Safety Inspections

Continuous Improvement, Effectiveness & Efficiency

By Erich Fruchtnicht, John W. Fellers and Clay D. Hanks

The Texas A&M Health Science Center's (TAMHSC) environmental, health and safety office is charged with ensuring the safety of all faculty, staff, students and visitors at eight geographically dispersed campuses across Texas. Paramount to this responsibility is identifying and assessing hazards so that appropriate measures can be taken to provide a safe environment and train personnel accordingly.

To accomplish this, staff regularly perform detailed inspections of all TAMHSC facilities. Based on data collected, they recommend facility improvements for code compliance, take proactive steps to address potential hazards, and create and assign training for faculty, staff, students and researchers to address any of the noted safety deficiencies.

IN BRIEF
- **Performing risk assessment and conducting laboratory and fire life safety inspections in an academic setting can be time consuming and labor intensive.**
- **Monitoring trends in safety deficiencies to target appropriate training for faculty and staff is a crucial step in making an SH&E program more effective.**
- **Finding an economical solution that leverages technology can make the assessment/inspection process more efficient.**
- **Through the use of mobile devices, sound risk assessment methodology and a risk-based inspection schedule, academic institutions can continuously improve their safety inspection and training programs.**

The detailed nature of these safety inspections had historically required the focused time and effort of several staff professionals. In fact, completing a full inspection of some larger TAMHSC facilities required a three-member team working approximately four 8- to 10-hour days. On average, it took an additional 32 employee-hours to enter the handwritten data into a computer and generate reports that were, on average, approximately 60 pages in length. The process of reentering data once the inspection was complete introduced the risk of transcription errors. This risk was compounded if the original author of the inspection notes did not enter the data due to the subjectivity of handwriting interpretation.

Furthermore, different inspectors were often deployed to conduct follow-up inspections. Although all inspectors are fully qualified to perform the task effectively, each inspector naturally has a slightly different perspective on the individual safety deficiencies noted. Differing perspectives among inspectors or even differing levels of awareness or astuteness in the same inspector on different days are unavoidable; this affects the consistency of hazard identification and, consequently, the consistency and reliability of reports.

New Solution Needed

Since opportunities to expand resources or add personnel were limited due to difficult economic conditions, the inspection process needed to become more efficient. The selected solution needed

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to 1) increase inspection efficiency; 2) reduce the number of staff professionals and total employee-hours required to conduct inspections; 3) maintain data integrity by eliminating duplicate entry related to using handwritten notes as reference; 4) ensure valid and reliable outputs that were meaningful for benchmarking and trending; and 5) generate reports automatically. The solution had to be easy to implement (e.g., user friendly) and cost effective, and it had to work equally well at each campus location and for each inspector.

Nancy Eaker, TAMHSC laboratory safety manager, conducts lab inspection using an iPad.

Ideally, a thorough inspection methodology and process should result in quantifiable data that identify areas of potential hazard; use a solid analysis process to determine probability; incorporate nationally recognized standards to determine potential severity and ultimately provide risk classifications. TAMHSC has developed and adopted a formal risk assessment strategy that uses both qualitative and quantitative data. This strategy creates a data-driven risk assessment and acts as a guide for staff professionals that ensures proper application of the risk model in determining a facility-specific inspection frequency; provides consistency in inspection process; results in reliable and valid output data; and improves inspection efficiency over the previous process. Having this formal risk assessment process in place helps TAMHSC staff target training opportunities, reduce and eliminate risks, and provide a safe environment for faculty, staff, students and visitors.

TAMHSC's SH&E professionals perform detailed safety inspections and walk-throughs of all TAMHSC facilities. The frequency of these activities is determined by overall hazards, as identified in the facility hazard summary, as well as data collected during the detailed annual laboratory and fire life safety inspections. Frequency is subject to change as hazards and inspection data change over time. At a minimum, the risk-based inspection schedule is reviewed annually to determine the inspection frequency for the next calendar year.

Inspections are conducted annually by experienced SH&E professionals with backgrounds in laboratory and fire life safety; the process encompasses all buildings, rooms, labs and any other spaces within TAMHSC-owned or -operated facilities. The process involves a two-step hazard response: 1) individual deficiency response; and 2) inspection frequency modification based on an analysis of building-wide and room-specific deficiency data.

