Best Practices: How to Ensure Accurate Fire Code Reporting of your Chemical Inventory

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Best Practices for Fire Code Reporting

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Addressing chemical fire code requirements in the laboratory enables organizations to satisfy regulatory requirements and provide safety for their employees, the community and the environment.

Abstract

This white paper seeks to clarify one of the key aspects of laboratory and site safety by addressing best practices in fire code reporting. A close look is provided at applicable fire codes, how to identify inventory affected by fire codes, and how to leverage industry best practices for fire code reporting integrity. The most common points of failure in fire code reporting systems, from the transition of permits to ongoing management and reporting, are examined as well as how to gain control of fire code reporting to readily satisfy regulations.

Ensuring safety on site is high on the list of priorities for any organization. No one wants to be the cause of pain and suffering to any employee, visitor, the surrounding community, and certainly not the environment we are all trying so hard to protect. But accidents happen every day, many of which are caused by errors or oversights that could easily have prevented the incident. Addressing fire code requirements pertaining to chemical management on site and reporting the organization's compliance efforts will help ensure that accidents don't happen.

The history of regulatory oversight in this area is peppered with new regulations that arose in response to changes in society. These changes have affected everything from laboratory building codes to the use, type and amount of chemicals in inventory required for production or research and development (R&D) activities. There are chemicals and storage containers in the lab that simply weren't a part of production or R&D even twenty years ago, such as Honeywell's Electronic Material's application-specific process chemicals or ATMI Nowpak® high-performance liner-based containers that are commonly used now due to advances in chemical knowledge and handling technology. There is also greater knowledge about the attributes of various chemicals once considered benign, such as mercury and lead, which are now considered detrimental if used improperly.

Regulatory oversight is meant to assist organizations in ensuring that their laboratories not only store, handle and dispose of chemicals safely, but also ensure that the buildings where chemicals are stored have safety built in. It is crucial that the local fire department knows where chemicals are stored to ensure that firemen deploy the proper response. These regulations — which range through all levels of government from federal to state to local jurisdictions — are meant to assist the organization's Environment, Health & Safety (EHS) professionals in addressing safety

issues, but many times the regulations conflict, confuse and confound those who are entrusted with the safety of people and the community.

Understanding the issues surrounding fire code reporting can go a long way towards maximizing both laboratory and overall site safety.

The Importance of Fire Code Reporting

Laboratory scientists and chemists are quite knowledgeable about the various properties of the chemicals and materials with which they work. However, this type of knowledge is not enough to prevent accidents, nor does it address or include all the requirements of the various fire codes. On July 24, 2001 a UC Irvine chemistry lab exploded, injuring three people, destroying years of research, and causing an estimated $10 million in damage. The fire in the physical science building was on the second floor of the six story building and occurred when a graduate student purified benzene in a solvent purification still. The residue of the purification process, metallic sodium, caught fire and caused the explosion.

Figure 1. A fire at the UC Santa Cruz labratory on January 11, 2002 injured no one but gutted two large research labs, damaged other areas of the building, and closed several other buildings in the Science Hill area of the campus.

Safety training alone does not prevent accidents. The laboratory environment itself must be examined to create as much built-in safety as possible in order to minimize damage and injury in the event of human-error. There have been several changes to building and fire codes to improve safety, such as the modern requirement for fire-related control areas. In addition, modern construction materials are often designed to make buildings more burn resistant. While these are important changes, there is still more that can be done. According to industry analyst Greg Jakubowski, "Depending on their contents, laboratory fires can present firefighters with many different hazards and challenges. If departments come prepared, a fast and efficient response may ensure firefighter safety and preserve the lab; however, an uninformed response can compromise not only firefighter safety, but also the public's safety, and can result in the loss of critical research. Fire departments must be aware of the working laboratories in their coverage area, their contents, their activities and how to respond safely and effectively to incidents that may occur inside them."1

Since lab fires are a very real possibility, it is critical to ensure that businesses do as much as possible to ensure that fire code regulations are addressed. This goes beyond ensuring that the correct permits are obtained and involves ongoing management and reporting. The more accurate the knowledge is concerning chemicals and other regulated materials in inventory, the better the lab can report accurate information to various agencies that need correct, current information. Leveraging best practices will drive greater laboratory and site safety.

