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**DEFENSE NUCLEAR FACILITIES  
SAFETY BOARD**

Washington, DC 20004-2901



November 24, 2015

The Honorable Ernest J. Moniz  
Secretary of Energy  
U.S. Department of Energy  
1000 Independence Avenue, SW  
Washington, DC 20585-1000

Dear Secretary Moniz:

On November 23, 2015, the Defense Nuclear Facilities Safety Board (Board), in accordance with 42 U.S.C. § 2286d(a)(1), approved Recommendation 2015-1, *Emergency Preparedness and Response at the Pantex Plant*, which is enclosed for your consideration along with all related findings, supporting data, and analysis. As you will recall, the Board transmitted Recommendation 2014-1, *Emergency Preparedness and Response*, to you on September 3, 2014, regarding the need for the Department of Energy (DOE) to take actions to improve the emergency preparedness and response capability at defense nuclear facilities. Recommendation 2015-1 identifies the need to address specific deficiencies with, and strengthen regulatory compliance of, the emergency preparedness and response capability at the National Nuclear Security Administration's Pantex Plant that require timely resolution.

After you have received this Recommendation, and as required by 42 U.S.C. § 2286d(b), the Board will promptly make the Recommendation and any related Secretarial correspondence available to the public. The Board believes that this Recommendation contains no information that is classified or otherwise restricted. To the extent that this Recommendation does not include information restricted by DOE under the Atomic Energy Act of 1954, as amended, please arrange to have it and any related Secretarial correspondence placed promptly on file in your regional public reading rooms. The Board will also publish this Recommendation in the Federal Register.

The Board will evaluate DOE's response to this Recommendation in accordance with the Board's Policy Statement 1, *Criteria for Judging the Adequacy of DOE Responses and Implementation Plans for Board Recommendations*.

Sincerely,

  
Joyce L. Connery  
Chairman

Enclosures

c: Mr. Joe Olencz

**RECOMMENDATION 2015-1 TO THE SECRETARY OF ENERGY**  
***Emergency Preparedness and Response at the Pantex Plant***  
**Pursuant to 42 U.S.C. § 2286a(b)(5)**  
**Atomic Energy Act of 1954, as Amended**

**Dated: November 23, 2015**

The Defense Nuclear Facilities Safety Board (Board) recommends that deficiencies identified with the implementation of existing requirements in Department of Energy (DOE) Order 151.1C, *Comprehensive Emergency Management System*, be corrected at the Pantex Plant to ensure adequate protection of workers and the public. During a series of interactions,<sup>1</sup> we identified three areas of concern regarding the site's emergency preparedness and response capability. Pantex Plant personnel took action in response to some of the concerns identified, but significant concerns still exist. We conclude that each area of concern by itself has the potential to threaten the adequate protection of the public health and safety in the event of an operational emergency. Those areas of concern are (1) inadequate drill and exercise programs, (2) no demonstrated capability to provide timely, accurate information to the public regarding off-site radiological consequences, and (3) inadequate technical planning bases and decision-making tools. We believe that DOE and the National Nuclear Security Administration (NNSA) must address these concerns in order to ensure the adequate protection of the public and the workers at the Pantex Plant.

The Board communicated its concerns with emergency preparedness and response across the DOE complex in its Recommendation 2014-1, *Emergency Preparedness and Response*. The issues identified in this report are specific to the Pantex Plant and concern the NNSA Production Office (NPO) and contractor's<sup>2</sup> inadequate implementation of existing DOE requirements.

**Background: Emergency Preparedness and Response Capability.** Personnel at the Pantex Plant conduct work vital to our national defense. Due to the nature of the operations and the spectrum of materials in use at the site, the range of possible accidents varies widely. Working with high explosives, hazardous chemicals, and radioactive materials results in the potential for operational emergencies ranging from industrial process-related accidents to significant material releases due to energetic events. The site is also subject to a range of natural phenomena hazards; tornados, high winds, lightning strikes, rain-induced flooding, and earthquakes are all possible in the region. Of particular concern to us are those accident scenarios that may cause radioactive material to be dispersed and deposited off site. Given the short distance from some facilities to the site perimeter and the average wind speeds at the site, these materials may affect public lands in the emergency planning zone within a short period of time.

