Development of the NIOSH Determination of Sound Exposures (DOSES) mining noise exposure management software

E.R. Spencer, G.P. Cole and E.R. Bauer
Mining engineer (retired), computer engineer and mining engineer, respectively,
National Institute for Occupational Safety and Health (NIOSH), Pittsburgh, PA

Abstract

Overexposure to hazardous noise has been found in most mining sectors, with up to 100% of the surveyed workforce experiencing a noise dose that exceeds the U.S. Mine Safety and Health Administration (MSHA) permissible exposure level (PEL). As a result, miners show elevated rates of hearing impairment of 70-90% by retirement age. To help manage noise exposures, the U.S. National Institute for Occupational Safety and Health (NIOSH) developed the Determination of Sound Exposures (DOSES) software and implementation guide for use by mine management and safety personnel. This paper describes the development, functions and basic operation of the initial-release version of DOSES. A revised version is being developed to incorporate additional user-suggested functions, and its development and implementation to assess noise control solutions will be described in a future article. The software relies on a time-motion study that profiles the worker's daily activities. Observations about the worker's location and tasks or other activities are recorded along with the start and end time, to determine the duration of the tasks so they can later be matched up with the noise data. The software gives the user the option of assessing dose relative to the MSHA PEL, the action level or the NIOSH recommended exposure limit. The software generates a variety of interactive on-screen displays showing where, when and how the worker's noise dose accumulated. It also can generate customizable printed reports. These outputs can be used to highlight the tasks, locations and times that are associated with the greatest amount of a worker's noise exposure. DOSES simplifies and streamlines the record keeping and analysis associated with time-motion studies and worker noise exposures, so mine management can make engineering noise control or administrative control decisions to limit the noise overexposure of their workers.

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Key words: Noise exposure; Dose; Hearing loss; Mining

Introduction

The Determination of Sound Exposures (DOSES) software (Cole et al., 2009) was developed by the U.S. National Institute for Occupational Safety and Health (NIOSH) specifically for use by mine management and safety personnel. DOSES simplifies and streamlines the recordkeeping and analysis associated with time-motion studies and worker noise exposures, making it easier to identify and solve noise problems. The software relies on a time-motion study that profiles the worker's daily activities. At the same time, noise measurements are collected with a dosimeter or sound level meter (SLM). Observations about the worker's location and tasks or other activities are recorded, along with times and durations so they can later be matched up with the noise data. After the completion of a time-motion study of the worker's daily tasks and locations associated with possible noise sources and measurement of the worker's noise exposures during the recorded events, the information is entered into DOSES. The program then displays information about the worker's accumulated noise dose over time. The software gives the user the option of assessing dose relative to the NIOSH recommended exposure limit (REL), the Mine Safety and Health Administration (MSHA) permissible exposure level (PEL) or the MSHA action level (AL). To obtain the NIOSH REL dose, the software uses a 3-dB exchange rate, an 80-dB threshold level and an 85-dB criterion level (NIOSH, 1998). To obtain the MSHA PEL dose, the software uses a 5-dB exchange rate, a 90-dB threshold level and a 90-dB criterion level. To obtain the MSHA AL dose the software uses a 5-dB exchange rate, an 80-dB threshold level and a 90-dB criterion level (64 Fed. Reg. 49548) (*Fed. Reg.*, 1999).

The software generates a variety of interactive onscreen displays showing where, when and how the worker's noise

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Table 1 — System requirements.

Operating system: Windows 7/ Vista/ XP/ 2000		
Hardware	**Minimum**	**Recommended**
Processor	Pentium 200 Hz or equivalent	Pentium III or greater or Celeron 600 MHz or equivalent
Disk space	80 MB	80 MB
Memory	64 MB of RAM	256 MB of RAM
Screen resolution	800 × 600	1,024 × 768

dose accumulated. It also can generate customizable printed reports. These outputs can be used to highlight the tasks, locations and times that are associated with the greatest amount of the worker's noise exposure. Mine safety personnel can then use these reports to make decisions about how to reduce or eliminate the factors that are creating an overexposure.

System requirements

To run the DOSES program effectively, the user's computer should meet the system requirements shown in Table 1.

Collecting time-motion data

As with any data analysis program, the utility and validity of results generated by DOSES depends greatly on the quality of information entered. Task observation, or time-motion study, is the basis for the program's input and must be as complete and detailed as possible. Completeness is important, because any gaps in observations and recorded durations could compromise the value of the results if any critical events related to overall noise exposure are missed. These inaccurate results could lead to invalid comparisons and misguided or ineffective exposure reduction attempts. DOSES can also accommodate estimated or extrapolated data, including data from task-based methods or projected estimates based on a task sample. For effective time-motion studies, the following must be considered: Whether to perform task observations or location observations, what timeframe to record and whether to conduct full- or partial-shift observations (Hager, 2008; Virji et al., 2009).