What Are Best Practices?

Best practices are "best in class" business policies, procedures, and processes that have continuously proven successful for many organizations. The challenge lies in keeping up with the changes in both technology and industry as these are continuously impacting Best Practices. Best practices, as applied to an organization's fire code reporting system, involve the following: addressing the different regulations in a coherent manner, understanding and identifying inventory affected by fire codes, and addressing the regulations with a single consistent comprehensive Chemical Inventory System (CIS).

These best practices are directly affected by how the CIS is organized and managed, and are significantly different today than they would have been even a decade ago. With the increased use of commercial software and the outsourcing of Information Technology (IT) tasks, many organizations have implemented an off-the-shelf CIS solution to ensure that the processes used to manage the chemical inventory effectively address a wide range of regulatory requirements, including fire code reporting.

Best Practices for Fire Code & Regulatory Reporting

Perhaps the first question to ask is the simplest: "what are fire codes?" In a nutshell, these are codes designed to ensure protection from fire hazards by requiring specific storage, handling and disposal activities designed to ensure site safety. And, fire codes are just a start as there are an astounding array of not only fire codes but also associated regulations that the organization's EH&S professionals must ensure are met, including but not limited to:

- National Fire Protection Association (NFPA) Codes
- International Code Council (ICC)
- International Fire Codes (IFC)
- OSHA Substance Specific Standards
- OSHA Hazard Communication Standard (HCS)
- 29 CFR 1910.1450 Specific Hazardous Substances
- 29 CFR 1910.119 Process Safety Management
- Department of Homeland Security (DHS) 6 CFR Part 27
- American National Standards Institute (ANSI) Standards
- Compressed Gas Association (CGA) Standards
- Environmental Protection Agency (EPA) Regulations
- DEA Regulated Substances
- CDC Defined Select Agents

Recently, enforcement efforts have intensified, making report accuracy more important than ever. The requirements are usually simple enough: report the hazardous chemicals that are on site and where they are in the building(s). If a fire does occur, the local fire department will know how to contain and extinguish it. In the event that a fire occurs, and the local fire department's knowledge is only that the building contains hazardous chemicals, they are at a dangerous disadvantage. This lack of knowledge could lead to incorrect decision making when responding to fire or HazMat incidents. The problems that will result — including any fiscal responsibility — will be considered the result of inaction on the part of the lab or business responsible for the reporting.

Essentially, these requirements have been promulgated to protect workers, equipment, facilities and the environment from the hazards associated with chemicals. Because such requirements can number in the thousands, simply identifying all of the applicable chemical safety-related requirements that govern any particular work activity with chemicals can be a monumental task. Thus, this identification is an important component of any chemical inventory system, (such as Material Safety Data Sheets (MSDS), which can and should be purchased from a software vendor that has thoroughly researched the requirements, particularly since the cost of these programs is reasonably low.

In addition to the important regulations listed above that address fire safety issues, there are state codes that have been based on either NFPA or ICC codes. Almost every state has already adopted and is enforcing one or more of these model codes. So, close adherence to NFPA and ICC requirements goes a long way toward safety compliance and best practices.

In addition to the fire codes, most states have revised their business codes to address fire safety issues; e.g., most current state building codes address use and occupancy issues, building heights and building egress issues that are tied closely to the state fire codes. For instance, use and occupancy issues now define occupancy based on use and not on occupant load. In addition, occupancies are now subdivided into five types, one of which is hazardous occupancies which are in turn further defined by use, such as whether the building performs semiconductor fabrication or health hazards, etc. Based on the category in which the site or building falls, there are maximum allowable quantities of hazardous materials, such as flammable liquids, for designated control areas at the site (Figure 2). Ensuring that these criteria are addressed continuously is a best practice.

