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# ESTABLISHING NUCLEAR FACILITY DRILL PROGRAMS



**U.S. Department of Energy**  
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## FOREWORD

This document provides information to DOE staff and contractors that can be used by training staffs (e.g., instructors, designers, developers and managers) and others for the development and conduct of facility drills. This document has been prepared on the basis of drill programs used at various DOE nuclear facilities. Users are not obligated to adopt any part of this document; rather, they can selectively use the information to establish or improve facility training programs as applicable. This document was based upon DOE Handbook *Establishing Nuclear Facility Drill Programs*.

Beneficial comments (recommendations, additions, and deletions) and any pertinent data that may be of use in improving this document should be addressed in the Comments Section of this forum.

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## **1. SCOPE**

### **1.1 Purpose**

*Establishing Nuclear Facility Drill Programs* provides DOE contractor organizations with guidance for development or modification of drill programs that both train on and evaluate facility training and procedures dealing with a variety of abnormal and emergency operating situations likely to occur at a facility. This document focuses on conducting drills as part of a training and qualification program (typically within a single facility), and is not intended to include responses of personnel beyond the site boundary, e.g. Local or State Emergency Management, Law Enforcement, etc. Each facility is expected to develop its own facility specific scenarios, and should not limit them to equipment failures but should include personnel injuries and other likely events.

A well-developed and consistently administered drill program can effectively provide training and evaluation of facility operating personnel in controlling abnormal and emergency operating situations. To ensure the drills are meeting their intended purpose they should have evaluation criteria for evaluating the knowledge and skills of the facility operating personnel. Training and evaluation of staff skills and knowledge such as component and system interrelationship, reasoning and judgment, team interactions, and communications can be accomplished with drills.

The appendices to this text contain both models and additional guidance for establishing drill programs at the Department's nuclear facilities. Appendix A is a template that can be used to establish contents and format of a drill scenario. Appendix B provides scenarios typical of many facilities. Appendix C describes cues and props that can be used to represent various conditions. Appendix D contains information on methods and content of typical evaluation criteria.

### **1.2 Applicability**

DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*, requires a continuing training program for certified operators and certified supervisors that includes, at a minimum, the following as related to job performance: a) annual training and examination covering abnormal facility procedures and emergencies; and b) drills conducted in the facility or on a simulator to enable facility operating personnel and operating teams to maintain their ability to respond to abnormal or accident situations. This document has direct applicability for those facilities having certified operators and supervisors. It describes several methods of developing, conducting, critiquing, and evaluating drills. Where drill programs are not specifically required by DOE Directives (e.g., facilities not subject to Order 426.2), portions of this document may be selectively implemented by a facility to improve the training and qualification of its operating personnel.

Numerous methods of conducting drills are available to a facility. There is no one set way to conduct drills, and the facility should develop drill scenarios that utilize the facility and facility operating personnel during all conditions of facility operation. DOE O426.2 also encourages the use of alternative approaches to training. Alternative methods of conducting drills that are presently being used at DOE facilities are discussed in Section 11, Alternative Methods of Conducting Drills. The information presented in this text can be applied to any method or setting chosen. Whatever the method or setting, the drill scenario should meet the needs of the facility operating personnel.

The processes described herein may also be used to develop drill scenarios that require assistance from other facilities or for site emergency drills. Specific recommendations concerning the development of these drills are not offered since DOE O 151.1C, *Comprehensive Emergency Management System*, and associate Guides contain requirements and guidance, and outline criteria for these types of drills.