Task observations versus location observations. Depending on the classification of the worker being observed, it may be better to use one method of observation over another. Most of the time it is recommended and logical to use task observations. This is done by recording each task a worker performs and the task's duration. Observing a machine operator, for instance, would logically involve task observations, because these operators tend to remain with their machine, positioned at a relatively fixed location and perform a uniform and repeated series of tasks throughout their shift. For example, a continuous miner operator, even operating remotely, would stay at a relatively fixed position with respect to the continuous miner and complete tasks such as moving (tramming), cutting, loading, cutting and loading, waiting on shuttle car, etc. Location observations best suit time studies of workers who move about frequently during the shift, perform many different tasks and spend time at many locations. Examples include utility workers in underground coal mines or plant workers at coal preparation plants. These workers are on the move during the entire shift, but return to specific locations often during the shift. They may repeat similar tasks, but tend to repeat them at the same locations throughout the shift. It is recommended that no matter which method of observation is used, detailed notes should be taken. When task observations are employed, the specific location of those tasks should be noted on the data sheets. Conversely, when location observations are used, the specific tasks being performed at each location must be noted. The end goal is to be able to get an accurate picture of each component of the employee's noise exposure, so that crucial noise exposures can be managed and the difference in total dose (pre- and post-noise control) can be ascertained.

Timeframe recorded. A second important part of the data collection process is determining the timeframe for recording each task/location. At a minimum, times should be recorded at a resolution of one minute. Even better is to note the time intervals to the second, i.e., in the format: hr:min:sec. As experience is gained conducting observations for various occupations, the precision and detail of both the observations and recording times will be easier to determine based on length of each task or time at each location. Long-duration tasks/locations likely require a less stringent time recording (hr:min), while rapidly occurring tasks or changing locations would require a "tighter" recording time (hr:min:sec).

Duration of study. The duration of the observations must be considered. Full-shift observations take just that—a full shift—to complete, plus the time needed to enter the observation data and dosimeter files into DOSES. This is a substantial time commitment for the observer. However, full-shift observations are recommended when the sources of a worker's noise exposure are not already well understood. The benefits of a full-shift observation include a complete description of what the worker has done during the shift and a full-shift dose measurement that can be used for compliance purposes. For certain workers, partial-shift observation can still be useful when time does not permit full-shift observation. If a worker is known to perform the same tasks, the same number of times and for the same duration each time during a shift, it may be possible to ascertain that worker's exposures with a partial-shift observation. Observing several complete cycles of each of the tasks performed may be sufficient. The user should observe whether there appears to be consistency across several different observations of a task. If the sound pressure levels appear to vary, DOSES simplifies the process of performing more detailed analysis. Separate instances of a task can be relabeled as different tasks and DOSES can show the contribution of each observation independently. Others (e.g., Hager, 2008, Virji et al., 2009) have provided guidelines on when time-motion studies are most appropriate or when task-based estimates can be used.

Data sheets. The abbreviated data collection sheet shown in Fig. 1 is an example of the type of information that should be recorded when completing a time-motion study for use in the DOSES program. The bold items are field titles while the non-bold items would be filled in by the observer. DOSES is designed for time-motion study data to be entered by start/stop time. The start and stop time of each work task and/or location and the related sound pressure level (SPL) measurement are critical to the final analysis report. It is important to keep the start and stop times sequential without any gaps. DOSES enforces sequential data collection to assure that no exposure events are overlooked. In cases where a gap in data collection is intended, the user can enter a filler task with a zero SPL if no events that will contribute to overall dose are

Data Sheet	**Observations for:** Continuous Miner Operator		
Date: 11/11/2007	**Mine:** XYZ	**Section:** North 11	**Emp. First Name:** Sam
Unique ID: 1234	**Manufacturer:** Smith	**Model:** XYZ-1	**Serial No.:** 12345
Normal Shift: [Y]	**Shift Production:** 2,000 tons		**Dosimeter Tag:** 12345
Observer: Jane Doe	**Other Info:** Pittsburgh Coal Seam 3.4 m		

Time Start	**Time Stop**	**Task – Location Observations**				**Sound pressure level Measurements**
		Mantrip	Downtime	Con. Miner Operator at Face	Tramming in Crosscut	
06:00:00	06:25:20	X				95 dB(A)
06:25:20	07:00:45		X			73 dB(A)
07:00:45	11:00:00			X		97 dB(A)
- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
15:05:05	15:20:05				X	92 dB(A)
15:20:05	15:55:10		X			75 dB(A)
15:55:10	16:20:45	X				97 dB(A)

Figure 1 — Example of time-motion study sheet.

thought to have occurred during the period. It is also important to attempt to list all possible tasks or locations on the data sheets before beginning the study and to leave some blank columns for unanticipated tasks or locations. The program also requires entries for the date of the study, the employee's MSHA occupation code and the MSHA equipment operated code (MSHA, 2001). These data are needed to complete the DOSES analysis of the worker's work tasks and/or location contributions to the cumulative daily dose. If the mine has a recordkeeping system for their hearing loss prevention program, these data could be maintained within the system to track the effectiveness of implemented noise controls.