Hazards are classified into three categories at the time of inspection:

1) corrected immediately in the inspector's presence;

2) addressed within 30 days of receipt of the inspection report and verified during follow-up inspection;

3) action required pending administrative review.

To determine the categorization, the SH&E inspector considers many factors such as likelihood of an adverse event taking place due to the hazard identified; severity of a probable adverse event; facility occupancy; and existing safety features. Once a risk is identified, an inspector determines the appropriate mitigation steps and communicates this information via an inspection report to the responsible party for implementation.

Staff begin conducting follow-up inspections approximately 30 days after inspection reports are distributed to ensure that corrective action has been taken and to provide additional input or guidance as needed. Through this process, risk is identified, mitigation is determined and communicated, and, through subsequent follow-up and routine inspections, the effectiveness of the process is evaluated for continuous improvement.

After the inspection, deficiency data are collected and analyzed for trends and to generate a global view of deficiency frequency. The analysis enables staff professionals to focus on specific areas, buildings or rooms, and assign personnel to attend targeted training to address the noted safety deficiencies in order to eliminate their recurrence. The analysis automatically sets the inspection frequency for the following year based on preset criteria derived from nationally recognized standards.

Since output from a data analysis is only as reliable and valid as the input, it is crucial to ensure consistency in the inspection and data acquisition process by removing the possibility for human error. To this end, a multipart technology solution was leveraged.

TAMHSC's Solution

Following an evaluation of budgetary constraints and existing available technology, a relatively inexpensive yet promising solution was identified: leverage existing technology with specialized software. After researching cross-platform software solutions that would be both mobile and user-friendly, staff professionals determined that iFormBuilder mobile platform by Zerion Software deployed on Apple iPads would help inspectors perform their duties in ways that addressed the inefficiencies of the existing process. The application is a fully customizable form generator that can be

Table 1

Possible Severity Categories in MIL-STD-882

Category description	Category number	Possible resulting mishap
Catastrophic	I	Death or system loss
Critical	II	Severe Injury or system damage
Marginal	III	Minor Injury or system damage
Negligible	IV	Less than minor injury or system damage

Note. Basic Guide to System Safety, *2nd ed., by J.W. Vincoli, 2006, Hoboken, NJ: Wiley.*

Table 2

MIL-STD-882 Probability Levels

Category description	Level	Probability of mishap
Frequent	A	Likely to occur frequently
Probable	B	Will occur several times during life cycle
Occasional	C	Likely to occur sometime
Remote	D	Unlikely, but may occur
Improbable	E	So unlikely that it can be assumed it will not occur

Note. Basic Guide to System Safety, *2nd ed., by J.W. Vincoli, 2006, Hoboken, NJ: Wiley.*

used on iOS and Android mobile devices and is operated through a hosted server making it accessible wherever an Internet connection is available. Personnel can use a web-based control panel to create and modify forms, and assign to the appropriate inspector. The control panel also allows for data modification, filtering, report generation and data export in multiple file formats. An extensive online support community aids in designing forms with more complex requirements (e.g., data retrieval, Boolean logic in entry field display). The group's existing inspection forms were simply recreated using the newly implemented software application and assigned to inspectors as necessary.

iPads are standard issue for all TAMHSC safety personnel as the devices improve mobile work and communication capabilities. These same devices were used to implement the new inspection process and, thus, expanded the utility of existing assets while reducing total costs. All TAMHSC campuses have Wi-Fi, which enables iPads to be used to their full potential and allows a persistent connection to a hosted server from anywhere an inspection would be conducted.

That said, a continuous Wi-Fi connection is not required throughout the inspection. As long as the device has the most recent version of the inspection form, it can function offline and store the inspection results in memory for upload to the hosted server at a later point when an Internet connection is readily available.

The primary cost incurred for the new process was the subscription to the iFormBuilder software package. TAMHSC decided that the "exploring" package ($2,000 per year) provided the best fit and value. The hardware needed to implement the solution was already owned (iPads) or installed (Wi-Fi). The only remaining step was to install the software on each device and design forms via the online interface. Both tasks were relatively simple, and any major roadblocks with regard to form design and implementation were addressed and resolved by working with the online support community and tech support.

Inspection forms are designed to match handwritten versions, and they include headings and detailed drop-down menus of inspection items that cue the inspector to look for specific safety deficiencies in a checklist manner. Menus are derived from previous inspection data, industry experience and applicable regulatory requirements so they guide the staff inspector through the process.

