatics at Thermo Fisher Scientific, explains how the new solution helps get scientists closer to the paperless lab.



Leading LIMS Solution Bridges the Lab and Enterprise

Katie Evans, Sr. Product Manager, talks about Thermo Scientific SampleManager LIMS, the leading LIMS solution, and how Thermo Scientific software solutions bridge data gaps in the lab and across the enterprise with leading laboratory management technologies.



Chromeleon Enabling Seamless Data Flow from Lab to Enterprise

Darren Barrington-Light talks about Thermo Scientific Chromeleon CDS and the latest release of the leading chromatography software from Thermo Fisher Scientific. Learn how our CDS solutions link into Laboratory Information Management to unleash the power of data in your enterprise and across your research.



Chromeleon Combines LC, GC, MS Instrument Control as well as Method and Data Management

Thermo Scientific Chromeleon CDS software combines the control of, and data collection from your chromatography (GC & LC) and MS instruments. Unifying workflows for these analytical instruments means that different sources and types of data can be overlaid, compared, backed up, and processed in one application. Chromeleon combines method creation and quantitation, and performs library-based compound identification. Streamlining data collection and experimental management liberates time for scientists so they can focus on science instead of logistics. This increase in efficiency is invaluable in an enterprise or other high-throughput environment.



Introducing AppsLab — Your Online Access to Thousands of Apps & Experts

Whether you need to find a solution to a new separation challenge or just want to optimize your chromatography – the AppsLab Library gives you access to Thermo Scientific application notes and methods online. It already holds more than 1,900 applications for GC, HPLC, IC, GC-MS, IC-MS, and LC-MS and continues to grow. Search, filter, and download complete applications and one-click workflows for immediate execution.



Case Study

Sakhalin Energy Utilizes Thermo Scientific SampleManager LIMS™ for Largest Russian LNG Project Ever

Sakhalin Energy is bringing onstream one of the largest integrated oil and gas projects in the world in Russia's Far East. The Sakhalin II Project combines partnership incorporating the recovery, production and transportation of oil and Liquified Natural Gas (LNG). Sakhalin Energy standardized on Thermo Scientific SampleManager LIMS (Laboratory Information Management System) for use in its main laboratory located at its LNG plant/Oil Export Terminal (OET), as well as in upstream satellite laboratories throughout Sakhalin Energy.

Profile

Headquartered in Yuzhno-Sakhalinsk in Russia, Sakhalin Energy was founded in 1994 to develop the Piltun Astokhskoye (PA-A) oil field and the Lunkskoye gas field east of Russia. The fields are located off the north-east coast of Sakhalin in waters frozen for six months of the year.

The Sakhalin II project refers to the world's biggest integrated oil and gas project. It is being built from scratch in the harsh sub-artic environment of Sakhalin Island located in the Sea of Oshotsk. Sakhalin II is the largest single foreign investment project in Russia at \$10 billion, and is the first offshore



development project in Russia, as well as Russia's first Liquified Natural Gas (LNG) project.

The two fields contain reserves of approximately 140 million tons (1 billion barrels) of oil and 550 billion cubic meters (20 trillion cubic feet) of natural gas. The oil reserves equate to more than one year of crude oil exports from Russia and the gas reserves represent nearly five years of Russian gas exports to Europe or enough to supply current global LNG demand for four years. To export the gas, the company is building Russia's first-ever LNG plant, which converts the gas to a liquid by cooling it to a temperature of minus 161 degrees Celsius (minus 258 Fahrenheit) so that it can be transported by ship.

The Sakhalin LNG plant will be the world's second in a cold climate. The gas will be transported from the gas field platform by pipelines to an Onshore Production Facility (OPF) and then via an 800 km onshore pipeline to Prigorodnoye in the south of Sakhalin Island, the site of the LNG plant and oil and LNG export terminals. The OPF's main purpose is to process gas and condensate produced at the Lunkskoye gas field before pumping them into the pipeline system for transportation to the oil export terminal and LNG plant.



