RESEARCH ARTICLE

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

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.

By F.E. Camino

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

F.E. Camino is affiliated with the Center for Functional Nanomaterials, Brookhaven National Laboratory, Upton, New York 11973, United States (E-mail: fcamino@bnl.gov).

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

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. Figure 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 'Results and discussion' 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 Figure 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.

Figure 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

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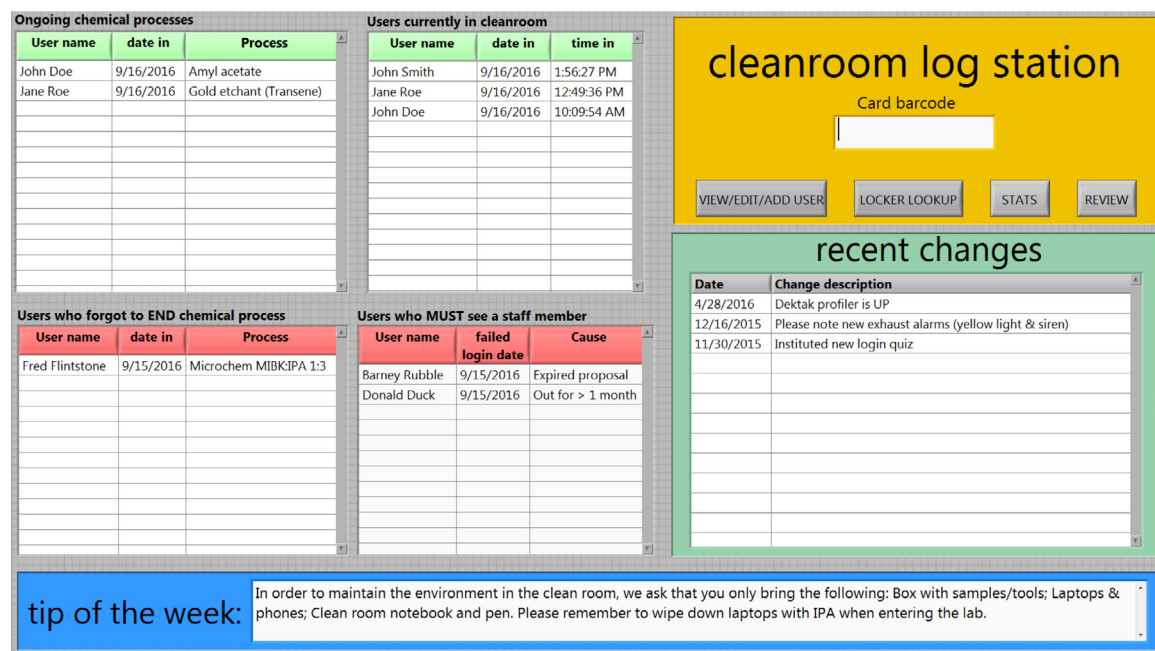
Figure 1. User interface of the facility login program. The different sections of the interface are explained in the text. The four commands in the login area (yellow background) launch additional software modules, which allow staff to perform several administrative actions. "VIEW/EDIT/ADD USER" allows 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.

lists those activities which appear ongoing for more than 12 h. (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 'Results and discussion'. The bottom right table lists users who generated an unsuccessful login, due to a non-compliance with a facility guideline, and are blocked from accessing the facility. This process will be explained in more detail in Section 'Results and discussion'.

RESULTS AND DISCUSSION

One safety component of the facility login software is to list the people currently using the facility (top right table in Figure 2). This list can, in principle, be accessed online. Thus, it can be used by safety personnel to account for

people that used the facility during an emergency situation requiring facility evacuation, such as fire or toxic gas release events.

Another safety contribution is the program's capability to block users from accessing the facility when one of the conditions defined in the software is not satisfied. These conditions can be tailored to a particular facility, and in general, can be grouped into administrative (e.g., user proposal expired or user has unassigned locker) and safety related. In the nanofabrication facility of the Center for Functional Nanomaterials, the safety related conditions are:

- **User absent from facility for more than 30 days.** In this case, the user is listed in the bottom right table of the user interface (Figure 2) and asked to meet with a staff member. This feature offers staff the opportunity to discuss with the user about recent changes in the operation of the facility. Staff also uses this chance to review basic safety concepts, such as facility and building alarms and evacuation protocols.

- **User failed to answer login quiz question correctly.** One popular feature of the software is to present users with a safety quiz question at login (Figure 3). These questions are based on basic safety knowledge that all users need to be aware of. In case of a wrong answer, the user is asked 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.

The facility login software can also interact with other safety controls. For example, the top table on the left half of Figure 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