Since each inspector uses the same forms pulled from a hosted server, input fields are the same in each inspection; this guarantees consistency in data acquisition. In addition, the software integrates with the built-in technologies that allow an inspector to take photographs and record voice memos during the inspection that are automatically incorporated. These hardware-based capabilities add tremendous value to the resulting report. When the inspection is complete, data are uploaded via Wi-Fi to the hosted server and stored for automatic report generation and raw data download.

Use of the tablet also enables an inspector to use streaming audio and video to work in real time (in this case via Apple's FaceTime application) with a subject-matter expert to examine and assess field conditions. Since TAMHSC is spread across eight campuses throughout Texas, inspectors can conduct inspections with confidence knowing that experts are available through the full use of the iPad platform. This eliminates the need to have the expert travel for on-site consultation and makes them available to multiple inspectors across the state simultaneously without compromising inspection process integrity.

Aside from the efficiency benefits of the chosen solution, the process allows for intense data analysis to produce benchmarking and trending in safety deficiencies that were previously unattainable. Additionally, staff professionals can automate the inspection schedule generation based on quantifiable data.

Thanks to this solution, safety inspections are more efficient and effective because they require less time and have expanded access to appropriate experts. Efficient identification of safety deficiencies and accurate inspections facilitate better training requirements for faculty, students, researchers and staff. The immense savings in work hours from autogenerating reports was worth the cost of system implementation. However, the added ability to analyze resulting data to guide inspection frequency and target training has reinvented how staff professionals service each campus.

Challenges & Problems

Implementing any new process, especially a process that leverages technology, inevitably presents challenges. The decision to transition from handwritten inspections to an electronic method was an easy one based on the efficiencies realized, but

Nathan Jennings, TAMHSC assistant fire marshal, inspects a fire pump using an iPad.

the decision as to which software to use presented significant challenges. Staff conducted an extensive search of available technologies that would provide for an electronic and mobile platform. Parameters such as the ability to use existing tablet devices, automated report generation, custom form development and an option to conduct room-by-room inspections were used in the initial search.

All involved quickly noted that the ability to use tablet devices (in this case, the iPad) limited potential deployment options as many companies offered software designed for handheld computers or scanning devices. Going this route would have required significant initial costs to purchase hardware and set up software and other expenses. The average initial cost quoted by companies researched to provide equipment and software licenses to equip five inspectors was approximately $20,500; this was simply out of the department's price range. Since most capabilities offered by the more expensive programs were desirable (e.g., automated tracking of deficiencies, work order generation, bar code scanning, detailed statistical analysis), finding an equally capable yet affordable option was a challenge.

To reduce the initial purchase costs of an electronic inspection platform, the team assessed what functionality was needed to conduct effective safety inspections and to acquire, sort and use the resulting data in a meaningful way. The group determined that it was most important to be able to create custom forms to meet the exact parameters of each type of inspection; have data collected during inspections automatically processed by the software in such a way that it could be easily formatted and used for report generation and risk analysis; and use the already available TAMHSC-owned iPads.

These criteria guided the App Store search, which used terms such as safety inspection, EHS, SHE, inspection and inspection form, until a suitable application was discovered. Although the application selected did not have all the features of more expensive options, it more than adequately met the group's needs and offered some unexpected benefits such as the ability to take pictures and record voice memos for inclusion in the inspection record; integration with a third-party bar code scanning application that made use of the device's built-in camera; ability to assign inspections to specific personnel; and the ability to send inspection findings via e-mail from the app.

Once the application was selected, the next challenges were getting approval from the information technology group. This group confirmed that the software met both state and institutional IT requirements and helped create iTunes App Store accounts for each team member.

The actual implementation of developed inspection forms presented its own challenges. Each individual had unique familiarity with the iPad and other technology, which resulted in different learning curves. Those with more technology experience adjusted to the electronic inspection process on the first day, while others found it more difficult. Individual meetings and training with SH&E staff as necessary to explain the process of downloading the app and using the forms helped to ensure that all personnel were informed. Most personnel adapted quickly. Additionally, an internal standard operat-

Using iPads for SH&E Inspections

Likes

- Customized to exact specifications.
- Preloaded inputs in the form of drop-down menus provides for quick data entry.
- Forms can be standardized for use across all campuses making inspections consistent.
- Updates to forms are made once and then pushed out to all users.
- Can send inspection report directly via e-mail from device.
- Can utilize in-device camera to take pictures as well as conduct video conferencing during inspection.
- Can assign an incomplete inspection to another user to finish from the device.