The decision to invest in a new LIMS to manage the sampling process from upstream to sample report was imperative for Sakhalin Energy's new laboratory.

Prigorodnoye's ice-free sea makes it a perfect location to enable full year round export of oil and LNG. Divided over two liquefaction trains, the LNG plant has a capacity to produce a total of 9.6 million tons of liquified natural gas. Shell's Double Mixed Refrigerant (DMR) process was selected for the Sakhalin plant. This DMR technology was specifically developed for cold climates like Sakhalin has, and for locations with large seasonal temperature variations. Under these circumstances, DMR achieves much higher power utilization than the conventional C3/MR process would of the 88 MW GE Frame-7 gas turbines that drive the refrigeration process.

Sakhalin is located close to emerging economies in Asia and will guarantee uninterrupted supply of LNG to Asian markets year-round. Customers in Japan, South Korea and the U.S. have already bought all the gas to be produced at Sakhalin for the next 20 years.

Requirements

The Sakhalin II Project is the largest integrated oil and gas development project in the world and as such, has a major undertaking for sampling and testing. Environmental and Health and Safety compliance have been important drivers in the development of Sakhalin II both to monitor the field operations and plant processes and to measure product specification and quality test the products. The function of the laboratories on Sakhalin Island include quality testing of oil and gas, process monitoring at LNG plants, testing at upstream facilities and environmental monitoring across the island.

In order to provide a real-time round-the-clock analytical regime, an ultra-modern laboratory was commissioned to be located at the LNG plant/OET. This new central laboratory is also supported by upstream satellite laboratories. In 2007, the state-of-the-art LNG/OET laboratory successfully passed certification tests to the requirements of Gosstandart and the international ISO 17025 standard.

Laboratory specialists are now analyzing samples of oil, gas, chemicals and wastewater from the LNG/OET site. In addition, the laboratory will be used to analyze, as required, samples brought from the Onshore Processing Facility (OPF) as well as managing non-routine samples.

The decision to invest in a new LIMS to manage the sampling process from upstream to sample report was imperative for Sakhalin Energy's new laboratory. Sunil Pandya, the Head of Laboratory for Sakhalin Energy, explains, "Our laboratory has well-defined procedures for essential quality control work, for scheduling samples, to managing resources and reporting on samples. To manage the workload and

integrate with the instrumentation, we selected Thermo Scientific SampleManager LIMS for the laboratory. SampleManager is a widely used LIMS for the oil and gas industry and it is implemented in our main laboratory, in the upstream satellite laboratories as well as for data management of environmental monitoring throughout Sakhalin Energy operations."

Solution

The laboratory provides analytical services to the LNG/OET facilities. It generates analytical reference data for product quality and custody transfer invoicing, calibration of on-line process analyzers, plant performance, equipment condition and environmental monitoring. It also provides expert advice on LNG and crude oil Sales Purchase Agreements (SPAs) and plant troubleshooting. It also provides ad-hoc laboratory services to other Sakhalin Energy assets (OPF, pipelines, offshore platforms).

The majority of samples are taken by operations staff and delivered to the laboratory. Laboratory staff train the senior operators and maintenance technicians to collect samples. Laboratory staff collect special samples that require complex sampling techniques, such as 2-phase samples, flue gas, etc. The sampling and testing requirements are agreed and scheduled with operations, engineering, environmental and technology departments.

Various internal customers use the analytical reference data:

- Operations for plant performance monitoring and product export
- Engineering for equipment condition monitoring
- Technology for efficiency checks and troubleshooting
- Environmental services for environmental monitoring and compliance
- Marketing for customer liaison support
- Finance for invoicing

Objectives

- To provide unbiased laboratory services and advice to LNG/OET and third parties in a timely, accurate and reliable manner
- To achieve and maintain a high standard in health, safety and environmental performance

The new LNG/OET laboratory handles the samples coming from upstream operations, through the LNG plant and the final products. The analyses of final products are performed when the LNG storage tanks are prepared and isolated or during the ship's loading. When sufficient reproducible results are obtained, the mean and weight average composition are both calculated. The mean composition of each cargo is used to calculate density and gross heating value and all values are included on the Certificate of Quality.