## 2. SOURCE DOCUMENTS

- A. DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*, April 2010.
- B. DOE Order 151.1C, *Comprehensive Emergency Management System*, November 2005
- C. DOE-STD-1070-94, *Guidelines for Evaluation of Nuclear Facility Training Programs*, Reaffirmed June 2013.
- D. DOE G 151.1-1A, *Emergency Management Fundamentals and the Operational Emergency Base Program*; July 2007
- E. *Advanced Test Reactor (ATR) In-Plant Drill Program*, Lockheed Idaho Technologies Co., May 1994.
- F. *Facility Drills and Monitored Evolutions*, Westinghouse Savannah River Co., January 1994.
- G. *Fast Flux Test Facility (FFTF) In-Plant Drill Program*, Westinghouse Hanford Co., December 1994.
- H. *High Flux Beam Reactor (HFBR) Drill Manual*, Brookhaven National Laboratory, January 1995.
- I. *Research Reactors Division Drill Manual*, Lockheed Martin Energy Systems, December 1992.
- J. *Utilities Operations Administrative Procedure*, Westinghouse Hanford Co., February 1994.
- K. *Westinghouse GOCO Conduct of Casualty Drills*, Westinghouse Hanford Co., June 1994.

### 3. DEFINITIONS

**Cues and Props** - Information used to control the progress of the drill.

**Drill Conduct** - The control and evaluation of a drill in a fashion that will safely, fairly, and accurately allow facility operating personnel to demonstrate the adequacy of their response capabilities.

**Drill Coordinator** - A knowledgeable, experienced person, who ensures that drills are conducted safely and that all participants follow approved, established procedures. This person has the overall responsibility for safe conduct, coordination, continuity, evaluation, and critique of the drill.

**Drill Evaluator** - A person assigned to a specific drill for the purpose of evaluating, recording, and reporting the strengths and weaknesses of facility operating personnel activities and functions.

**Drill Initiation** - The event(s) that signals the beginning of a particular drill scenario.

**Drill Safety Monitor** - The person(s) whose sole responsibility is to ensure the facility is not placed in an unsafe condition. The drill safety monitor has the authority to stop the drill at any time and direct that the facility be placed in a safe condition.

**Drill Scenario** - A narrative of a hypothetical or real situation which serves as a theme or basis upon which the action of a drill is based to meet the established goals, scope, and objectives. A scenario contains adequate information (technical data) on facility operations and other conditions to allow facility operating personnel to respond as realistically as possible.

**Drill Team** - A group of people conducting, monitoring, and evaluating the drill (drill coordinator, evaluators, safety monitor, observers).

**Evaluation Criteria** - The standards the drill coordinator uses to determine when an objective has been adequately demonstrated. Evaluation criteria are developed for each drill objective.

**Initial Conditions** - Those conditions set forth in the drill scenario that must be met before the drill can be initiated.

**Objective** - Specific measurable performance objectives that are used for drills. These objectives are designed to demonstrate or test specific portions of participants' knowledge of facility operations.

**Observer** - One who is responsible for observing a drill, but who is not authorized to interact with facility operating personnel.

**Restoration** - The return of facility equipment to a desired and specified condition to permit continued operation. Identification of final facility condition following the normal completion of a drill scenario.

**Simulation** - An enactment representing a real situation. Specific events of the scenario may be simulated for practical reasons during a drill (operations of critical facility equipment, entrance into high radiation areas, etc.).

**Termination Conditions** - (1) Those conditions as described in the drill scenario, that when met, terminate the drill and restore the facility to a safe condition. (2) Those limits, established in the drill scenario, that if exceeded during the conduct of the drill require an immediate halt to the drill, and a return to a safe and stable condition.

## 4. INTRODUCTION

Proper response to abnormal conditions is vital for ensuring personnel safety and protecting facility equipment and the environment. Personnel must be able to take the immediate actions necessary to safely mitigate the consequences of an unexpected or abnormal and potentially dangerous condition. Drills focus on the actions that are necessary to respond to abnormal conditions that present a hazard to personnel, equipment, or the environment.

The primary objective of a drill program is to train and qualify personnel. Drills are an integral component for safe and efficient facility operation. To successfully achieve this goal, drill participation should be integrated into initial and continuing training. An effective drill program is one of the best means available to management for assuring that the operating staff can safely deal with unplanned, potentially hazardous situations.