Identifying the proper response is becoming a serious problem. It is easy to determine the appropriate response when there is only one chemist in a building. But when there are multiple tenants in a building, each with a different emergency response system, it is difficult for fire departments to stage the appropriate response.

Not only is occupancy an issue, but additional building height and area limitations are now being enforced, with the limits being based on the type of construction and the occupancy. The reason for this goes back to the changes in society that are driving changes in business. For example, new construction in San Francisco, CA involves multi-story buildings with multiple occupants. In one high rise project under consideration, there will be a University of California (UC) laboratory in an upper story and other tenants below. Before the recent growth of multi-occupancy buildings, there used to be only one tenant per building, making both building and fire codes easier to enforce. These new building projects involving multiple tenants are creating a code enforcement nightmare.

Material Classification			Table 60.2.2.1 Maximum Allowable Quantity of Hazardouse Materials per Control Area[a]							
Physical Hazards			Stored[b]			Use-Closed[b]			Use Open[b]	
Material	Class	High Hazard Protection Level	Solid	Liquid	Gas	Solid	Liquid	Gas	Solid	Liquid
CFC: Has Separate Line Items			Lbs. (Cu.Ft.)	Gal. (Lbs.)	Cu.Ft.	Lbs. (Cu.Ft.)	Gal. (Lbs.)	Cu.Ft.	Lbs. (Cu.Ft.)	Gal. (Lbs.)
Flammable Liquid[c]	I-A	2 or 3		30[e,f]	CFC = 60 Gal.		30[e,f]	CFC = 60 Gal.		10[f]
	I-B & I-C	2 or 3		120[e,f]			120[e,f]			30[e,f]
	Combination (I-A, I-B, I-C)	2 or 3		120[e,f,1]			120[e,f,1]	CFC = 15 Gal.		30[f,1]

Figure 2. This table highlights the maximum allowable quantities of hazardous materials per control area according to the California Fire Code 2007 revision.

The good news is that solutions are being found. Seattle, WA, for instance, is quite progressive and has made numerous provisions for retrofitting existing buildings that have turned to multiple occupancy. The City approached the challenge head-on to both protect building heritage and ensure building and tenant safety. Other states will also need to determine alternate means to provide equivalent protection.

There is much more to satisfying fire codes than ensuring safe chemical storage and handling in the lab. Chemical management has also been significantly changed in recent state codes. There are separate chapters and provisions on the storage and use for a wide range of items, including:

Hazardous Materials

- Aerosols
- Combustible Fibers
- Compressed Gases
- Corrosive Materials
- Cryogenic Fluids
- Explosives and Fireworks

Flammable and Combustible Liquids

- Flammable Gases
- Flammable Solids

Highly Toxic and Toxic Materials

- Liquified Petroleum Gases
- Organic Peroxides
- Oxidizers

Pyrophoric Materials

- Pyroxylin (Cellulose Nitrate) Plastics
- Unstable (Reactive) Materials
- Water Reactive Solids and Liquids

If a building's tenants have any of the hazardous materials that fall within the list above on site, the building must meet control area requirements. Previous code iterations dictated a simple requirement of four control areas per building. Now, most codes use a more complex formula and pro rates the amounts of hazardous materials allowed per floor based on where they are kept, with the amounts being reduced the higher up the materials are in the building. As a result, it is more critical than ever to have an accurate list of inventories by hazard class. All the tenants in the building must submit this information. In addition, there are multiple occupancy types that must be addressed, hence the difficulties associated with reporting escalate exponentially.

Other issues of concern include requirements for walls that incorporate fire barriers with designated minimum burn rates (such as no less than three hours). Many labs will need to revisit what chemicals they have on site, how all the different chemicals are stored and whether they meet the current parameters. Retrofitting is possible as witnessed by Seattle's success, but many organizations will need to implement new laboratory control areas.

Addressing Fire Code Safety & Reporting Deficiencies

One department alone can not solve the challenge of addressing hazardous materials management in a way that meets code requirements. For example, the lab may be involved in purchasing materials, but is not the central authority. Typically only bits and pieces are known individually, without complete knowledge of the full inventory picture anywhere in the organization. Achieving a complete understanding of the inventory on site is a team effort involving laboratory management, facilities management, inventory management, and the EH&S professionals.