Dislikes

- Having to stop and charge the battery on a particularly long inspection.
- Weight of device and cover can become an issue during long inspections.
- Report generation can still require manual editing.

ing procedure was developed for reference on using the program to conduct safety inspections.

Other notable challenges were finding an appropriate cover to make handling the device during inspections more user-friendly. The team determined that a cover with a vertical strap on the back that crossed the back of the hand provided added stability for data input. Using the iPad during long inspections also proved to be tiring as the device's weight can cause fatigue after several hours of holding it. To combat this, some personnel have downloaded the app onto their phones and use these devices to conduct inspections. Also, during a longer inspection, device charging can be problematic if one must stop midinspection to do so. To alleviate this, inspectors often find a power source during a lunch break or other similar rest period.

Perhaps the most frustrating challenge is occasional data loss. Typically, this issue has been traced to user error. However, the use of an evolving app has associated risks, and when such losses occur, some may call for a return to handwritten methods. Through continual training on the device and app and also through new developments such as a save-as-you-go feature, these loss occurrences can be negated. Overall, the improved efficiency of the inspection process more than makes up for the rare data loss event.

Table 3

Process for Determining Mishap Probability

Building deficiency percentage	Category description	Level
> 75% occurrence	Frequent	A
> 50% occurrence	Probable	B
> 25% occurrence	Occasional	C
> 5% occurrence	Remote	D
< 5% occurrence	Improbable	E

Analysis

The goal of the analysis was to generate both a hazard classification and a probability of mishap that, when combined, create a risk assessment code (RAC) in alignment with many nationally recognized standards. The hazard classification would be determined by SH&E personnel based on specific criteria. Data from inspections would be used to determine the probability of mishap.

In determining hazard classifications and levels of areas within TAMHSC facilities, staff professionals reference several nationally recognized organizations that specialize in composing accepted codes and standards to regulate building and process safety. Following are definitions from these codes, standards and guidelines of the various hazard classifications and levels.

NFPA

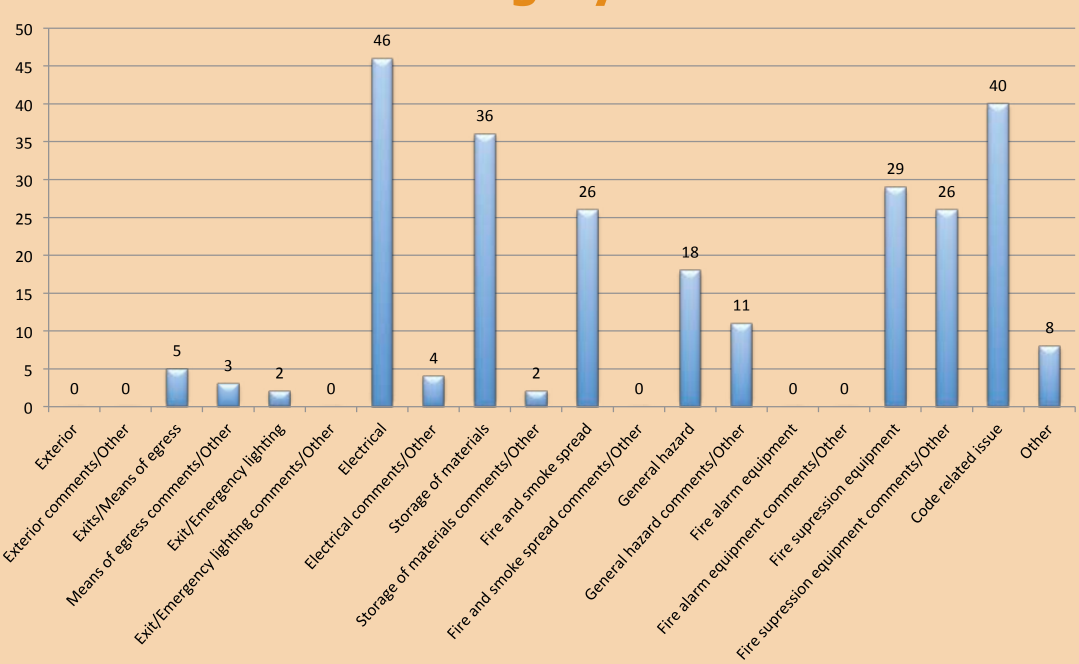
•**Laboratory Hazard Class A** is a lab that is considered to be a high fire hazard due to the quantity of flammable and combustible liquids. A Class A lab has a maximum quantity in use of 20 gallons per 100 sq. ft of lab space not to exceed 800 gallons and a maximum combined quantity of in-use and storage that is twice that of the in-use maximum quantity.