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<sup>1</sup> Interactions included the Board's March 2013 public meeting and hearing in Amarillo, TX, two Board technical staff reviews in October 2012 and December 2014, and exercise observations in January and August 2014 and February 2015.

<sup>2</sup> Consolidated Nuclear Security, LLC, became the management and operating contractor in July 2014. The previous contractor was Babcock & Wilcox Technical Services Pantex.

**Board Finding: Drill and Exercise Programs.** Based on our observations, we conclude that the Pantex Plant contractor has not demonstrated adequate capabilities through its drill and exercise programs. The Pantex Plant contractor's execution of emergency drills and exercises is insufficient to provide opportunities for all personnel to develop and demonstrate proficiency at emergency response. No site-wide exercises conducted since 2011 have simulated any significant radiological consequences. No site-wide exercise was conducted in 2013 (although a hurriedly executed, unchallenging small-scale scenario in January 2014 purportedly fulfilled the 2013 site-wide exercise requirement). The Board also observed that both NPO and contractor capabilities to assess site performance in drills and exercises are inadequate, and believes this limits the effectiveness of the existing programs. A robust drill and exercise program would be varied enough to address all response elements across the spectrum of hazards and facilities over time.

**Board Finding: Timely, Accurate Information to the Public Regarding Off-Site Radiological Consequences.** Our review found no demonstrated capability to provide timely, accurate information to the public regarding off-site radiological consequences. State radiological monitoring response teams are located in Austin, TX, and must travel nearly 500 miles before they are available to monitor affected areas.<sup>3</sup> The Pantex Plant emergency response organization develops and provides models of radioactive material releases to state and county officials, but no verification of these models with real-world measurements is performed until state radiological monitoring response teams arrive.<sup>4</sup> Pantex Plant contractor assets may be released at the plant's discretion in accordance with existing memoranda of understanding and agreement between the site and the counties/state. However, we found no instance in the last five years where the contractor exercised off-site monitoring. Finally, we note that while existing DOE requirements establish a thirty minute threshold for off-site notification, the proximity of some Pantex Plant facilities to the plant boundary is such that material could contaminate off-site locations in a shorter time period.

**Board Finding: Technical Planning Basis and Decision-Making Tools.** The Board reviewed the technical planning bases and decision-making tools for the Pantex Plant's emergency management program and found that they are inadequate to demonstrate protection from time-sensitive events and do not consider all hazards at the site. Decision-making tools<sup>5</sup> lack significant details and include built-in delays that hinder effective execution. While the existing decision-making tools, such as emergency action levels (EALs), may minimize the risk

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<sup>3</sup> The DOE Radiological Assistance Program (RAP) is a national emergency response asset that provides around-the-clock first-response capability to assess radiological emergencies, and has a team stationed in Amarillo, TX. This team may not be consistently available due to competing priorities and may not have sufficient local resources to support a response outside the Pantex Plant. DOE has not incorporated the RAP into the Pantex Plant's existing exercise program, leaving to question the capability of the RAP resources to provide off-site support. Additionally, there is potential that the RAP team could be deployed elsewhere at the time of an incident, precluding the use of that resource.

<sup>4</sup> The dispatch of state radiological monitoring response assets may also be delayed due to the issues identified with the Pantex Plan decision-making tools.

<sup>5</sup> Decision-making tools currently available exist to aide operators and first responders with a quick determination of the likely magnitude of accident consequences, communicate protective actions to workers, and ensure protective action recommendations are delivered to public decision-makers in a timely manner.

of false alarms, their design precludes providing timely, accurate, and conservative recommendations to the public.

**Conclusion.** The mission of the Pantex Plant is vital to our nation's defense, and the consequences of a significant accident would be difficult to overcome. A robust, comprehensive, tested, and sustainable emergency preparedness and response capability is vital to ensure the adequate protection of the public health and safety during operational emergencies. Specifically, deficiencies must be addressed in the drill and exercise programs, in demonstrating the capability to provide timely, accurate information to the public regarding off-site radiological consequences, and in the technical planning bases and decision-making tools.