When using the time-motion study sheet, there is a need to be consistent, especially within a specific job classification. First, it is important to always label the worker occupations with the same names using the MSHA occupation codes (MSHA, 2001). Second, it is suggested that task and location descriptions also be consistent, to allow for comparisons between time studies of the same employee and between employees with the same occupations. DOSES could be used as input to an analysis of employee groups, including similar exposure groups (Mulhausen, 2006), although it does not fully automate the process.

Instrumentation. The instrumentation best suited for conducting exposure and SPL analyses includes a person-wearable dosimeter for monitoring worker noise exposure and an SLM for measuring the SPLs for each task or at each work location. DOSES can use data from a wide range of dosimeters used for occupational noise assessment. It allows for downloading of dosimetry data from all of the dosimeters commonly used at mining operations, including those that have received MSHA intrinsic safety approval for use in underground coal mines. Virtually any dosimeter can also be used as long it generates time-stamped SPL data in plain ASCII text files. Therefore, companies can choose their own SLM or dosimeter for measuring SPLs.

Dosimeter settings for the NIOSH REL, MSHA PEL and MSHA AL are shown in Table 2. For most mining applications, the MSHA PEL and AL are the dosimeter settings likely to be used, although DOSES does not require any particular

Table 2 — Dosimeter settings.

	NIOSH REL	**MSHA PEL**	**MSHA AL**
Weighting	A	A	A
Threshold level	80 dB	90 dB	80 dB
Exchange rate	3 dB	5 dB	5 dB
Criterion level	85 dB	90 dB	90 dB
Response	Slow	Slow	Slow
Upper limit	140 dB	140 dB	130 dB

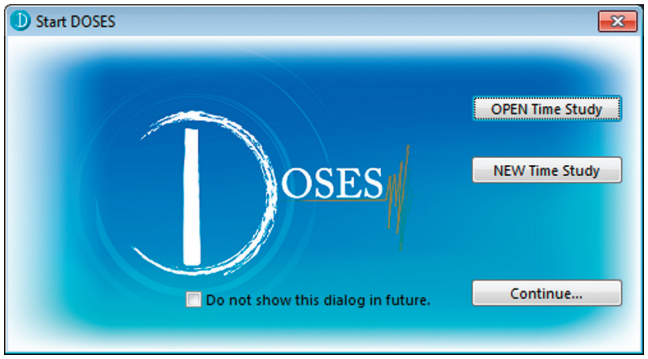


Figure 2 — Start DOSES splash screen.

setting, as long as a time and sound pressure level are being saved to the dosimeter's internal memory. DOSES calculates the dose relative to three criteria—NIOSH REL, MSHA PEL and AL—from the time and SPLs downloaded from the dosimeter.

User instructions

When the DOSES program is opened it displays the start DOSES splash screen, which shows three button choices: open time study, new time study and continue (Fig. 2). To open a saved file, the user must select the open time study button. A file browse dialog is displayed to allow selection of a previously saved study.

To enter a new study, the user must select the new time study button. To close this screen, the user selects the continue button, the start DOSES screen closes and the DOSES time study editor screen is displayed in a disabled mode. From here, the user selects open, new or exit from the file menu, or the help files can be viewed. The other menus will be disabled until an existing study is opened or a new study is created.

Time study properties—new study screen: time study. The next window is the default screen when new time study is selected from the start DOSES screen (Fig. 3). The other

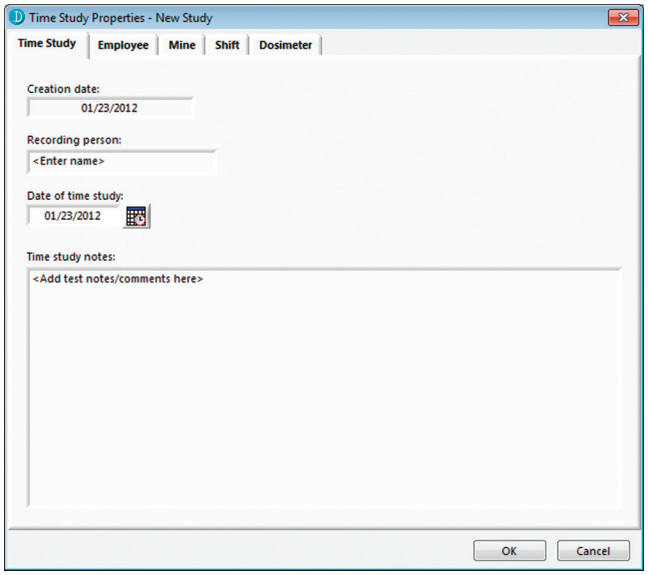


Figure 3 — Time study properties - new study screen: time study.