•**Laboratory Hazard Class B** is a lab that is considered to be a moderate fire hazard due to the quantity of flammable and combustible liquids. A Class B lab has a maximum quantity in use of 10 gallons per 100 sq. ft of lab space not to exceed 400 gallons and a maximum combined quantity of in-use and storage that is twice that of the in-use maximum quantity.

•**Laboratory Hazard Class C** is a laboratory that is considered to be a low fire hazard due to the quantity of flammable and

Figure 1

Number of Rooms Found Deficient for Each Hazard Category



combustible liquids. A Class C lab has a maximum quantity in use of 4 gallons per 100 sq. ft of lab space not to exceed 200 gallons and a maximum combined quantity of in-use and storage that is twice that of the in-use maximum quantity.

•**Laboratory Hazard Class D** is a laboratory that is considered to be a minimal fire hazard due to the quantity of flammable and combustible liquids. A Class D lab has a maximum quantity in use of 1 gallon per 100 sq. ft of lab space not to exceed 75 gallons and a maximum combined quantity of in-use and storage that is twice that of the in-use maximum quantity (NFPA, 2011).

Example Calculation

A lab in a larger TAMHSC facility is listed as having 415 gross sq. ft of space. According to the chemical inventory for this room, it contains the following combined in-use and in-storage quantities of flammable and combustible liquids: flammable liquids = 24 gallons; combustible liquids = 3 gallons.

According to the formula in NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals (2011), one must first calculate the number of 100 sq. ft units in the space. In this case, that would be 415/100 or 4.15. Next, divide the combined total of flammable and combustible liquid gallons by 4.15. This would mean that there are approximately 6.5 (27 divided by 4.15) combined gallons of flammable and combustible liquid per 100 sq. ft of lab space. Based on this calculation, the lab is classified as Class C per the NFPA definition—6.5 combined gallons in-use and in-storage is less than the 8-gallon in-use and in-storage limit per 100 sq. ft.

CDC

•**Biosafety Level 1** is suitable for work involving well-characterized agents not known to consistently cause disease in immunocompetent adult humans, and presents minimal potential hazard to lab personnel and the environment.

•**Biosafety Level 2** is suitable for work involving agents that pose moderate hazards to personnel and the environment. Lab personnel have specific training in handling pathogenic agents and are supervised by scientists competent in handling infectious agents and associated procedures; access to the laboratory is restricted when work is being conducted; and all procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment.

•**Biosafety Level 3** encompasses clinical, diagnostic, teaching, research or production facilities where work is performed with indigenous or exotic agents that may cause serious or potentially lethal disease through the inhalation route of exposure. Lab personnel must receive specific training in handling pathogenic and potentially lethal agents, and must be supervised by scientists competent in handling infectious agents and associated procedures.

•**Biosafety Level 4** covers work with dangerous and exotic agents that pose a high individual risk of aerosol-transmitted laboratory infections and life-threatening disease that is frequently fatal, for which no vaccines or treatments exist, or a related agent with unknown risk of transmission (CDC, 2009).

International Code Council: Occupancy Classification

•**High Hazard Group H** includes, among others, the use of a building, structure or portion thereof that involves the manufacture, processing, generation or storage of materials that constitute a physical or health hazard in quantities in excess of those allowed in control areas complying with Section 2703.8.3, based on the maximum allowable quantity limits for control areas set forth in Tables 2703.1.1(1) and 2703.1.1(2) of the International Fire Code.