**Recommendations.** To address the deficiencies summarized above, the Board recommends that DOE and NNSA take the following actions at the Pantex Plant:

1. Ensure the Pantex Plant drill and exercise programs comprehensively demonstrate proficiency in responding to emergencies for all hazards, all facilities, and all responders, consistent with the technical planning bases and any updates to them, over a five-year period in accordance with DOE Order 151.1C (or subsequent revisions). As part of this demonstration of proficiency:
  - a. Develop and institute a basis for conducting the drill program in support of emergency operations.
  - b. Strengthen the exercise program to provide an adequate number of challenging scenarios per year, including at least one full-scale, site-wide exercise, in order to maintain qualifications and ensure proficiency of the emergency response organization and first responders.
  - c. Conduct a comprehensive assessment of the drill and exercise programs bases, schedule, and execution against a risk-ranked set of:
    - i. All hazards;
    - ii. All facilities; and
    - iii. All response elements.
  - d. Evaluate and improve the effectiveness of the NPO and contractor processes used to critique drills and exercises.
2. Develop and implement processes and demonstrate the capabilities to:
  - a. Ensure the timeliness and accuracy of notifications to state and local authorities is commensurate with the initiation of off-site release of radioactive material at the Pantex Plant.
  - b. Provide consistent radiological monitoring support if an accident releases radiological material off-site, until state resources arrive and can assume responsibility for off-site monitoring.

3. Evaluate, incorporate, and validate (correctness, completeness, and effectiveness), the following changes to the Pantex Plant decision-making tools and notification processes:
  - a. Evaluate the emergency action level (EAL) process for those accident scenarios identifiable solely via instrumented systems to reduce delays in determining and implementing protective actions.
  - b. For those accident scenarios that are not identifiable solely via instrumented systems, evaluate the range of emergency conditions and potential indicators, and identify where new monitoring systems can be added or existing administrative controls can be modified to improve timeliness of response.
  - c. For all scenarios, evaluate if some protective actions should be initiated based solely on initial indicators (i.e., a precautionary evacuation) while confirmatory indicators are sought.
  - d. Upon completion of these evaluations, incorporate new guidance and training for any changes made to the EAL decision-making tools and notification processes into the drill and exercise program.

  
Joyce L. Connery, Chairman

**RECOMMENDATION 2015-1 TO THE SECRETARY OF ENERGY**  
*Emergency Preparedness and Response at the Pantex Plant*

**Findings, Supporting Data, and Analysis**

**Introduction.** During the past three years, members of the Defense Nuclear Facilities Safety Board's (Board) staff conducted several activities to gain and maintain awareness of the state of emergency preparedness and response at the Pantex Plant. In October 2012, the staff team conducted a wide-scope program review supporting preparations for the Board's March 2013 public meeting and hearing in Amarillo, TX. After the public meeting and hearing, members of the Board's staff interacted with the National Nuclear Security Administration (NNSA) Production Office (NPO) and the contractor<sup>1</sup> to address supplemental questions and clarify statements made during the hearing. In 2014, members of the Board's staff observed two site-wide emergency response exercises. In December 2014, the Board's staff team conducted another program review to examine specific aspects of the Pantex Plant emergency management program. The Board's staff team observed the execution of certain emergency management program elements during a site-wide emergency response exercise conducted in February 2015. In addition, the Board's Site Representative at Pantex, who is stationed there on a full-time basis, made observations regarding the emergency preparedness and response capability of the Pantex Plant as part of his routine oversight of the Pantex Plant facilities and operations.

During each of these activities, the Board's staff team provided on-site feedback to NPO and the contractor, and culminated this exchange with a formal teleconference close-out brief on March 17, 2015. Pantex Plant personnel took action in response to some of the concerns identified during the activities noted above, but significant concerns still exist. The following section expands on observations provided to the Pantex Plant during the March 2015 teleconference and provides the technical basis for further Board action.

**Observations.** The Board's staff team's observations are organized into three main sections: the drill and exercise programs, notification and support to off-site agencies, and technical planning bases and decision-making tools.<sup>2</sup>

*Drill and Exercise Programs*—Based on its observations, the Board's staff team concludes that the Pantex Plant contractor has not demonstrated adequate capabilities through its drill and exercise programs. The Board's staff team found that the Pantex Plant emergency drill and exercise programs do not provide sufficient opportunities for personnel to develop and demonstrate proficiency at emergency response with respect to all response elements across the spectrum of hazards and facilities. The drill program does not act as part of a comprehensive training and qualification program, but during the last few years has mainly supported preparation for the site's annual exercises.

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<sup>1</sup> Consolidated Nuclear Security, LLC, became the management and operating contractor in July 2014. The previous contractor was Babcock & Wilcox Technical Services Pantex.