The rigor and detail of a drill program will vary with facility complexity and hazard potential. For example, a drill conducted at a reactor facility may involve several people and require a high level of detail, whereas a drill conducted at a site support facility may involve only a few people and require less detail. Drills conducted on safety related systems or components at high hazard facilities may require a large drill team using a detailed drill scenario, while drills conducted on safety systems at a low hazard facility may require a drill team of only a few persons.

To ensure proper implementation of a drill program, the duties, roles, and responsibilities of personnel involved and the mechanics for conducting the drill should be delineated. This ensures consistency of development, conduct, evaluations, critiques, and feedback into the training and drill programs. Alternative methods of conducting drills should be included as an integral part of the drill program to ensure the program is meeting its intended mission of training facility operating personnel. Facility management should determine the appropriate level of effort and resources to implement each element of the drill program, consistent with the risk and complexity of the facility.

Regardless of the size, complexity, and risk of a facility, an effective drill program includes the following essential elements:

- Developed drill scenarios
- Trained drill team personnel
- Process for drill conduct

- Criteria for drill evaluation
- Drill critiques
- Incorporated feedback from drills
- Alternative methods of conducting drills

The remainder of this document addresses each of these elements.

## 5. DEVELOPING DRILL SCENARIOS

All drills should be conducted in accordance with a drill scenario approved by facility management or a group or individual(s) specifically identified by facility management to approve drills. While anyone may prepare a drill scenario, only qualified personnel should validate the scenario to determine its credibility, technical accuracy, and safety implications. When preparing a scenario, remember that a simple drill may often accomplish training objectives more effectively than a complicated one. However, the more detailed the scenario is in terms of cues and props and specific duties of evaluators and safety monitors, the lesser the chances are for a problem occurring during the drill. In any case, drills developed to be conducted in the facility should not lead to or have the potential for safety concerns.

Components that should be included in the scenario are Scope, Purpose, and Terminal Objective(s), Initial Conditions, Precautions and Limitations, Drill Team Duties, Drill Initiation, Expected Response and Evaluation Criteria, and Termination and Restoration. These are discussed below and shown in a template in Appendix A, and in example scenarios in Appendix B. Different formats are shown as examples in Appendix B.

**Scope, Purpose, and Terminal Objective** - Defines the boundaries (scope) of the drill, the reason (purpose) for running the drill (i.e., verify operators can startup the machinery with failed...), and the guidelines for evaluation of the outcome of the drill terminal objective. Generally these should be stated on the cover sheet.

**Initial Conditions** - Identifies initial conditions for the drill, i.e., the facility configuration needed to meet the objective. All organizations that could be affected by the conduct of the drill should be listed here and notified prior to drill initiation. Examples of these organizations include the fire department, safeguards and security, and facility emergency response organizations.

**Precautions and Limitations** - Lists any special safety or hazard considerations here as well as Technical Safety Requirements (TSR) for the affected systems or components. Hazards are generally identified in facility procedures, Safety Analysis Reports, special test operational requirements, etc.

**Drill Team Duties** - Includes specific instructions for each person performing drill team duties, i.e., the initiator, evaluator, safety monitor, cue and prop handler, etc. Each drill team member should be listed by name so there is no confusion as to who has what drill function. The drill safety monitor should not allow facility operating personnel to take any actions that would adversely affect safety or cause equipment damage. No other responsibilities should be assigned to this

person. Directions should emphasize that anyone knowing of an unsafe condition should terminate the drill. Details for any special actions or activities if required, such as intervention points (i.e., if an action is to be simulated rather than performed). Intervention points should be adequately described so the evaluator, safety monitor, or other individual monitoring can adequately control the situation.

**Drill Initiation** - Describes how to initiate the drill (e.g., the event being performed to cause the facility operating personnel to suspect a problem). The drill initiation event should be very specific.