•**High Hazard Group 1** encompasses buildings and structures containing materials that pose a

Table 4
Hazard Matrix

	Hazard categories			
Frequency of occurrence	Catastrophic I	Critical II	Marginal III	Negligible IV
A: Frequent	1A	2A	3A	4A
B: Probable	1B	2B	3B	4B
C: Occasional	1C	2C	3C	4C
D: Remote	1D	2D	3D	4D
E: Improbable	1E	2E	3E	4E

Note. Basic Guide to System Safety, *2nd ed., by J.W. Vincoli, 2006, Hoboken, NJ: Wiley.*

Table 5
Risk Index as Described in MIL-STD-882

Risk assessment code	Risk criteria
1A, 1B, 1C, 2A, 2B, 3A	Unacceptable
1D, 2C, 2D, 3B, 3C	Undesirable
1E, 2E, 3D, 3E, 4A, 4B	Acceptable with review
4C, 4D, 4E	Acceptable without review

Note. Basic Guide to System Safety, *2nd ed., by J.W. Vincoli, 2006, Hoboken, NJ: Wiley.*

Table 6
Inspection Frequency

Risk assessment code	Inspection frequency
1A, 1B, 1C, 2A, 2B, 3A	Daily until corrected
1D, 2C, 2D, 3B, 3C	Monthly (1 and 2); quarterly (3)
1E, 2E, 3D, 3E, 4A, 4B	Annual
4C, 4D, 4E	Annual

tional Fire Code (International Code Council, 2012).

Figure 2

Automatically Generated Inspection Schedule

Facility	RAC-Lab	RAC-FLS	Inspection Frequency - Lab	Inspection Frequency - FLS
HSC Facility #1	3C	3D	Quarterly	Annual
HSC Facility #2	4C	4D	Annual	Annual
HSC Facility #3	-	4A	-	Annual
HSC Facility #4	-	4E	-	Annual
HSC Facility #5	3C	3D	Quarterly	Annual
HSC Facility #6	-	4D	-	Annual
HSC Facility #7	3B	3D	Quarterly	Annual
HSC Facility #8	3C	3D	Quarterly	Annual
HSC Facility #9	3E	3D	Annual	Annual
HSC Facility #10	3E	3E	Annual	Annual

detonation hazard.

•**High Hazard Group 2** are buildings and structures that contain materials that pose a deflagration hazard or a hazard from accelerated burning.

•**High Hazard Group 3** includes buildings and structures that contain materials that readily support combustion or that pose a physical hazard.

•**High Hazard Group 4** encompasses buildings and structures containing materials that are health hazards.

•**High Hazard Group 5** applies to semiconductor fabrication facilities and comparable research and development areas in which hazardous production materials are used and the aggregate quantity of materials is in excess of those listed in Tables 2703.1.1(1) and 2703.1.1(2) of the International Fire Code (International Code Council, 2012).

Risk Assessment Methodology

Using these definitions, SH&E staff conduct a high-level qualitative review of known hazardous operations within TAMHSC facilities and report this information in a facility hazard summary. This information, combined with the detailed data collected during the room-by-room safety inspection process, is used to assign categories of severity, probability and frequency to each facility and lab. This process is consistent with methodology set forth in Military Standard 882 (MIL-STD-882). Tables 1 and 2 (p. 30) provide additional explanation of this method.

Data Analysis

The next step involves analysis of the data extracted from the application software, typically output in spreadsheet (i.e., Excel) format. Data in the spreadsheet are in the form of comma-separated text strings for each noted deficiency and are organized into cells. Each column corresponds to a heading or entry field from the inspection form, and each row corresponds to the room in which the inspection was performed. One data column contains a building description code that is used to sort data by building. Multiple deficiencies in each deficiency category for a single room are reported in the same cell. This way, any cell containing comma-separated deficiencies is reflective of the deficiencies found in that room only.

The text strings are broken into individual entries and converted to numerical data to demonstrate the total number of deficiencies per category per room. From these data, staff can calculate an overall compliance percentage for the building (i.e., the ratio of noted deficiencies to the total number of deficiencies possible) and a percentage of rooms in compliance (i.e., the ratio of rooms in which no deficiencies were found to the total number of rooms in the building). These two values are used as a building grading system to help guide efforts to target training to those personnel and/or find ways to improve the safety program on those campuses or in those buildings.