<sup>2</sup> The focus of the Board's staff reviews was not comprehensive in all elements of the emergency management program. Additional problems may exist in other elements of the program, such as federal oversight and the quality of the site's agreements with off-site stakeholders.

Department of Energy (DOE) Order 151.1C *Comprehensive Emergency Management Program* [1] outlines several requirements for drill and exercise programs. Specifically, Section 4.b (Exercises) states:

- A formal exercise program must be established to validate all elements of the emergency management program over a five-year period.
- Each exercise must have specific objectives and must be fully documented (e.g., by scenario packages that include objectives, scope, timelines, injects, controller instructions, and evaluation criteria).
- Exercises must be evaluated.
- A critique process, which includes gathering and documenting observations of the participants, must be established.
- Corrective action items identified as a result of the critique process must be incorporated into the emergency management program.

Additionally, specified facility-level requirements include:

- Each DOE/NNSA facility subject to this chapter must exercise its emergency response capability annually and include at least facility-level evaluation and critique.
- DOE evaluations of annual facility exercises (e.g., by Cognizant Field Element, Program Secretarial Officer, or Headquarters Office of Security and Safety Performance Assurance) must be performed periodically so that each facility has an external DOE evaluation at least every three years.
- Site-level emergency response organization elements and resources must participate in a minimum of one exercise annually. This site exercise must be designed to test and demonstrate the site's integrated emergency response capability. For multiple facility sites, the basis for the exercise must be rotated among facilities.

Scope of Exercise Scenarios: Based on observing implementation across DOE's sites, the Board's staff team summarized these requirements as the need to exercise *all facilities, all hazards, and all response elements*. The following sections describe the Board's staff team's observations of the Pantex Plant's implementation of drill and exercise requirements.

For the five-year period (2011–2015) reviewed by the Board's staff team, the following scenarios represent the totality of Pantex Plant's site-wide exercises:

- 2011: Explosion in a nuclear explosive facility with no contamination outside the facility.

- 2012: Seismic event leading to building damage (no radiological or hazardous material release).
- 2014a: Liquid nitrogen release from a truck accident (make-up for no exercise in 2013).
- 2014b: Severe event (tornado) table-top.
- 2015a: Severe event (seismic) with a transportation accident, wildfire, and mass casualty (no radiological or hazardous material release).
- 2015b: Security event with hazardous material release.

The Board’s staff team reviewed documentation that showed some facilities at the Pantex Plant did not hold an evaluated activity to demonstrate response capability, regardless of whether the activity was a site-wide exercise, limited scope exercise, or other form of evaluation.<sup>3</sup> The plant’s analysis of the hazards for emergency preparedness and response is organized into a single emergency planning hazards analysis (EPHA), effectively identifying the plant as one facility when in reality there are numerous facilities with diverse hazards. This organizational structure contributes to the limited number of evaluated exercises at the Pantex Plant. Pantex is currently undertaking an effort to reevaluate the organization of the EPHA (i.e., dividing the single EPHA into multiple EPHAs). The Board’s staff team received conceptual information about this effort and will continue to review any proposed changes to the organization of the Pantex EPHA, since such a change may provide a formal basis for additional facility exercises.

The Pantex Plant has a range of hazards that may challenge emergency responders and decision-makers. Natural phenomena such as tornados, fires, lightning strikes, and rain-induced flooding exist alongside operational activities involving hazardous and radiological materials. The Board’s staff team observed, directly and by document review, the range of exercise scenarios being conducted and found them to be too limited compared to the range of hazards at the plant. Often these scenarios were simplistic and not sufficiently challenging to truly demonstrate response capability for the hazard being exercised. DOE Guide 151.1-3, *Programmatic Elements*, Section 3.0 “Exercises” [2] provides a method of scheduling exercises to ensure coverage of all hazards at a site over a five-year period. However, it is the opinion of the Board’s staff team that hazards with a higher frequency of occurrence, significance of consequences, or complexity of emergency response may need to be exercised more frequently than other hazards. Exercise scenarios from the past three years included a nitrogen spill, a

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<sup>3</sup> The Pantex Plant is a collection of buildings of various designs that house a variety of activities and operations that occur at the plant. There are bays and cells, which come in several variations and can be standalone or collocated, in which assembly and disassembly of nuclear explosive assemblies is conducted. There are buildings in which non-nuclear operations, such as explosive operations, are conducted. There is a variety of storage areas including storage of nuclear materials, nuclear explosive assemblies, explosives, and other hazardous materials. There are also various transportation activities within operational areas and across the site. For the purposes of exercises, various areas or types of operations could be grouped as representing different types of *facilities*. In the context of the layout of facilities at the Pantex Plant, the Board’s staff team believes that it would be appropriate to conduct some type of exercise or other form of evaluation for each representative type of activity and operation.

primarily table-top tornado event, and a simulated earthquake with no radiological material impact.