When determining inventory information for a new site, EH&S can't provide the reporting information regarding chemicals without working with the lab to define what chemicals are necessary for the work planned. Facilities managers need these reports to submit with their construction plans in the case of new buildings or with ongoing reporting requirements for existing sites. Accurate inventory must be performed and tables provided on the inventory data for every building.

One of the key areas where fire code safety and reporting deficiencies occur is the transition from permits to ongoing management and reporting. Starting a program is very different from maintaining one.

Many organizations still rely on manual inventory practices or static spreadsheet programs to manage inventory. This is acceptable if the organization is static, however a few organizations fit that model. Even so, these practices just can not keep up with the reporting demands in today's information-intensive environment. Because reporting requirements are focused on confirming the accuracy of the data, best practices involve access to real-time inventory information for accurate reporting.

Gaining Control of Fire Code Reporting

Gaining Control of Chemical Inventory

- Define hazard classifications on site
- Implement an electronic chemical inventory system
- Identify and input applicable chemical and materials inventory into the system
- Audit the system against existing fire code safety & reporting processes
- Conduct a gap analysis
- Develop end-to-end fire code safety & reporting SOPs that dovetails with the system
- Train users in fire code safety & reporting requirements

Three of the most important points to keep in mind when addressing fire code and regulatory reporting are: 1) the tasks associated with planning reporting tools and activities, 2) the permits required to perform associated chemical management tasks, and 3) the ongoing management tasks and systems used to support the reporting.

Typical fire code reports provide a copy of the site floor plan showing the location of the materials, including by container, the CAS/DOT ID#, the type of container, the size of the container, the container contents, the number of containers, and the total amount of the material on site as well as its common name. Many organizations have used spreadsheets to track this information. Unfortunately, spreadsheets are only as current as the last update, and do not provide real-time inventory information.

The right reporting tool is critical to fire code reporting success, whether providing accurate inventory reports for a new building or reporting inventory status for an existing one. Implementing an electronic Chemical Inventory System (CIS) helps to satisfy fire code regulation obligations by maintaining up-to-date inventories of the laboratory chemicals and