**Expected Response/Evaluation Criteria** - Describes the expected response and the evaluation criteria for all personnel actions. Typically, the expected response is already identified in a procedure. But, it is generally insufficient to just list the procedure. Include the details in this section so they may be properly evaluated. Details will also ensure that the safety monitor has a better chance of acting on a problem before damage occurs. Communications that are expected should also be listed so they may be evaluated. If any action or communication needs more evaluation criteria than the procedure describes, it should be included here. If there are a number of ways to accomplish a given task, the expected response should be the normally accepted method. If any other safe response is allowed, it should be stated here. Criteria for evaluating personnel actions should be listed in this section of the drill scenario. More information on the methods of listing the evaluation criteria is contained in Section 8, Criteria for Drill Evaluation and Appendix D, Evaluation Criteria.

**Termination and Restoration** -

**Termination** 1) States the event(s) that indicate when the drill should be concluded. The facility condition(s) that ensures all required and expected actions have been completed and the facility can continue to operate or be shutdown safely should be identified.  
2) States the event(s) that would cause an immediate termination of the drill due to a safety problem, TSR violation, or other problem, and would require immediate actions to place the facility in a safe condition.

**Restoration** Identifies any systems, components, or equipment that must be reset to normal operating status at the conclusion of the drill. This section could also be used as a verification section to ensure the reset of these items. It should include a mechanism to ensure restoration of the cues and props used in the drill.

## 6. TRAINING AND SELECTION OF DRILL TEAM

Prior to conducting a drill, the drill team members should be assembled and trained in the duties, responsibilities, and activities of their respective positions in the conduct of the drill. Drill team training does not necessarily mean formal training. The training may be accomplished during the pre-drill briefing. Each drill team member's duties should be individually addressed during the pre-drill briefing.

Evaluators and safety monitors should have a level of knowledge of the facility that is sufficient for their drill team duties. Persons providing cues and props should be trained in their application and interpretation as they apply to specific drill scenarios. They should also be knowledgeable of facility equipment locations, operating characteristics, other facility requirements, and consequences of improperly interpreted cues and props.

The drill coordinator should be designated by facility management. The drill coordinator should be qualified on the facility, system, or equipment specified in the drill scenario, and may be a member of the operating staff or the training organization. The drill coordinator is responsible for the briefing, conduct, and critique of the drill. The duties and responsibilities of the drill coordinator include:

- Developing and preparing the exercise package
- Obtaining necessary approvals for conducting the drill prior to conduct
- Ensuring completion of pre-drill notifications
- Verifying the qualifications of drill team personnel and that assignments match their qualifications
- Ensuring that drill team members are properly identified (e.g., arm bands, name tags)
- Verifying facility status and initial conditions prior to conducting the drill
- Supervising coordination and conduct of the drill
- Terminating scenario at the completion of the drill
- Terminating the drill if limits specified in the drill scenario are exceeded, or if actions taken by facility operating personnel affect safety of personnel or cause damage to equipment or the environment
- Ensuring the post-drill restoration and removal of simulations
- Ensuring that any post-drill notifications have been made
- Conducting a critique (verbal and written) with all personnel involved
- Completing drill documentation and filing appropriately

## **7. CONDUCTING DRILLS**

When conducting drills the process should always be the same. The reason a set process should be followed is to minimize risking injury to personnel, or damage to equipment or the environment. A part of the drill process is contacting outside organizations such as the fire department, safeguards and security, and emergency response units. They should be notified when drills are to commence, and to respond or not to respond as required by the drill scenario. Included in the notification of these organizations should be how they will be notified in the event of an actual facility abnormal condition. Conduct of drills includes the pre-drill briefing, drill initiation, and drill performance.

### **7.1 Pre-Drill Briefing**

The drill coordinator should hold a pre-drill briefing with the selected drill evaluators, safety monitors, observers, and visitors to discuss each person's role, past problems encountered, and any safety considerations. The drill coordinator should discuss each section of the scenario, including specific instructions concerning intervention points, and answer any questions team members may have. The drill coordinator should also discuss how drill termination will be identified for both normal and abnormal conditions and how the facility will be restored.