The potential for more significant consequences and complicated responses exists at the Pantex Plant's facilities. For example, a high explosive violent reaction has the potential to release radioactive material both on site, outside of the nuclear explosive facility (i.e., a bay), as well as off site. Fires in areas containing radioactive material have the potential to drive more significant radiological response actions by plant personnel. It is the opinion of the Board's staff team that the Pantex Plant should more frequently exercise challenging radiological responses.

The Pantex Plant has not consistently exercised all response elements between 2011 and 2015, which is insufficient to meet DOE requirements. There does not appear to be a deliberate approach to demonstrating integrated emergency response capability. For example, the August 2014 exercise [3] relied on to meet the annually required site-wide demonstration of proficiency, postulated a tornado affecting the site. This was the plant's first significant effort at exercising a severe event, but was also credited as the annual site-wide exercise. The Board's staff team observed that few field participants demonstrated their response capabilities. While this was a valuable training and planning activity for a severe event, this exercise was the sole site-wide event for that time period. The Board's staff team believes that it is appropriate to exercise a more complete array of site response elements, not just fire and rescue responders, demonstrating their proficiency. The 2013 exercise (conducted in January 2014) and the February 2015 exercise also did not involve significant field participation other than fire and rescue services. Within the last five years, Pantex has not completed a full participation exercise (i.e., all on-site employees participating through protective actions and response); site-wide exercises have only included participation from a small subset of the plant population.

Training and Qualification of Emergency Responders: The limited number and scope of exercises conducted each year also affects the training, qualification, and proficiency of emergency responders. The Pantex Plant's emergency response organization is made up of three shifts of responders on a rotating watch bill. It is unclear to the Board's staff team how the site can demonstrate proficiency and support training and qualification across all responders when an insufficient number of facility and site-wide exercises are being scheduled to support a three-shift emergency response organization. The Pantex Plant training, drill, and exercise program plan authorizes participation in a limited-scope evaluated activity (e.g., functional exercises or limited scope performance demonstrations) to maintain qualification within the emergency response organization [4]. Pantex Plant exercise after action reports document repeated emergency response organization shortcomings during site-wide exercises,<sup>4</sup> and demonstrate that these limited-scope opportunities are not sufficiently rigorous to qualify and maintain proficiency of personnel at emergency operations.

Exercise Assessment: The Board's staff team believes that the Pantex Plant's development and assessment of exercise objectives contributes to the continuing limited effectiveness of the emergency exercise program. The staff team assessed the exercise

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<sup>4</sup> The Board's staff team observed the past three site-wide exercises and also noted poor performance by the emergency response organization.

objectives and does not consider them to be effective tools for identifying problems that can be analyzed and corrected.

First, the objectives reviewed by the staff team were not always adequate to evaluate the effectiveness of actions taken by responders. For example, objectives do not always differentiate between taking an action and taking the right action in a timely fashion. The February 2015 exercise evaluation guide for the Plant Shift Superintendents (PSS) [5] included four criteria to evaluate the PSS’s objective of implementing protective actions (see Figure 1); the criteria do not address whether protective actions are implemented in time to be effective and whether the corrective protective actions are correct for the event.

<b>Pan-PSS.4</b>		<b>Given an Operational Emergency, implement time urgent Protective Actions in accordance with MNL 352187, <i>Operational Emergency Manual</i>.</b>
<b>Evaluator Checklist:</b>		
Check appropriate box:		
Yes: Successfully demonstrated the action.		
No: Did not successfully demonstrate or did not do the action		
N/A: Not applicable for this exercise		
N/O: Did not observe the action		
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> N/O	Were protective actions listed on the Emergency Action Level guide sheet? [P/E12.2, P/E12.3, P/E12.5, P/E12.6]	
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> N/O	What protective action (s) was implemented:	
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> N/O	Did the Pantex Plant Shift Superintendent communicate protective actions using the Public Address System, Pantex Communicator System and/or radio, and/or telephone?	
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> N/O	Did the Plant Shift Superintendent coordinate with the Incident Command or Central Alarm Station on the evacuation routes for evacuees? If applicable?	

