

**Information Collection Request for:
“EMERGENCY SELF-ESCAPE FOR COAL MINERS”
Supporting Statement A**

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List of Attachments

Attachment A – Applicable Laws and Regulations

Attachment B – 60 Day Federal Register Notice

Attachment C – Informed Consent Form

Attachment D – Initial Interview Protocol

Attachment E – CTA Interview Protocol

Attachment F—HTA Focus Group Protocol

Attachment G – Observation Form

Attachment H -- IRB Approval

- Goal of the study: To identify and specify the physical and mental tasks required for underground coal miners to successfully escape a mine emergency under various mine disaster scenarios. This initial effort will define the universal knowledge, skills, abilities, and other characteristics (KSAOs) as well as the cognitive processes that may influence a miner's ability to escape from a coal mine.
- Intended use of the resulting data: The NIOSH OMSHR Training Research and Development Team will utilize the fundamental framework of tasks/cognitive behaviors derived in this initial effort in subsequent studies related to coal miner training development across a broader sample of mines. It will inform the design, development and evaluation of mine emergency response training problems which require the performance of the critical tasks identified through this analysis.
- Methods to be used to collect: Observation, semi-structured research interviews, focus groups
- The subpopulation to be studied: Underground Coal Miners in the United States.

A. JUSTIFICATION

1. Circumstances Making the Collection of Information Necessary

Background

This is a new collection, with a two-year collection period requested. This study is being conducted by the National Institute for Occupational Safety and Health (NIOSH). NIOSH has the responsibility to conduct research relating to innovative methods, techniques, and approaches dealing with occupational safety and health problems. NIOSH sponsored a study that was conducted by the National Academy of Sciences (NAS) to examine the essential components of coal miner self escape during emergencies. The study focused on environmental and human-systems factors and technologies to develop recommendations for improving self-escape preparations and training, and identify potential gaps.

The research by NAS (National Research Council, 2013) resulted in seven major recommendations for future research in the following areas: assessment of emergency response, technology, decision science, safety culture, and training. Within the training area, there were five sub-recommendations based on their conclusion that, "A detailed systematic task analysis would identify KSAOs critical to a successful self-escape. These KSAOs will provide a general blueprint for self-escape training programs and essential competencies" (p. 115). The first recommendation called for NIOSH to conduct or sponsor a detailed, formal task analysis of mine self-escape, since no formal analysis exists. A formal analysis would provide a clearly understood set of activities and behaviors as the main focus of follow-on research and allow for tangential activities (e.g., mine rescue) to be regarded as such. In addition, an understanding of the human behaviors, competencies, decision points, use of technology and critical interactions among people would clarify the demands made on individuals, and the competency and technology requirements. Subsequent research can then utilize the task listing and KSAOs to focus on the gaps that exist in the support available to miners and key personnel in terms of training, technology, and information.

This formal task analysis should identify the physical and cognitive tasks for emergency escape and breakdown the KSAOs needed by mine personnel in the event of a mine disaster to successfully complete an emergency self-escape. This initial effort will define the universal KSAOs as well as the cognitive processes that may influence a miner's ability to escape from a coal mine. This analysis will identify potential gaps between worker demands and capabilities, and propose recommendations to either minimize those gaps or enhance existing systems (e.g., communications, training, technology). It will support the future research, outlined by the NAS study, providing results that can be used to identify gaps in training, technology, and information. Existing research on miner self-escape is limited and related literature from other industries is of limited applicability because miner self-escape is accompanied by unique risk factors, such as remoteness, water/gas obstacles, and lack of defined landmarks (Ji, Zhang, Chen, & Wu, 2010).

Section 501 through 513 of the Federal Mine Safety & Health Act of 1977, Public Law 91-173, as amended by Public Law 95-164, authorizes this data collection. It has been included as Attachment A.

2. Purpose and Use of the Information Collection

This small scale qualitative research study is expected to enhance the ability of miners to escape from underground coal mines in the event of a fire, explosion, collapse of the mine structure, or flooding of the area by toxic gas or water. Note that it is not about rescuing the miners, it is about enhancing the ability of the miners to self-escape from the mine.

This study does not include formal hypotheses to be tested. Instead, it will address a number of questions, including:

- What tasks (and critical tasks) do miners perform during self-escape?
- What knowledge beyond that needed to perform normal, routine mining tasks do miners require to facilitate successful self-escape from each of the four emergency scenarios?
- What skills having substantial cognitive components (such as reasoning, weighing and deciding among alternatives, recognizing when a course of action is not producing the intended results) beyond that needed to perform normal, routine mining tasks do miners require to facilitate successful self-escape from each of the four emergency scenarios?
- What other cognitive abilities or other cognitive competencies do miners require to facilitate successful self-escape from each of the four emergency scenarios?
- What gaps exist between what miners are required to do for self-escape and their capabilities?
- How can self-escape be improved by redesigning, eliminating, or modifying tasks or training, or by altering or introducing specific technologies/tools?

