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Use a login software in your research facility**

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Make safety awareness a priority: Use a login software in your research facility

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Abstract. A facility login software, whose objective is to improve safety in multi-user research facilities, is reported. Its most important safety features are: 1) blocks users from entering the lab after being absent for more than a predetermined number of days; 2) gives users a random safety quiz question, which they need to answer satisfactorily in order to use the facility; 3) blocks unauthorized users from using the facility afterhours; and 4) displays the current users in the facility. Besides restricting access to unauthorized users, the software keeps users mindful of key safety concepts. In addition, integration of the software with a door controller system can convert it into an effective physical safety mechanism. Depending on DOE approval, the code may be available as open source.

1. Introduction

The priority of all user facilities is to do research *safely*. As a result, most large research institutions have implemented high standards of safety. For example, Brookhaven National Laboratory complies with the OHSAS 18001 standard.¹ Periodic user training is an important factor to improve safety.² However, facility managers must use several additional administrative and engineering safety controls to enhance safety in the lab.³ This article presents an administrative control, which is simple to implement, yet quite effective in maintaining users aware of key safety concepts. It consists of a login software, which all users need to access prior to entering the facility. The software has several safety features, among which the most important are: 1) it blocks users from entering the lab if they have not used the facility for more than a predetermined number of days; 2) it presents users with a random safety quiz question, which users need to answer satisfactorily in order to use the facility; 3) it blocks unauthorized users from using the facility afterhours; and 4) it monitors the users currently using the facility.

The software was developed using LabVIEW 2014 Base System.⁴ Following a request by the author for DOE approval, the code may be made available as open source. The program has been implemented since 2010 in the nanofabrication facility of the Center for Functional Nanomaterials (CFN) at Brookhaven National Laboratory. Similar user facilities can modify the software to fit their operations, or, alternatively, can build their own applications based on the safety concepts and structure of the software presented here.

Section 2 describes the structure and safety features of the facility login software. Section 3 discusses the safety characteristics of the program, including ways to enhance its efficacy by interacting with other safety administrative and engineering controls.

2. Description of the software

Hereafter in this article, the term *facility* refers specifically to the nanofabrication facility (also known as the cleanroom) of the Center for Functional Nanomaterials at Brookhaven National Laboratory. This facility has several areas, but a single common entrance and exit in which the computer hosting the login software is located. Fig. 1 shows the user interface of the facility login software. The upper right section is the login area (yellow background), in which users input their ID in order to log into the program. For example, in CFN's nanofabrication facility, users log in and out of the facility by scanning a unique barcode on their ID badges. (Logging out is essential to ensure real-time account of users in the facility.) Section 3 describes the different actions that the software can take when a user logs in. In the lower area of the login section, there are four commands, which can only be used by staff for administrative purposes. The lower right and the bottom sections in Fig. 1 are the “recent changes” and “tip of the week” areas (green and blue background, respectively). The recent changes section is where staff inform users of recent relevant changes in the facility. In the tip-of-the-week area, staff provide users advice regarding the operation of the cleanroom. The information in both areas is obtained from excel spreadsheets, which are updated by facility staff.

Ongoing chemical processes

User name	date in	Process
John Doe	9/16/2016	Amyl acetate
Jane Roe	9/16/2016	Gold etchant (Transene)

Users currently in cleanroom

User name	date in	time in
John Smith	9/16/2016	1:56:27 PM
Jane Roe	9/16/2016	12:49:36 PM
John Doe	9/16/2016	10:09:54 AM

cleanroom log station

Card barcode

VIEW/EDIT/ADD USER LOCKER LOOKUP STATS REVIEW

Users who forgot to END chemical process

User name	date in	Process
Fred Flintstone	9/15/2016	Microchem MIBK:IPA 1:3

Users who MUST see a staff member

User name	failed login date	Cause
Barney Rubble	9/15/2016	Expired proposal
Donald Duck	9/15/2016	Out for > 1 month

recent changes

Date	Change description
4/28/2016	Dektak profiler is UP
12/16/2015	Please note new exhaust alarms (yellow light & siren)
11/30/2015	Instituted new login quiz

tip of the week: In order to maintain the environment in the clean room, we ask that you only bring the following: Box with samples/tools; Laptops & phones; Clean room notebook and pen. Please remember to wipe down laptops with IPA when entering the lab.

Figure 1. User interface of the facility login program. The different sections of the interface are explained in the text. The four commands in the login area (yellow background) launch additional software modules, which allow staff to perform several administrative actions. “VIEW/EDIT/ADD USER” allows to maintain the facility user database. “LOCKER LOOKUP” manages user locker assignments. “STATS” generates a facility usage statistical report, and “REVIEW” shows all the entries in the log database.

Fig. 2 shows the four tables on the left area of the user interface. The two tables on the left provide information obtained from a software that manages chemical processes in the facility.⁵ The top left table lists ongoing chemical processes, while the bottom left table lists those activities which appear ongoing for more than 12 hours. (A user is listed in this table either because the chemical process is actually ongoing, e.g., an overnight metal lift-off process, or because the user forgot to log off the chemical process.) The two tables on the right contain information pertaining to user login. The top right table lists the users currently in the facility. The access to this list is important from a safety point of view, as will be discussed in Section 3. The bottom right table lists users who generated an

to meet with a staff, who will try to clarify any questions that the user may have about this particular (or related) safety concept.

- **User does not have afterhours access.** Staff can designate which users are allowed access to the facility during afterhours and detect which users attempt to use the facility afterhours without authorization.

Figure 3. Pop-up window displaying a random safety question that users need to answer correctly in order to proceed to use the facility.

The facility login software can also interact with other safety controls. For example, the top table on the left half of Fig. 2 displays information from an independent software, which handles chemical processes in the facility.⁵ The table informs users of ongoing chemical processes, so they are aware of processes involving hazardous chemicals (e.g., hydrofluoric acid). In addition, the lists allows staff to verify if users are following the correct lab procedures.

Besides being an administrative safety control, the facility login software can interact with engineering safety controls. For example, the software can communicate with a software-activated door controller in order to provide or deny physical access to the facility.

The nanofabrication facility of the Center for Functional Nanomaterials (CFN) has an excellent safety record due to the training users receive, the supervision by staff, and the implementation of effective engineering and administrative controls, such as the facility login and chemical login software.⁵ Since the introduction of software-based administrative controls in 2010, the nanofabrication facility has had only one recorded incident, which occurred when a user by-passed one of the software's protocols.⁶ For the last three fiscal years, a large fraction of CFN users (91%) were satisfied with their CFN experience.⁷ The nanofabrication facility hosts over 150 users per year.

4. Summary

A multi-user facility login software, which determines whether a user is allowed to use the facility, has been developed. The software has several safety features, among which, the most important are: 1) it blocks users from entering the lab when users have not used the facility for more than a predetermined number of days; 2) it presents users with a random safety quiz question, which users need to answer satisfactorily in order to use the facility; 3) it blocks unauthorized users from using the facility afterhours; and 4) it allows to monitor the users currently in the facility.

Additionally, the software can enhance its safety contributions when communicating with other safety controls. When it interacts with a software that manages chemical processes,⁵ the facility login software displays ongoing chemical processes, which permits users to be more aware of potential safety hazards in the facility.

The software can also interact with physical control mechanisms, like door controllers, in order to be more efficient in blocking unauthorized users from entering the facility.

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