Any data required by the business is automatically available from the LIMS with sophisticated automatic data transfer. The LIMS is used to interface seamlessly with critical IT systems including Sakhalin Energy's corporate Energy Components (ER) package and Process Information (PI) system for efficient reporting and documentation support.

Thermo Scientific SampleManager LIMS was selected by Sakhalin Energy because of its pedigree in this industry. A proven system that works in the rugged demanding environs of the oil and gas industries, SampleManager LIMS is used in many organizations needing to demonstrate regulatory compliance while ensuring optimum product quality. The company required a LIMS that could provide documentation of compliance with ISO 17025, which is the international standard for analytical laboratories developing their data management systems for quality, administrative and technical operations.

Benefits

The Sakhalin Energy facility handles the entire process from extraction to issuing SOPs and Certificates of Quality with all samples tracking managed from within the SampleManager system. The laboratory has to operate according to GLP/OECD guidelines and uses SampleManager to demonstrate its procedural conformity.

Sakhalin Energy staff use SampleManager LIMS 24/7 to help manage the data from the thousands of samples that are required throughout the sampling stages on Sakhalin Island. Some instruments of the laboratory are planned to be connected into the LIMS so that reports can be accessed centrally and instruments can be scheduled for calibration, etc. from within the LIMS. The data from the facility's state-of-the-art equipment, including GCs, is all directly transferred into the LIMS and SampleManager is tasked with storing and tracking data processed in the laboratory. The LIMS is also used for data trending and analysis, or to identify when product is moving out of specification.



Since the implementation of SampleManager LIMS at the LNG/OET laboratory, major benefits realized include improved sample turnaround times, centralized access to data and improved operational efficiencies. The system also meets the laboratory's need for GLP and ISO 17025 compliance. The solution has been capable of handling standard and non-routine sampling requirements, providing audit trails to track deviations and amendments to each study. Sunil Pandya explains "SampleManager was selected due to its proven performance within the Shell group of companies and in this industry. Our laboratories have been designed from the ground up to support this site – this project represents the new frontier in oil and gas development and our laboratory needed a LIMS that was proven to be reliable in this environment and dependable for the future of the project."

The Chromeleon 7.2 CDS enterprise support for MS gives you the ability to control, process and report MS data from remote PC's or even from another building, another site, or even in another country! The sharing of data has never been so easy!



▲ **Chromeleon Enabling Seamless Data Flow from Lab to Enterprise**
Darren Barrington-Light, Product Marketing Specialist, Chromeleon CDS
Thermo Fisher Scientific

Conclusion

Sakhalin Energy is Russia's largest project in the oil and gas industry and its ultra-modern laboratory has been designed to provide the scientific background to ensure LNG production is maintained year-round. With both a commercial and a scientific driving rationale, Sakhalin Energy has equipped its laboratories with the technologies and infrastructure that allow it to deliver consistent support to the production and shipping cycle of finished product. To deliver this reliability of service while demonstrating regulatory compliance, Sakhalin Energy has standardized on SampleManager LIMS in its new state-of-the-art LNG/OET Laboratory. Since its implementation, the system has allowed Sakhalin to develop and manage a sophisticated sampling program with the objective that all the LNG supplies for the

emerging Asia markets will be delivered from Sakhalin Island for the coming decades.

SampleManager LIMS Helps Sakhalin Energy Meet ISO 17025 Requirements

The 2005 release of ISO 17025, General Requirements for the Competence of Testing and Calibration Laboratories, covers laboratories using standard, non-standard and laboratory-developed methods. This international standard is the accepted standard for analytical laboratories developing their data management system for quality, administrative and technical operations.

There are several critical areas of compliance for any oil and gas operation, including security, instrumentation calibration, maintenance of electronic records, traceability of procedures and personnel and environmental and equipment monitoring. The ability of laboratory managers at Sakhalin Energy to have control of this vital information is an important aspect of the oil and gas operation and ensures that production can continue uninterrupted by changes related to environment, personnel, instrumentation or equipment that falls out of calibration or becomes damaged in the production process.