To self escape, miners need to perform a set of tasks that apply specific knowledge and skills in moving through the mine, avoiding dangers, and using protective equipment. In some cases, using the protective equipment will prevent a miner from doing some tasks, and the miners need knowledge and skills to work around these limitations. The physical and mental requirements for successful self-escape need to be specified and compared with actual miner capabilities, and recommendations made on improving the likelihood of successful self-escape through the redesign of tasks and technologies to match miner capabilities under various

disaster scenarios. The approach is both *descriptive* (to describe how current self-escape is being currently carried out in the two representative mines) and *developmental* (to create recommendations for improving the likelihood of successful self-escape). We will collect preliminary, detailed hierarchical, and cognitive task analysis data from miners and mining experts, using structured interviews and focus group sessions. These data will include tasks and task criticality, knowledge and skills, required technology and tools, potential capability gaps, thinking processes and decisions.

From this study, investigators will collect, via an initial task analysis, information on what typically happens during a disaster, existing training capabilities, the tasks required of miners to self escape (focusing on the tasks considered most critical), the cognitive requirements and factors that affect them, and common processes and procedures in self escape. This will enable the researchers to develop a preliminary listing of tasks which will then be processed using a Hierarchical Task Analysis (HTA) to identify the most critical tasks and task sequences, relevant task conditions, and tools/equipment/technology utilized. A subsequent phase of the research will involve Cognitive Task Analysis (CTA) interviews to examine the critical tasks that depend largely on cognitive processes for successful performance. The CTA will result in process flows, identification of cues, leverage points in cognitive tasks, and key challenges. High level recommendations can then be made regarding how the self escape process can be improved by redesigning, eliminating, or modifying tasks or training, or by altering or introducing specific technologies/tools,

Data collection will occur at two coal mines (a large and a small mine) to gather information from two types of mines to better reflect the variability that exists among mines that may impact self-escape procedures and resource availability (e.g., tools/technology). Mines are required by the Code of Regulations to have certain types of equipment and procedures (e.g., refuge alternatives, escapeway maps, quarterly evacuation drills) but the actual application of those regulations may differ. By conducting this research with a large and small mine we will identify how potential differences in physical conditions (e.g., height of mine tunnels), number of miners, roles of escape team miners, type of mining process (i.e., long wall vs. room and pillar), technology and equipment (e.g., transportation vehicles, breathing apparatus), and communication systems, can affect self escape requirements. The two mines we anticipate participating in this study have different mine heights, have different number of personnel (>250 vs < 50), use different conveyance mechanisms (vehicles vs walking), different types of mining processes, and use different equipment.

This data collection will occur once over the next 2 years (after OMB approval) and is designed to gather information not previously available. These data collection instruments are not being used in any other research. The results we produce are expected to lead to recommendations for improvements to task requirements and procedures, equipment, training, and communication processes.

This data will be used by the Centers for Disease Control and Prevention (CDC), the National Institute for Occupational Safety and Health (NIOSH), and the Office of Mining Safety and Health Research (OMSHR) to improve miner self-escape. This research has been fully funded.

NIOSH serves as the neutral arbiter of science and enjoys collaborative and productive relationships with mine industry association representatives and the industry's regulatory agency. MSHA is a collaborator on NIOSH research as well as an end user on our results. NIOSH forges and maintains internal working relationships with MSHA colleagues throughout their organizational hierarchy. Those working relationships are then tapped to share preliminary findings, serve as reviewers of draft publications as well as end users of the final published results. Final results of this analysis will be public domain.

3. Use of Improved Information Technology and Burden Reduction

Automated, electronic, mechanical, or other technological collection techniques or other forms of information technology are not feasible methods for data collection for this research. Information must be gathered from individuals in an iterative fashion, by asking questions and then further clarifying the responses to reach the appropriate level of detail (e.g., unpacking a task into smaller, more detailed tasks), identify nuances (e.g., this condition (equipment failure) affects the performance of a task in a certain way while lack of visibility may not) or cues that imply a need for action or a decision (e.g., recognizing equipment failure, emergency signals).

Data collection will be through interviews and focus groups conducted in training rooms or offices. Collection will also include unobtrusive observation of miners in underground work areas or during training.

All data collection responses will be gathered by the researchers verbally or visually. Interviews and focus groups conducted outside the mine may be audio-recorded. There will be no requirement for the respondents to maintain any records pertaining to this research once the data collection is completed.