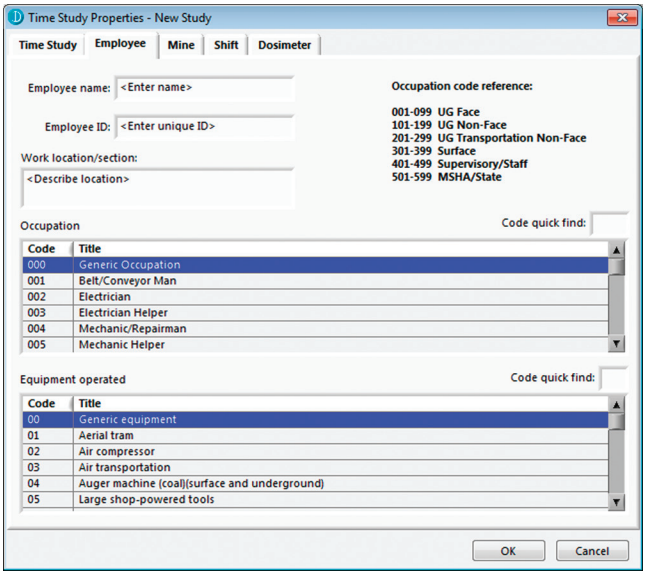


Figure 4 — Time study properties - new study screen: employee.

tabs, employee, mine, shift and dosimeter, are selected and the information filled in after the time study screen is completed.

Next screen: time study properties—new study screen: employee. For the employee tab (Fig. 4), the MSHA occupation and equipment operated codes are selected from the lists provided. Other personnel information can be entered in the text boxes.

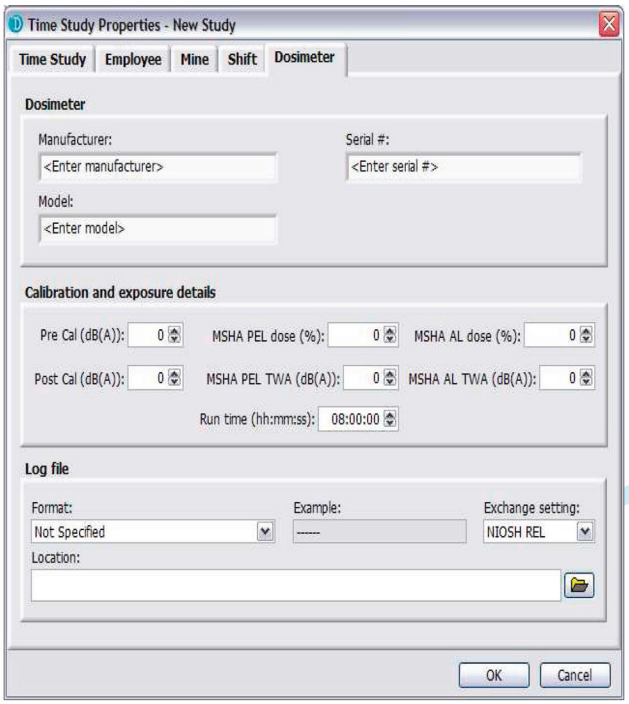


Figure 5 — Time study properties - new study screen: dosimeter.

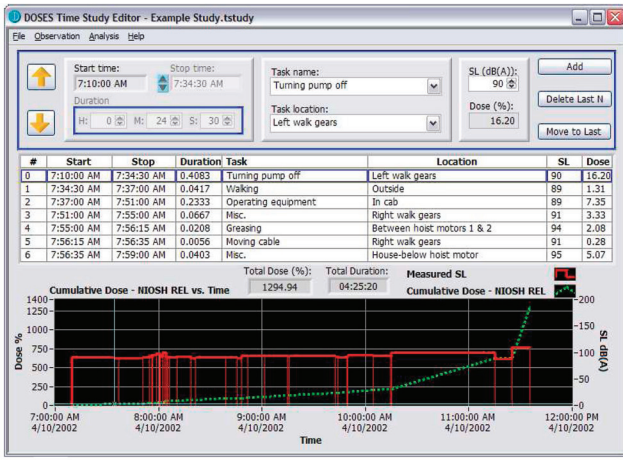


Figure 6 — DOSES time study editor screen.