**Figure 1. Emergency Management Exercise 2015-1 PSS Exercise Objective (PAN-PSS.4)**

Another example of an objective from the February 2015 exercise that the staff team believes was not adequate involved processing information (see Figure 2). This objective evaluates the collection of information by the PSS, but does not evaluate communication of this information to responders. The PSS received information about trapped victims involved in an on-site transportation accident event involving a passenger vehicle and a material transporter, but did not verify that the Incident Commander took the correct response. In fact, the Incident Commander was not notified that the on-site transportation accident had occurred, and no action was taken for almost an hour, at which point the Fire Department responded. During the controller/evaluator after action critique, the objective was evaluated as “Met” based on the fact that the PSS received the information; although the controller/evaluator did note in the After Action Report that “No communication with the Incident Commander was observed” [6]. This objective did not require the controller/evaluator to adequately consider the quality of the action taken upon receipt of the information.

Pan-PSS.2      Given an event, collect event information in accordance with MNL 352187, <i>Operational Emergency Manual</i> , or MNL 352190, <i>Operations Center Manual</i> .	
<b>Evaluator Checklist:</b> Check appropriate box: Yes:      Successfully demonstrated the action. No:        Did not successfully demonstrate or did not do the action N/A:      Not applicable for this exercise N/O:      Did not observe the action	
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> N/O	Did the Pantex Plant Shift Superintendent receive and accurately document all relevant extension 5000 incoming calls?
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> N/O	Did the Pantex Plant Shift Superintendent recognize audible alerts/alarms in the Operations Center?  If so, what are the audible alerts/ alarm that came in?
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/> N/O	Did the Pantex Plant Shift Superintendent receive and document the Incident Command initial assessment (from ESDC, if applicable)?  If so, where is the Incident Command set up?  Was secondary staging established? If so, where?

**Figure 2. Emergency Management Exercise 2015-1 PSS Exercise Objective (PAN-PSS.2)**

Second, if all objectives are weighted equally, the importance of certain actions over others cannot be distinguished. The Pantex Plant is undertaking an effort to change the grading scheme for emergency exercises to focus only on objective-by-objective performance and not incorporate any objective and criterion weighting or overall grade scheme. In the objective shown in Figure 1, selecting the correct protective action is a single criterion,<sup>5</sup> which could be missed. Yet if all other criteria are completed, the objective may still be met. The overall objective—to implement time-urgent protective actions—seems to be more valuable to an effective response than objectives that simply measure adherence to administrative procedures. It is the opinion of the Board’s staff team that, without some indication of an objective’s overall importance, the plant is likely to have difficulty interpreting the exercise results and will be challenged to prioritize and apply resources to those response elements that require additional attention and to address corrective actions.

Last, the Pantex Plant could meet all of its exercise objectives but still fundamentally fail to protect the workers and public. The February 2015 exercise is an example. During the participant hot wash and controller/evaluator after-action critique, most objectives were determined to be “Met.” Yet, on-site first responders were potentially exposed to an off-site chemical hazard. This was not considered an objective and, therefore, did not influence the positive perception of the exercise results by the participants, controllers, and evaluators. Developing meaningful objectives requires a balance between criteria that are reasonably observable versus the need to confirm a subjective quality (e.g., effectiveness). The ability to

<sup>5</sup> Note that the criterion actually asks, “What protective action(s) was implemented.” This discussion addresses the intent of that criterion (i.e., the Board’s staff team believes that the intent of the criterion was to determine “Was the correct protective action implemented?”).

measure the quality of action taken, sometimes by independent oversight, is a necessary part of objective evaluations.