4. Efforts to Identify Duplication and Use of Similar Information

After an exhaustive review commissioned by NIOSH, the National Academy of Sciences (NRC, 2013) determined that this work has not yet been conducted for underground coal mining in the United States, leading to the following recommendation to NIOSH:

RECOMMENDATION 7: To advance self-escape training:

A. The National Institute for Occupational Safety and Health (NIOSH) should conduct or sponsor a formal task analysis and an analysis of the knowledge, skills, abilities, and other personal attributes (KSAOs) required for miners to self-escape effectively in coordination with the efforts of the responsible person, the communication center and mine management (p.117).

5. Impact on Small Businesses or Other Small Entities

Data will be gathered at two mining companies, a large mine (over 4000 employees) and a small mine (less than 500). Efforts will be made to modify the data collection schedule (e.g., interviews, focus group sessions being held at end or beginning of shift) to accommodate miners from the small mine to minimize work interruption. Information gathered at the larger mine will be used as a “starter deck” for gathering information from the smaller mine to minimize the time requirements of the smaller mine employees.

It is important to gather data from both large and small mines to better reflect the variability that exists among mines and may impact self-escape procedures and resource availability (e.g., tools/technology). While governmental requirements/standards exist for the entire industry, it is important to understand the nuances in how those requirements are carried out.

6. Consequences of Collecting the Information Less Frequently

This is a one-time data collection effort.

7. Special Circumstances Relating to the Guidelines of 5 CFR 1320.5

This request fully complies with the regulation 5 CFR 1320.5.

8. Comments in Response to the Federal Register Notice and Efforts to Consult Outside the Agency

A. A 60-day Federal Register Notice was published in the *Federal Register* on December 11,, 2014, vol. 79, No. 238, pp. 73587-73588 (see Attachment B). There were no public comments.

B. In addition to the NAS, NIOSH researchers have consulted with persons outside the CDC and are currently under contract with The Group for Organizational Effectiveness (gOE), whose subcontractors include Aptima, Inc. and a mining expert. These companies have extensive job analysis, task analysis and competency analysis experience as well as working with high risk organizations and industries. The services of an expert mining consultant have been gained to ensure that the clarity of instructions and frequency of data collection is appropriate: Dr. Christopher Bise, Professor and Robert E. Murray Chairman of Mining Engineering at West Virginia University was the initial expert but unfortunately passed away. His replacement is Dr. Thomas Novak, Professor and Alliance Coal Academic Chair, Department of Mining Engineering, University of Kentucky, 230 Mining & Mineral Resources Bldg, 504 Rose Street, Lexington, KY 40506-0107, Phone: 859-257-3818, Thomas.Novak@uky.edu. Dr. Novak has extensive experience working with mining corporations.

Since this work is part of a larger, on-going, effort, the results will be used by NIOSH researchers and shared with The Mining Safety and Health Research Advisory Committee (MSHRAC) through regularly scheduled meetings. Identified critical tasks and decision points will also be disseminated to the larger mining community through any/all of the following: NIOSH numbered publication(s), trade journal articles (e.g., Coal Age, Coal News), The Bluefield Coal

Symposium, and annual mining conferences (e.g., Training Resources Applied to Mining (TRAM), Joseph A. Holmes Safety Association, and Society for Mining, Metallurgy, and Exploration (SME))

9. Explanation of Any Payment or Gift to Respondents

There will be no payment from the researchers or the government for participation. The mines are expected to provide normal pay to their employees during the time they contribute for data collection.

10. Assurance of Confidentiality Provided to Respondents

This submission has been reviewed by CDC's Information Collection Review Office who determined that the Privacy Act does not apply. Reasons for the determination include that respondents will not provide identifying information (e.g., name or SSN), therefore no IIF will be included in the data records. A participant code number will be used when completing information, but it will not be linked with a name or other identifying information. All information provided by respondents will be maintained by researchers in a secure manner. It will not be released to third parties, except where compelled otherwise by law. The data files will be analyzed and reported in aggregate and no individual respondents will be identified.

The data collection system will consist of a multiple-method approach, in that it will include a) review of available research, b) interviews and focus group meetings with participants, and c) unobtrusive observation (e.g., of drills). During interviews and focus groups, targeted questions are asked to elicit the level and type of desired information. This system of collecting information is "active" in that participants are presented stimuli (e.g., disaster scenarios, worker roles) and asked directly to provide their perceptions (e.g., of tasks or cognitive requirements needed to accomplish self-escape in that disaster). Observation checklists have been developed to capture relevant information during the unobtrusive naturalistic observations of self-escape drills. Information gathered from initial data collection efforts will inform subsequent data collection efforts (e.g., initial interviews will provide information for later focus groups and interviews). These data are then organized, collated, and re-presented to participants for confirmation of accuracy. Recommendations are generated based on study findings, related research and practices, and logical inference. High level recommendations will focus on how self-escape can be improved by redesigning, eliminating, or modifying tasks or training, or by altering or introducing specific technologies/tools. Future research would focus on the training modalities, techniques and protocols best suited for the KSAOs and interactions between miners, rescue personnel, the communication center, and mine management. Following that, a subsequent study would review current training to identify existing gaps within the mining industry.