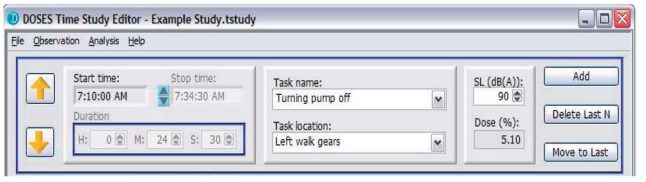


Figure 7 — Example of time study editor view.

#	Start	Stop	Duration	Task	Location	SL	Dose
0	7:10:00 AM	7:34:30 AM	0.4083	Turning pump off	Left walk gears	90	5.10
1	7:34:30 AM	7:37:00 AM	0.0417	Walking	Outside	89	0.00
2	7:37:00 AM	7:51:00 AM	0.2333	Operating equipment	In cab	89	0.00
3	7:51:00 AM	7:55:00 AM	0.0667	Misc.	Right walk gears	91	0.96
4	7:55:00 AM	7:56:15 AM	0.0208	Greasing	Between hoist motors 1 & 2	94	0.45
5	7:56:15 AM	7:56:35 AM	0.0056	Moving cable	Right walk gears	91	0.08
6	7:56:35 AM	7:59:00 AM	0.0403	Misc.	House-below hoist motor	95	1.01

Figure 8 — Example of time study table view.

Time study properties—new study screen: dosimeter. If a dosimeter was used to collect data, the information about the dosimeter and calibration can be entered by activating the dosimeter tab (Fig. 5). The dosimeter's log file location (drive and folder name) is entered in the window under log file. This file must first be exported from the dosimeter's software into Excel or a similar spreadsheet program and formatted to the specifications of one of the ten formats in the format drop-down list. Once a format is chosen from the list, an hour, minute, second and numeric format example appears in the example window. The chosen format example must be a duplicate of the dosimeter's log file format for the file to download into DOSES. After all the information is entered, the OK button is clicked on to move to the DOSES time study editor screen to enter the time-motion data. Once the data is read into DOSES, the dosimeter file is no longer needed to complete the analysis.

DOSES time study editor screen. The DOSES time study editor screen (Fig. 6), is initially disabled when the program starts. However, this screen is enabled when an existing time study is opened or a new time study is successfully started. This screen contains three areas: observation editor, table view and graph view. At the top of the screen, four menu options are available: file, observation, analysis and help.

Observation editor area. This area is initially disabled when the program starts. The screen is enabled when an existing time study is opened or a new time study is successfully started. The observation editor area (Fig. 7), contains five main features:

1. Previous/next observation (up/down yellow arrows).
2. Start time, stop time and duration.
3. Task name and task location.
4. SPL (dB(A)) and DOSE (%).
5. Editing buttons.

*Previous/next observation. P*ressing the up or down yellow arrows allow for movement backward and forward in the list of observations.

Start/stop time and duration text boxes. Each observation is defined in terms of a start time and stop time. The start time is set once, when initializing the first observation with the set study start time dialog. From then on, the observation start time is automatically set based on the stop time of the previous observation. The stop time is set as part of defining a new observation. It can be set by entering the exact stop time or by entering the duration in hours (H), minutes (M) and seconds (S). Regardless of how the stop time is set, the other stop time fields will update automatically.

Note: only the stop time of the last observation can be changed. If the stop time of an observation within the study needs to be changed, all observations following must be deleted and reentered. This is to ensure time continuity in the observations.

Time study table view. The time study table (Fig. 8) is located in the center of the DOSES time study editor screen. The time study table provides a tabular view of the observations that were entered into the time study. Movement around the time study table is possible by clicking on a row or scrolling down the table using the mouse or the keyboard. The table is updated automatically as observation data are entered. The current observation will have a blue border around it and new data cannot be entered by clicking on the last row of the table – only by using the observation editor.

Task name and task location list boxes. The task name and task location are entered for each observation. An entry is made by selecting the list box drop-down arrow and choosing from the list. A short explanation is displayed inside the list box for quick assistance. When starting a new time study with a previously unused occupation code, the add/edit option is the only option available for both task name and task location. After selecting yes to the "Do you want to edit task list?" dialog, an edit item list dialog appears, allowing for items to be added or removed from the list. Once the add/edit is completed, the new item(s) can be selected throughout the time study. The task name and task location list boxes are initially empty when creating a study using a new employee occupation code. They are populated as the observations are entered and automatically saved for future use according to the employee occupation code.