### **7.2 Drill Initiation**

The drill should be initiated by either the drill coordinator or by a drill team member in accordance with the drill scenario. Drill initiation can be coordinated by either time or event. The exact actions for the drill initiation should be identified. An example of an exact action is "Open breaker DC-34-BAC located in electrical panel DC-03-4. An alarm will immediately sound on the auxiliary pump control board indicating the loss of #3 pump control circuit." If an announcement is to be made that initiates the drill, the wording should be stated in the drill initiation section of the drill scenario and include the words "This is a drill."

### **7.3 Drill Performance**

After the drill initiation is performed, facility operating personnel actions should be as described in appropriate facility procedures. Every activity and response action should be carried out exactly, to the maximum extent possible, as it would be if the event were real. If alternative actions are allowed, they should be listed here.

Cues and props are used by the drill team to improve realism. They are used to simulate the circumstances of an actual abnormal facility condition. Examples of such may include simulated gauge readings, alarms, announcements, a fire, leaking water,

breaker positions, etc. Simulations may be in the forms of placards, stick-ons, made-up gauge faces, verbal commands, etc. Appendix C, Example Drill Cues and Props, contains examples of methods used to improve the realism and conduct of the drill. Drill team members should not lead facility operating personnel to the correct response action. This is especially true when facility operating personnel ask for clarification of a cue, prop, or action.

During the drill, evaluators document all activities on evaluation forms that are based on criteria found in the drill scenario. Each drill scenario should specify the areas of evaluation so that all actions required by facility operating personnel can be observed and evaluated. The evaluation forms are used to identify both individual and team performance strengths and weaknesses of facility operating personnel. They provide documentation of performance as part of training, identify problems with the conduct of the drill scenario, and aid in conducting the drill critique.

The drill scenario should be allowed to run to completion if possible. A normal termination would end the drill due to completion of the stated objective, or as determined by the drill coordinator. An abnormal termination would end the drill when a limit specified in the drill scenario, facility procedures, or TSRs is exceeded, or when actions taken by facility operating personnel would adversely affect the safety of personnel or cause damage to equipment or the environment. For abnormal terminations, facility operating personnel should immediately take all appropriate actions to place the facility in a safe condition. The facility should be restored to the condition specified in the drill scenario in accordance with approved facility procedures. Cues and props that were used in the conduct of the scenario should be removed from their location immediately. A checklist in the restoration section of the scenario is helpful in ensuring none of the cues or props are forgotten.

## 8. CRITERIA FOR DRILL EVALUATION

Evaluation is as important to the drill as planning or conducting it. The more thorough the evaluation process, the greater its benefit in the form of useful lessons learned. Evaluation serves two functions. It provides for evaluation of the personnel actions and for overall evaluation of the drill with respect to meeting the needs identified in the scope, purpose, and objective(s).

Evaluation criteria should be part of the required response/evaluation criteria section of the drill scenario. Regardless of whether the drill is conducted by the typical method of in-plant perform or by use of an alternative method (e.g., table-top), the evaluation criteria should take into account the setting. If the criteria is already developed for the in-plant setting and the scenario will be run in the table-top setting, the existing evaluation criteria should be verified satisfactory or the evaluation criteria should be revised to fit the setting.

Performance factors for which evaluation criteria should be developed are as follows:

- Component and system interrelationships - understanding the operating characteristics of each system and its major components, the relationships between systems, and how events in one system affect interfacing systems
- Reasoning and judgment - ability to apply knowledge of facility systems, components, procedures, and requirements to normal, abnormal, and accident situations
- Team interactions - ability of individual crew/team members to work effectively in controlling plant/facility operations and events
- Communications - ability to convey information accurately and effectively

Evaluation forms/documentation should be as straightforward as possible. A simple form with brief instructions and space to list identified strength and weaknesses works well, as does criteria listed alongside the action being observed. A checklist can be used for the evaluator to rate various activities. The forms should contain space for listing the criteria, the time the event occurred, the person or job position being observed, and the grade assigned to the action performance. Regardless of the format or method chosen, the evaluation should match the objective descriptions. This ensures the actions being observed and the drill are being evaluated consistently to the same criteria. When the objective descriptions have been developed they should be used consistently throughout the drill program. Appendix D contains several example formats of evaluation criteria.