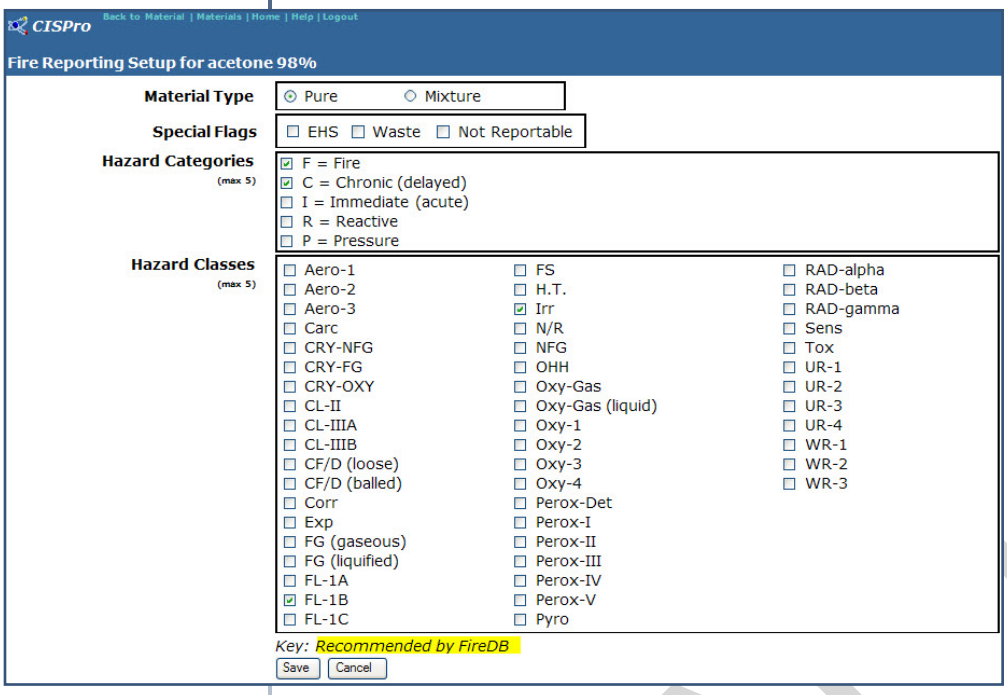

Figure 3. A web-based CIS will reduce training time and should allow virtually unlimited custom configuration to meet evolving processes and workflows, yet meet regulated and non-regulated requirements.

providing reports for various agencies in a timely manner.

A Commercial Off-The-Shelf (COTS) CIS solution enables labs to keep track of where chemicals are and how much are available, as well as generate reports listing chemicals by location, vendor, name, CAS number, formula, etc., and quickly access hazard information during an emergency (Figure 3).

Best practices CIS solutions provide a high-performance, relational database system for tracking chemicals and other laboratory supplies.

Accurate, real-time inventory information enables all types of laboratories to operate more effectively, regardless of whether the facilities are regulated or non-regulated or whether Good Manufacturing Practices (GMP) are utilized. A truly effective best practices CIS solution, however, goes beyond inventory management and government compliance. Such a best practices CIS will address each stage of the chemical management lifecycle, which begins with procurement and extends through use and disposal of chemicals.* In addition to making it easy to add items to inventory, it must be just as intuitive to ensure that empty containers and out of date materials are removed and disposed of correctly as well as to ensure that the system can recover information.

Figure 4. Utlizing bar codes and a bar code scanner enables organizations to quickly, easily, and automatically add items to the chemical inventory database when the bar code is scanned.

Gaining control of inventory for fire code reporting purposes starts with obtaining a real-time CIS solution. Implementing the CIS begins with populating the database with inventory information. If it's inventory for a new facility, then anything that comes on site should be bar-coded which automatically adds the item to the database when the bar code is scanned (Figure 4). The inventory is then categorized (manually or automatically as specified by the organization) and maintaining the database is easy (Figure 5). For existing facilities, populating the database with existing inventory can be a significant challenge. But even for this task, tools exist. For instance, ChemSW has a Rapid Loader software solution that allows fast physical inventory to get a site up and running quickly. Rapid Loader loads chemical and container information into the electronic inventory system quickly and efficiently.

After populating the CIS database with existing inventory, an internal audit must be performed to check not only for accuracy and completeness, but to determine how well the system conforms to fire code safety and reporting requirements. Most commercial CIS solutions don't have this capability built in, and take considerable customization to meet fire code requirements.

CONTAINER

CAS/DOT ID#	Type	Size	Material	# of	Total Qty	Common Name
1075	Cylinder	30lbs	Steel	10	300	Propane

Figure 5. Bar code scanners typically display information concerning the CAS ID#, type and size of container, the container material and quantity as well as the total quantity, and of course, the name of the material being recieved.

For this reason, Integrated Engineering Services (Santa Clara, CA) collaborated with ChemSW on the development of two software modules to help users meet Hazardous Material Inventory Statement (HMIS) reporting requirements. ChemSW's Fire Code Reporting module and the Fire Code Classifications database produce accurate documents formatted to meet both IFC and NFPA code requirements. The Fire Code Reporting module enables the easy transformation of that chemical inventory information into the exact formats required for building and fire code compliance. It interacts with the CIS seamlessly and transparently to allow users to set up reports for hazardous materials based on a variety of properties from physical and structural to quantity, location, ingredients, etc., depending on the code requirement (Figure 6). The Fire Code Classifications Database provides values for over 8,000 potentially hazardous chemicals, and works synergistically with the reporting module. It is the most comprehensive such database available and helps users compile the information for their reports. Access to this database and the formatted reporting significantly streamlines the production of accurate reports.

Because code specifications throughout the country are being consolidated, and enforcement efforts have intensified, it was critical to ensure that these solutions could keep pace with those changes. Thus, flexibility is built in, and the modules updated frequently as reporting requirements evolve.