There will be two types of semi-structured interviews conducted with participants: 1) initial interviews, and 2) Cognitive Task Analysis (CTA) interviews. For the initial interviews, information will be gathered on what should happen during self-escape, the risk points involved, training and preparation of personnel, and suggestions for preventing/reducing risks.

CTA interviews will gather information on the cognitive processes involved in self-escape (e.g., planning, decision making, information requirements, technology).

There will be two types of focus groups conducted with participants: 1) initial focus groups, and 2) Hierarchical Task Analysis (HTA) focus groups. Initial focus groups will utilize a series of questions that will guide the initial focus group discussion (e.g., for a given emergency: what are the tasks, situation cues, information needs, equipment, communication processes). Each task will be broken down to the appropriate level. A determination of criticality of tasks will be made to inform the subsequent HTA data collection. HTA focus groups will focus on the most critical tasks and identify task requirements (e.g., the beginning/end of the task, environmental/social conditions, tools/equipment/technology), planning elements for each task, and subsequent confirmation of the accuracy of the decomposition of tasks.

Unobtrusive observations of regularly scheduled mandated emergency escape drills will be conducted at each mine site. Observation checklists have been developed to capture relevant information during the unobtrusive naturalistic observations of self-escape drills (e.g., signage, lighting/symbols, mine maps, transport, team elements, instructional displays, communication, personnel tracking, debrief).

Data will be kept secure. Risks to privacy will be minimized by not collecting participant names (we will obtain verbal informed consent). Participant code numbers will be used during interview data collection and will be assigned to all responses made by an individual participant. The codes will be used for data analysis purposes only and will not be linked with a name or other identifying information. For focus groups, because the data collection is occurring in a focus group format, researchers can only guarantee participant security on our behalf. Because individuals will be sharing comments during a group conversation, we cannot guarantee confidentiality on behalf of their peers and/or coworkers, however we do encourage participants to not share information that others provide during the discussion.

All records will be securely stored and will be destroyed no later than six years after the end of the project. Data will not be released to third parties, except where compelled otherwise by law. The data files will be analyzed and reported in aggregate and no individual respondents will be identified.

Individuals will be informed during both the recruitment process and informed consent process that providing information throughout their participation is completely voluntary. They will also be informed that they may terminate their participation at any time, without fear of negative consequences. Study researchers/facilitators will verbally read and obtain informed consent from respondents. A hardcopy of this consent form will also be provided to respondents (see Attachment C) before data collection begins. In the consent script, respondents are advised that:

- Participation is voluntary
- Any recording of information is anonymous
- Participants can designate info that they do not want recorded
- Data will be reported in aggregate form only

(in hours)							
Underground coal miners	Recruitment Script	30	1	5/60	3	\$28.11	\$84
Underground coal miners	Informed Consent	30	1	5/60	3	\$28.11	\$84
Underground coal miners	Initial Interviews	6	1	1.5	9	\$28.11	\$253
Underground coal miners	CTA interviews	12	2	2	48	\$28.11	\$ 1349
Underground coal miners	Initial focus group sessions	12	6	1	72	\$28.11	\$2024
Underground coal miners	HTA focus group sessions	12	6	1	72	\$28.11	\$2024
Totals				Burden	207	Costs	\$5818

13. Estimates of Other Total Annual Cost Burden to Respondents and Record Keepers

There will be no additional cost for record keeping because the respondents are not required to maintain records as a consequence of this research.

14. Annualized Cost to the Federal Government

The cost for externally contracted researchers to conduct the study is \$515,070 for the two year study. The cost of a federal employee to monitor the contract is typically 10% of the employee's FTE (2,080 hours worked per year * .10 = 208 hours), at an average rate of \$35 per hour. The total federal employee costs for this 3 year contract is \$35 per hour * 208 hours per year * 3 years = \$21,840. The total cost of this effort including contracted funding (\$515,070) and federal employee monitoring (\$21,480) is \$536,910 for two years. This amounts to an annualized cost of \$178,970.

15. Explanation for Program Changes or Adjustments

This is a new data collection.

16. Plans for Tabulation and Publication and Project Time Schedule

Research Activity	Date Completed
Initial Interviews	12/31/15
Initial Task Analysis Focus Group Session	2/28/16
Hierarchical Task Analysis Focus Group Session	5/30/16
Cognitive Task Analysis Interviews	10/30/16
Final Reports	7/31/17

17. Reason(s) Display of OMB Expiration Date is Inappropriate

Not requested.

18. Exceptions to Certification for Paperwork Reduction Act Submissions

There are no exceptions to the certification.