Note: removing an item from the list box does not remove it from the observations in the time study. Those entries will have to be manually reset to a valid list box value.

Sound pressure level and dose. Each observation contains

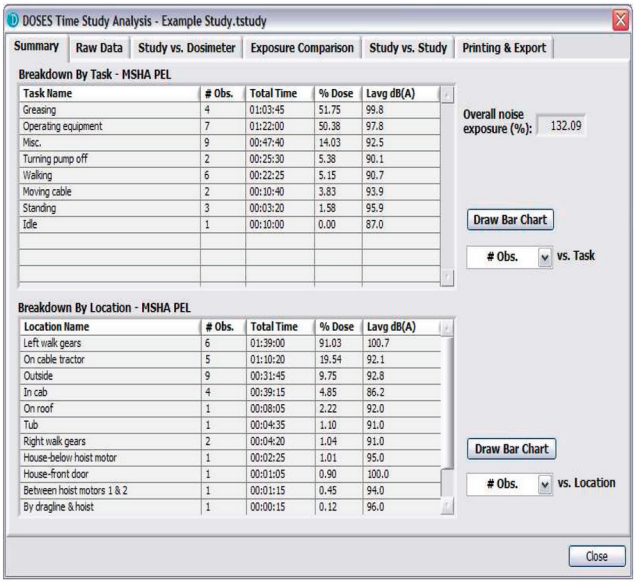


Figure 9 — Example of summary section.

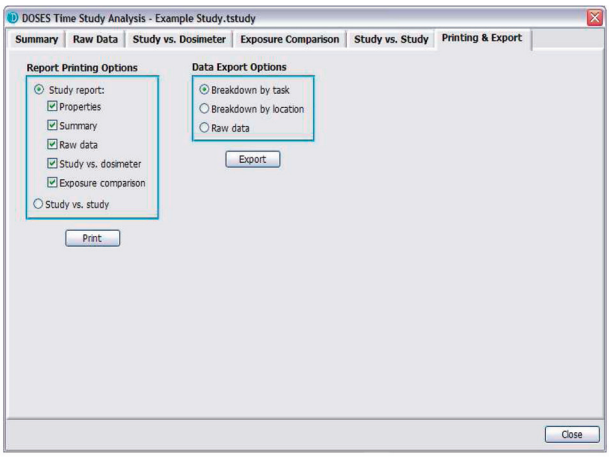


Figure 11 — Time study analysis - printing & export screen.

a SPL number that is entered by either typing the number in the area provided or by using the numeric up/down control and moving to the desired number. The numeric up/down control increases or decreases the number by 1 dB(A). The dose is calculated by the program after the SPL is typed in.

Time study analysis – summary tab. In the summary section (Fig. 9), the entered data are shown in two separate tables—one where the breakdown is by task, the other where the breakdown is by location. Included for reference alongside the breakdown by task table is the overall noise exposure (%) generated from the time study. The table can be sorted by clicking on any of the column headers. Clicking the same column header multiple times will toggle the sort between ascending and descending order. Sorting the tables by % dose is recommended to bring the tasks and locations that are the main contributors to the overall dose to the top. Sorting the tables by LAVG is recommended to bring high noise tasks and locations to the top of the list. Some of these tasks or locations may need attention even if they do not contribute significantly to the dose in the current study, because they could be potentially hazardous if another worker happens to engage in them for longer periods of time. It is possible to chart the information contained in the table visually by clicking the draw chart button located below the table. The adjacent list box provides the option to chart the number of observations, total time, % dose or LAVG dB(A) versus the task name. To change the category, select from the list box by using the drop-down arrow.

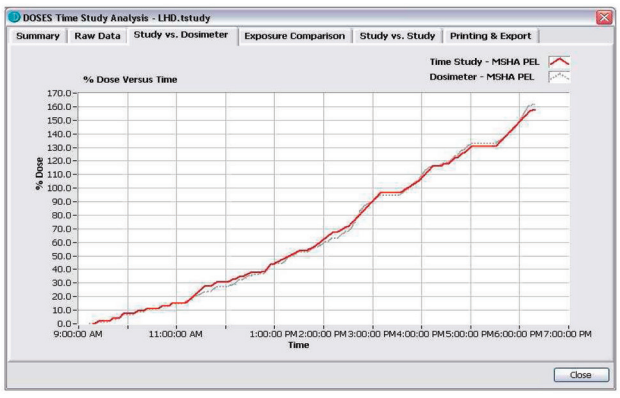


Figure 10 — Example of study vs. dosimeter graph.