After the inventory system has been audited, conduct a gap analysis to determine what's missing with regard to fire code safety and reporting, and develop and implement the necessary SOPs to address the regulations and dovetail the system with the SOPs.

Once the system satisfies both the organization's internal operational requirements as well as relevant external code requirements, train the users in how to use the inventory system and in fire code safety and reporting requirements.

Training is the biggest hurdle for most organizations and involves not only getting everyone to use the system but assigning a gatekeeper for it. This is a very different way of operating since most organizations do not have a single person who acts as an inventory gatekeeper. Operating without a gatekeeper is comparable to jumping without a parachute; if the distance is short, you'll be OK, and if it isn't then all sorts of problems can arise. The gatekeeper is responsible for ensuring that nothing comes on site without being added to the inventory system and that no orders are placed for inventory items outside of the system. To do this successfully and eliminate any covert ordering activities, an educational process must occur that underscores how advantageous it is to use the new system. Focusing on code compliance is not terribly interesting to the average user. Instead, focus on easy access to materials and the assurance that users won't run out of the chemicals they need. One Life Sciences company, for example, solved this challenge with an innovative in-house chemical delivery program modeled after a popular pizza delivery scheme. In this company's case, users receive materials within 30 minutes of ordering or it's "free" and their department is not charged. This something-for-nothing concept ensured rapid adoption of the new inventory system, once users found out how easy it was to

order materials this way, they continued to use the system. The gatekeeper for the inventory system must be extremely aware of inventory usage trends in order to be responsive to the organization's needs and ensure the system's success.

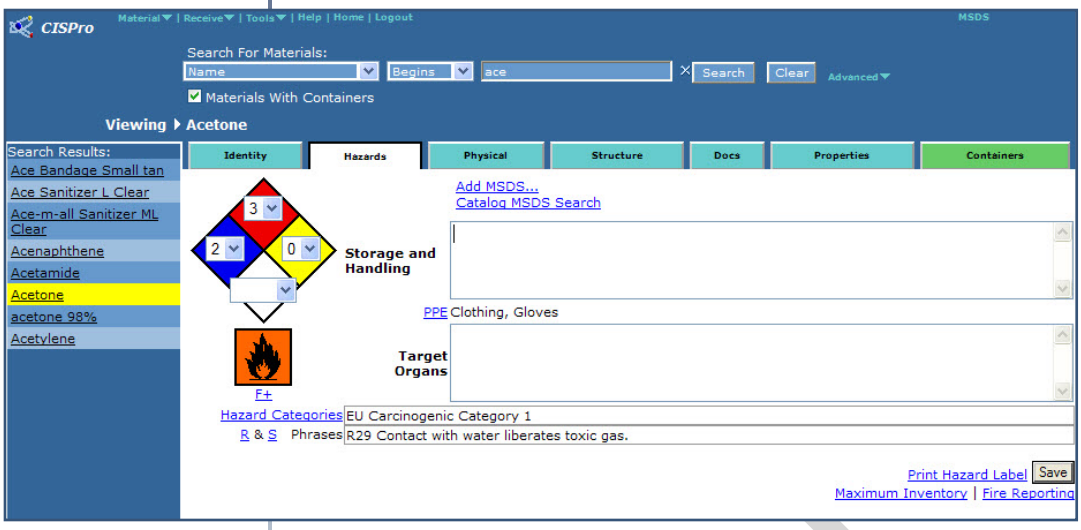

Figure 6. ChemSW's HMIS fire code reporting module streamlines compliance for organizations such as biotech and pharmaceutical companies that are producing more chemicals as a result of automation, and thus generating more regulatory oversight.