## **9. CRITIQUING DRILLS**

Immediately following the drill, the drill coordinator should hold a critique to formally conclude the drill. The critique should be documented on facility forms specifically designed for this purpose. In cases where the drill is a requirement for qualification, the critique should be filed as part of the participant's training record.

A drill critique is not necessarily a chronology of the events of a drill. It is an analysis of what went right and any shortcomings with facility operating personnel actions, the drill scenario, facility equipment, cues and props, drill evaluators, safety monitors, etc. The critique should include an analysis of expected versus actual facility operating personnel actions, a review of scenario events, and identification of shortcomings in the scenario or drill conduct. The drill team should meet, discuss their evaluation notes, discuss the actions taken by facility operating personnel, and discuss the drill performance. A good practice is to have the participants evaluate themselves first, then have the drill team add in anything missed. The drill coordinator should make a determination of whether the drill objective was met or not, and also list the personnel and the positions on which they were evaluated or trained on the critique form.

Notes should be kept for referral the next time the same drill is conducted. Lessons learned should be generated, distributed to all appropriate facility operating personnel to ensure that maximum training value is gained, and filed for future reference. Deficiencies in training, equipment, procedures, etc., identified in the critique should be documented and corrected.

## 10. INCORPORATING FEEDBACK FROM DRILLS

A mechanism should be in place to upgrade the drill program, and individual weaknesses identified during the conduct of drills. A new feedback program is not needed if an existing facility feedback process is already in place.

If the critique results indicate that the facility operating personnel could not control the situation presented in the drill scenario, a determination should be made of whether the problem was due to a lack of training, inadequate procedures, drill scenario problems, etc. If training is the problem, the facility training program should be upgraded. Immediate training needs should be identified and included in to the continuing training program. The initial training program should also be modified to include the information identified on training deficiencies. Good practices should be identified and factored into initial and continuing training programs. As appropriate, personnel deficiencies should be corrected by remediation and/or retraining. All completed remediation or retraining should be documented and filed in the person's training record.

Problems encountered with any portion of the drill scenario should be identified in the drill critique. These problems should be corrected before the drill scenario is conducted again. For example, items that may be considered include:

- Improving identification of initial conditions or initiation methods for the drill
- Using more or fewer personnel to run the drill
- Dealing with unexpected problems encountered during the conduct of the drill (i.e., the drill scenario or facility conditions)
- Correcting communications problems
- Replacing inaccurate or inappropriate cues or props
- Equipment malfunctions

## **11. CONDUCTING DRILLS BY ALTERNATIVE METHODS**

A facility is not limited in the method used to conduct drills. The preferred method of conducting drills is to perform them during normal facility operations and with actual facility equipment. However, if facility conditions will not allow performance of a drill, alternative methods may be necessary. Alternative methods include table-top discussions, facility walkthroughs, simulator exercises (if available), and/or use of mock-ups.

Realism is more difficult to create during facility simulations or table-top discussions than during in-plant drills. Therefore, during simulations or table-top discussions personnel being evaluated should describe their activities and actions. Their descriptions will provide the prompts for the drill team members to supply cues and props. Careful coordination of cues and props by drill team members, with the descriptions of activities supplied by the facility operating personnel, can ensure that facility operating personnel receive valuable training without direct interaction with the facility. During conduct types of drills using alternative techniques, the drill team members should be careful not to lead the facility operating personnel to the correct response action.

During in-plant simulations or table-top discussions, the initiation will have to be stated or supplied by a cue or prop. Since cues or props cannot be heard, the drill team will have to ensure that cues and props are seen by the facility operating personnel. All materials that facility operating personnel would normally have available to them in the facility should also be available to them when conducting a table-top discussion if practical.