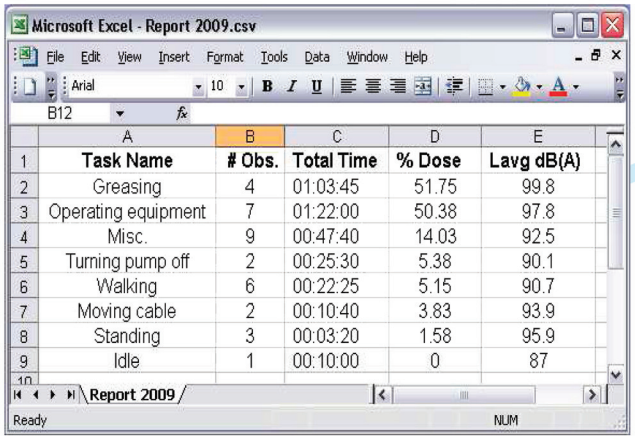
Time study analysis - study vs. dosimeter screen. Using the study vs. dosimeter tab (Fig. 10) displays a plot of the time study using one of the pre-selected calculations: NIOSH REL, MSHA PEL or MSHA AL. The purpose is to provide a comparative view of the time study data and the dosimeter data.

Time study analysis dialog – printing & export screen. The printing & export tab (Fig. 11) has the controls for printing reports and exporting the data. There are two report options for printing: study report and study vs. study. Specific options can be chosen for what parts to include in the study report by clicking the appropriate checkboxes. After the report option is chosen, left click the print button to access the print dialog. From this dialog, select whether to print to a file (HTML) or selected printer and the page orientation.

Export button. The data are exported in an ASCII comma-delimited format with a default .csv extension, which makes it readable by Microsoft Excel and other data analysis software (Fig. 12). After selecting the export option (Fig. 11), left click the export button to access the export file dialog to select or choose to destination file.

Interpretation of Results

The primary outcome of DOSES is an understanding of a worker's noise exposure, what causes that exposure or where the exposure is occurring. The charts, graphs and tables generated by DOSES are all designed to display this important information. Specifically, the outputs summarize a worker's tasks/locations, time at each task/location and the dose accumulated at each task/location. This information is initially displayed as a compilation by tasks/locations, listed from highest accumulated dose task/location to lowest accumulated dose task/location. This information can be sorted by task/location,



	A	B	C	D	E
1	Task Name	# Obs.	Total Time	% Dose	Lavg dB(A)
2	Greasing	4	01:03:45	51.75	99.8
3	Operating equipment	7	01:22:00	50.38	97.8
4	Misc.	9	00:47:40	14.03	92.5
5	Turning pump off	2	00:25:30	5.38	90.1
6	Walking	6	00:22:25	5.15	90.7
7	Moving cable	2	00:10:40	3.83	93.9
8	Standing	3	00:03:20	1.58	95.9
9	Idle	1	00:10:00	0	87

Figure 12 — Microsoft Excel spreadsheet example.

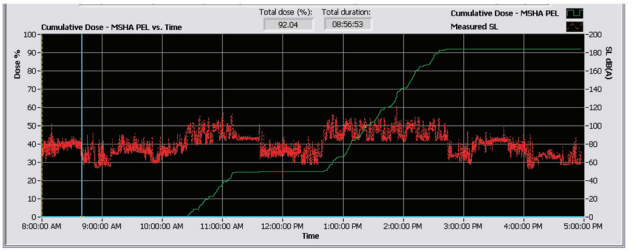


Figure 13 — DOSES-dosimeter - graph view example.

duration or accumulated dose. Mine safety personnel should be looking for the tasks or locations that result in the most accumulated dose. Once this determination has been made, then the appropriate intervention strategies can be selected. Interventions directed at the tasks or locations that result in the most dose have the best chance of significantly reducing a worker's noise exposure.

Interventions

DOSES is especially useful for evaluating the success of interventions intended to reduce noise exposure. There are two general types of exposure reduction interventions: engineering controls or administrative controls. Engineering noise controls attempt to reduce the SPLs at the source or along the path from the source to receiver. The worker is exposed for the same length of time, but since the SPL is reduced, less noise exposure occurs. Engineering controls might include quieter motors, reduced impact noise, sound barriers, sound-absorbing material, control rooms and reduced metal-to-metal contact. Administrative controls attempt to remove the worker from the noisy area. In this case, the SPLs remain the same, but since the worker does not spend as much time near the noise, the overall noise exposure is reduced. Administrative controls may include minimizing or eliminating tasks in high SPL areas, remote monitoring, training to allow for faster task completion and job rotation. In most cases, the most effective noise reduction is the use of an engineering control that reduces the SPL. When all feasible engineering controls are implemented, administrative noise controls are the next best choice. One starting point for identifying specific engineering and administrative controls is MSHA Program Information Bulletin No. P08–12, *Technologically Achievable, Administratively Achievable, and Promising Noise Controls (30 CFR Part 62)* (Stricklin et al., 2008).