SampleManager LIMS offers a centralized system to access data and extract information, enabling effective management of laboratory operations. SampleManager LIMS provides evidence and documentation to support laboratory compliance with ISO 17025.

SampleManager addresses the security required for laboratories conducting testing in their "permanent facilities, at sites away from permanent facilities, or in associated temporary or mobile facilities," by providing full security controls, including "group security," which can be used to segregate work from different clients or in different laboratory areas. SampleManager's enhanced functionality covers a broad range of requirements, including validation of methods, instrument calibration, sampling, control of non-conformance testing and reporting of results.

To meet ISO 17025 requirements regarding the "control of non-conforming testing and/or calibration work", SampleManager has built-in functionality for incident management and statistical analysis of both calibration standards and sample results. SampleManager also automatically maintains all electronic records and makes them available for either reviewing or reporting, and has built-in archiving, which allows for the removal of older records once their retention period has expired. Full audit trail facilities are standard for SampleManager, allowing full traceability of the personnel and the procedures that were entered. These built-in capabilities allow laboratories to more easily review their quality system by having ready access to all incidents, corrective actions, non-conforming results and other events.



SampleManager's existing functionality includes powerful and flexible report writing, making it possible to create any report format required by the laboratory, and including any data stored within the SampleManager database.



To address the Technical Requirements of the standard, SampleManager has built-in functionality to handle environmental monitoring, a critical component of laboratory compliance with ISO 17025. Within SampleManager, environmental monitoring of key areas of the laboratory can be scheduled on a routine basis. Certain instrumentation can be connected via SampleManager's Instrument Manager function, and data can be collected and logged at periodic intervals. Validation of methods is a critical ISO 17025

requirement, for which SampleManager has built-in functionality to allow lab managers to be in continuous compliance. SampleManager's Batch Management functionality provides analytical QA/QC support, including automatic and interactive sample assignment according to pre-defined templates.

Equipment and instrument calibration, also an important part of ISO 17025, is managed by SampleManager through Instrument Calibration Scheduling, allowing the

LIMS to prevent the use of any instrument that is past its calibration due date. SampleManager provides reporting that indicates which instruments are out of compliance or need calibration. Finally, to comply with ISO 17025 reporting requirements, SampleManager's existing functionality includes powerful and flexible report writing, making it possible to create any report format required by the laboratory, and including any data stored within the SampleManager database.



Streamline your laboratory workflow using Thermo Scientific™ Chromeleon™ 7.2 Chromatography Data System (CDS) software. This software delivers superior instrument control, automation, data processing, and more. The first CDS to unify the workflows for chromatography and routine quantitative mass spectrometry (MS) analysis, Chromeleon software provides full integration of Thermo Scientific gas chromatography (GC-MS/MS) and liquid chromatography (LC-MS/MS) instruments. Run your analyses in an enterprise environment—from method creation to final report.

Additional Case Studies

▲ The World's Largest Gas to Liquids Facility Runs on Thermo Scientific SampleManager LIMS

▲ Sakhalin Energy Utilizes Thermo Scientific SampleManager LIMS for Largest Russian LNG Project Ever

▲ The Real Benefits of Standardizing on a Single LIMS in the Gas and Petroleum Industry

▲ Implementation of Thermo Scientific SampleManager LIMS at Sinopec Guangzhou



If your lab is challenged by increasingly complex data management, let us show you the power of Integrated Informatics, the center of lab data acquisition, management and storage.





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This eBook has been developed to give you a comprehensive resource when searching for the laboratory data management solutions that can help your business meet the most pressing business and regulatory challenges. Inside you'll find expert commentary on how Integrated Informatics can help you meet ISO 17025 requirements or manage daily workflow and SOP compliance issues in the lab.

You'll also find case studies from some of the largest oil and gas companies in the world, as well as technical product information and other supporting materials. You can rely on Thermo Scientific Integrated Informatics — a complete package of integrated software solutions — to help you unlock the value of your data and leverage that data for business optimization.



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