Thus, the more robust and comprehensive the CIS, the better the gatekeeper will be able to perform not only ongoing inventory management tasks, but act proactively in a Just-in-Time (JIT) fashion that better enables the organization to control costs. JIT inventory delivery can be performed with inventory storage on-site as shown in Figure 6. JIT purchasing from suppliers on an as-needed basis also keeps costs streamlined. But the organization's stockrooms can also be kept off-site or centralized at a single site, thus mitigating many building and fire-code reporting requirements. Alternatively, on-site stockrooms can be owned by the supplier and not the user organization similar to the in-store pharmacies found in drugstores. Choosing the most appropriate JIT approach depends on a number of factors, ranging from the size of the lab, to the number of chemicals required on site, rate of chemical usage, building type, etc.

It is critically important for the organization to accurately manage and report hazardous materials. Failure to report hazardous materials is a violation of the fire code and a Class One misdemeanor, punishable by a fine of $2,500 or by up to six months imprisonment or both. Each day that a violation continues unabated it is considered to be a separate offense, so the misdemeanor can magnify exponentially.

Finally, from a risk analysis standpoint, compliance is the only way to go. If an accident occurs and the site was discovered to be out of compliance, the organization will not be covered by insurance policies for the loss. Implementing a best practices CIS that helps the laboratory and the organization address fire code reporting requirements not only helps ensures compliance, but also makes good corporate and fiscal sense.

Summary

In summary, a best practices CIS must be extremely adaptive to the needs of all types of users, whether it is the chemist ordering supplies or the gatekeeper managing the system. Inventory purchasing must be streamlined to make this work, with automatic email triggers that notify the gatekeeper when inventory reaches a specified amount, and a method for removing an item from the system when the container is empty.

Leveraging the best practices described above provides the assurance that the CIS your organization implements is effective, thereby driving inventory integrity. Regardless of what chemicals or supplies are kept on site, upon receipt all material is categorized, entered into inventory, and labeled appropriately, ensuring that the inventory data you report is unquestionably accurate.

Compliance with EH&S regulatory requirements is a key component of inventory integrity. An accurate inventory makes it easier to ensure regulatory compliance. In short, inventory integrity can drive three key benefits for your organization:

- Regular inventory maintenance will purge hazardous material from your site in a timely manner
- An effective CIS reduces inventory on site, and thus reduces risk
- Reduced risk equals reduced liability

An efficient, comprehensive CIS helps your organization with fire code reporting and emergency preparedness goals in many more ways than just streamlining inventory management activities, containing inventory costs, and complying with regulations. It will help maximize laboratory and overall site safety for everyone involved.

References

1. Jakubowski, Greg, Fire Attack: Jeckyll & Hyde Fires, FireRescue Magazine, November 2006, Vol 24, Issue 11.

For More Information

* For more information about Chemical Inventory Systems, please request ChemSW's white paper entitled Best Practices for Managing Laboratory Chemical Inventory.

About the Author

Jeff Tarter is a principal with Integrated Engineering Services in Santa Clara, CA. He has a B.S. in Chemical Engineering and is a Certified Hazardous Materials Manager with extensive experience in regulatory and environmental issues. He is an expert on the International building, fire and mechanical codes, and NFPA requirements relating to the storage, handling and use of hazardous materials, as well as air quality and wastewater pretreatment standards, and emergency response requirements. As a former regulatory agent, Jeff has developed numerous regulatory guidelines, served on several hazardous material subcommittees and actively participated on various code rewrite committees. As an Integrated Engineering Services consultant, Jeff has primarily been involved in the design of hazardous material transport systems, solvent dispense and waste collection systems, toxic gas installations, wastewater treatment and exhaust abatement systems. Jeff can be reached at JeffT@Intengr.com.

About ChemSW

Founded in 1991, ChemSW is a leading provider of chemical and biochemical inventory management systems, MSDS systems, and other chemistry laboratory software and services. ChemSW's wide range of products enable companies to streamline laboratory processes and reduce chemical purchasing and disposal costs. The CISPro Chemical Inventory System® provides a high-performance, relational database system for tracking chemicals and other laboratory supplies. ChemSW supports over 15,000 customers in more than 40 countries throughout the world. Their software is installed in thousands of laboratories, from the smallest of chemical stockrooms to the largest enterprise environments. For more information about the company and their products, visit http://www.ChemSW.com.