Intervention examples. Examples of interventions performed by NIOSH can illustrate some of the possibilities for noise reduction that could be evaluated with DOSES. To conduct these studies, NIOSH used several different time-consuming analysis techniques and software packages, a process that can be streamlined with DOSES.

One of the workers in underground coal mining likely to experience noise overexposure is the continuous mining machine operator. Exposure data collected by NIOSH showed that continuous mining machine operators had MSHA PEL doses as high as 347% (Bauer et al., 2006). Some of the interventions that have been implemented include coated flight bars and coated tail rollers (engineering controls) and remote operator positioning and job rotation (administrative controls).

In another case, plant operators in coal preparation plants had MSHA PEL doses as high as 221% (Bauer et al., 2006). The plant operators are the workers who routinely travel throughout the plant checking processes, cleaning and performing minor maintenance. They are exposed to many different SPLs emanating from any number of different pieces of processing equipment. Some of the interventions include: control booths, urethane screen decking, chute liners and enclosing noise sources such as air compressors and pumps (engineering controls); remote monitoring, restricting travel to the lowest SPL areas and job rotation with control room operators (administrative controls).

In a talc-processing plant, the baseline sound pressure level measurements ranged from 93 dB(A) to 104 dB(A) (Spencer and Reeves, 2009). The initial engineering noise controls consisted of acoustic curtains installed around the fluid energy mill fans and a large crusher. Acoustic curtains were then used in front of the other crusher and the air classifying mills (ACMs), sound-absorbing material was inserted under the hood of ACM 2 and maintenance and repairs on ACM 3 were completed. The sound pressure levels measured after this work was completed (with the 60" roller mill off), ranged from 88 dB(A) to 94 dB(A), a significant reduction of 10 dB(A) from the highest baseline sound pressure level. For the loudest ACM, the noise controls consisted of building a larger shroud, lining the inside of the shroud with a sound barrier material and filling the interior of the shroud with sound-absorbing material. The final control for this study was wrapping the duct of a 60" roller mill with a sound barrier material. The sound pressure level near the duct work of the 60" roller mill was reduced by about 4 dB(A). Using all these noise controls and fixing ACM 3, the mill floor's sound pressure level was reduced to a range of 90 dB(A) to 94 dB(A).

Finally, in surface coal mining, dragline oilers had MSHA PEL measured doses as high as 193% (Bauer et al., 2008). Interventions have included: sound barrier curtains around motor-generator sets, quieter motor blower fans and wrapping of ductwork with insulation (engineering controls); restricting oiler time in the "house," remote greasing and job rotation with dragline operator and dozer operator (administrative controls).

Intervention success. Judging intervention success is accomplished by conducting time studies before a noise control has been implemented, then comparing the post-intervention time study with the pre-intervention time study. For instance, if an engineering control has been implemented, one would look for a dose reduction related to tasks using the modified equipment. If an administrative control has been employed as the exposure reduction method, one would simply check to see if the time spent at that location or task is less and, subsequently, if the result is less dose accumulation. DOSES allows these types of analyses to be completed rather easily by comparing pre- and post-intervention tables or dose graphs. Modeling of noise controls using the pre-intervention tables or dose graphs can determine the value of the noise controls before they are installed, thereby saving time and money. This is done by taking the attenuation of the selected noise control and applying it to the SPL and using the total duration to determine the post-intervention dose.

Summary

By using DOSES, mine personnel can easily perform similar studies of exposure reduction interventions at their mines without needing the specialized analysis software and expertise employed in the NIOSH studies to evaluate noise control and administrative control solutions. The software requires very little additional equipment and works especially well with a series of task observations associated with sound pressure level readings. NIOSH welcomes feedback from the DOSES user community via the contact information contained in the DOSES help system. For instance, suggestions from early users have been incorporated into a new test version that facilitates the use of high-resolution dosimeter data. In this dosimeter-optimized version, every data point collected by the dosimeter appears on the editing screen (Fig. 13). The user can then use a cursor to select groups of data points that are associated with a task rather than entering task descriptions minute-by-minute. A follow-up paper is planned to introduce the revised version and provide more detailed implementation guidelines for noise control solutions. This and other user-suggested improvements will be incorporated into future iterations of DOSES that will be distributed through the NIOSH website.

Disclaimer

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the views of the National Institute for Occupational Safety and Health. Reference to specific brand names does not imply endorsement by the National Institute for Occupational Safety and Health.

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