The hazard categories analyzed are

Hazard Categories Analyzed by TAMHSC

Fire & Life Safety

Exterior
Exterior comments/other
Exits/means of egress
Means of egress comments/other
Exit/emergency lighting
Exit/emergency lighting comments/other
Electrical
Electrical comments/other
Storage of materials
Storage of materials comments/other
Fire and smoke spread
Fire and smoke spread comments/other
General hazard
General hazard comments/other
Fire alarm equipment
Fire alarm cquipment comments/other
Fire suppression equipment
Fire suppression equipment comments/other
Code-related issue
Other

Laboratory Safety

Housekeeping
Housekeeping comments/other
General safety
General safety comments/other
Biosafety
Biosafety comments/other
Chemicals
Chemicals comments/other
Safe lab practices
Safe lab practices comments/other
Fume hoods
Fume hoods comments/other
Safety equipment
Safety equipment comments/other
Waste disposal
Waste disposal comments/other
Electrical
Electrical comments/other
Radioactive materials
Radioactive materials comments/other
Other

listed in the sidebar on p. 34, and some categories have as many as 23 possible deficiencies within them with the "comments/other" option designed as a catch-all in the event that an inspector notes a deficiency that is not specifically listed within the category drop-down menu on the form or further description is needed.

Identifying the hazard category that was deficient in most rooms is of use because it indicates the category in which a mishap is most probable for that building and may be used to determine the probability of mishap (Table 3, p. 32). In Figure 1 (p. 32), this maximum value would be the electrical category with 46 rooms having noted deficiencies.

When viewed collectively in a hazard matrix (Table 4, p. 33), these data points provide a tool for determining acceptable and unacceptable risks. Table 5 (p. 33) shows the corresponding risk index as described in MIL-STD-882 and essentially explains each RAC in a way that can demonstrate the necessity and implied priority of response.

Based on the risk index, TAMHSC safety staff develop a risk-based inspection schedule for the following calendar year. The group interprets MIL-STD-882 risk criteria to imply a resolution time frame and, as a result, created the inspection frequency schedule (Table 6, p. 33). As noted, assignment of inspection frequency is based on staff's professional judgment and experience, and the hazard to TAMHSC personnel or equipment presented by a deficiency of the corresponding RAC remaining unresolved for longer than the follow-up inspection period.

Separate risk assessment codes are assigned based on the fire-and-life-safety and laboratory safety data to ensure that divergent categories of hazards are addressed according to the maximum risk each presents. As the inspection processes are performed separately, the data acquired in each should be handled and analyzed separately for an apples-to-apples risk comparison. Derived RACs, with inspection frequency applied, result in the auto-generated inspection schedule (Figure 2).

The long-term goal is to perform multiyear analyses to determine trending in noted deficiencies, their locations and frequencies. Trending will inform safety program and training adjustments by providing a metric of their success.

Additionally, the analysis process can be applied to similar inspection processes as hazard category labels are irrelevant from a data processing standpoint. Any set of headings and subcategories could be substituted, allowing for an identical analysis process for many other form-derived data. For example, the group plans to apply the inspection process and data analysis to the radiation safety program. The ultimate result will be analyzing all risk-centric programs identically for better trending data.

Future revisions of data analysis will incorporate a greater degree of automation and built-in flexibility in the input fields. This change will remove the data preprocessing that must be completed before inspection data are loaded into the analysis code. It should be possible to automate every aspect of the risk analysis, excluding the inspections and possibly the assignment of hazard classification, which is best determined by an experienced professional and is somewhat subjective by nature.

Erich Fruchtnicht, TAMHSC radiation safety office, conducts a radiation safety inspection using an iPad.

Conclusion

Using current technology (i.e., iPads) and risk assessment methodology has greatly improved inspection efficiency and effectiveness. TAMHSC has significantly reduced the time consumed by report creation through auto-generated reports from acquired data. Additionally, the employee-hours required to complete inspections has declined and the group expects further decreases as the program develops.

Thanks to the selected technology, software and data processing approach, TAMHSC now can more consistently and accurately identify, quantify and assess risk. The combination of technology, process and inspection methodology improves efficiency and provides quantifiable data.

These data can then be used to devise responses to identified risks in a sound, fact-driven manner, such as by assigning specific personnel in the most safety-deficient areas to attend targeted training. Since hazards are identified room-by-room for each building, these data are used to monitor improvements, implement changes in training, and maximize safety program efficiency and effectiveness.

The new inspection process has produced significant savings. In 2012 compared to 2011, with the implementation of this new technology, employee-hours recorded to conduct inspections dropped approximately 51.09% while delivering a greater degree of validity and reliability. This will result in continuous savings in both less time spent and reduced travel to the eight campuses across Texas. **PS**

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