The Board's staff team believes that deficiencies in assessing performance in exercises also contribute to the continuing limited effectiveness of the emergency management program. Exercise participants conduct hot washes at the end of each exercise. The hot washes are intended to be a vehicle for participants to self-critique their response performance, including both positive and negative aspects, and to identify potential areas for improvement. The hot washes that the Board's staff team observed at the Pantex Plant tended to focus on faults with the exercise scenario rather than issues with emergency response performance. The participants raised issues such as the perception that a scenario was unrealistic or that controllers did not have adequate simulations for what the participants would observe in real-life. Many participant observations focused on deficiencies in administrative equipment and tools, such as printer or fax machine problems. While the readiness of these resources is important to an adequate response, the purpose of the exercise program is to demonstrate proficiency. Many participant observations also focused on the positive results of their actions, but failed to identify whether the actions taken would have been effective during the given emergency scenario. As a best practice, mature organizations tend to have an experienced functional team leader (e.g., the Emergency Operations Center (EOC) Emergency Director) lead the hot wash, rather than rely on the exercise controller/evaluator for this role. Most response elements at the Pantex Plant do not incorporate this practice.

For each exercise, controllers and evaluators conducted after action critiques to collect data and observations about the performance of exercise response participants, as well as concerns with exercise control. While these were preliminary data gathering activities, the Board's staff team noted the same lack of critical assessment among the exercise evaluators. Evaluators did not explicitly compare the actions taken by participants to the expected or most desirable responses as they related to the fundamental purpose of emergency response. For example, while data on when a particular communication was faxed may have been collected, the quality and usefulness of the communication to inform its addressee were not evaluated. Discussions focused on specific functional area performance, as assessed against binary objectives such as a checklist, but did not address the effectiveness of interfaces between functional areas.

For example, during the February 2015 exercise, the EOC received information concerning an off-site release of a hazardous chemical from a train accident. The consequence assessment team performed modeling to inform decision-makers of the effect on plant personnel, including first responders. Fire Department personnel who responded to the on-site transportation accident were within the projected plume while performing rescue operations. Neither the PSS nor the EOC informed the Fire Department personnel of the potential exposure (e.g., type of material, quantity, timing, or recommended personal protective equipment). This information was eventually provided to the incident command late in the scenario. Exercise objectives were evaluated as "Met" for these individual functional areas during the evaluator after action critique. The effectiveness of organizational interfaces can be masked by such stove-piped evaluations.

Emergency Management Drill and Exercise Program Oversight: The Board's staff team considers it a significant deficiency that NPO and contractor oversight did not identify the issues discussed in this section. Other than the emergency management program manager, the Board's staff team observed limited evidence of interaction with NPO functional area subject matter experts in the evaluation of exercise reports. NPO review of exercise assessments appears weak in that exercises with observed deficiencies do not result in reports with commensurate findings. Where issues are identified, the contractor's causal analyses are often weak or superficial, leading to development of ineffective corrective actions and recurrence of the same issues in subsequent exercises. The concern with ineffective corrective actions is also evident when DOE's independent oversight organizations observe exercises and provide reports to the plant. DOE's Office of Emergency Management Oversight (formerly HS-63 and also OA-30) provided reports highlighting concerns with the Pantex Plant's emergency management program; these reports also identify recurring issues that the contractor has not effectively addressed [7, 8, 9, 10].

*Timely, Accurate Information to the Public Regarding Off-site Radiological Consequences*—The Board's staff team found no demonstrated capability to provide timely, accurate information to the public regarding off-site radiological consequences. Accident scenarios postulated at the Pantex Plant may result in the release of radioactive material or other hazardous materials from facilities. The released material may then be carried across the site boundary and contaminate public roads and land. The proximity of some facilities at the plant to the site boundary is such that in certain scenarios, material could contaminate off-site locations within a short period of time.

Notification to off-site organizations provides two important functions: first, it warns members of the public to take protective action in response to an accident; second, it initiates off-site response assets that can control access and conduct radiological monitoring. The notification processes used at the Pantex Plant may not provide enough time for protective action recommendations to be issued and executed before radioactive material is dispersed off-site. Any delay in notification adds to the time necessary for state response assets to deploy. Notification may be delayed due to the emergency action level (EAL) decision-making processes. Additionally, state radiological monitoring assets may be delayed in reaching the vicinity of Amarillo due to geographic constraints.<sup>6</sup> The response teams, located in Austin, TX, must travel nearly 500 miles before they are available to monitor the affected area. Notification delays would also impede instituting access control to public use areas around the site. While the Pantex Plant emergency response organization develops and provides models of radioactive material releases to state and county officials, actual monitoring to verify material deposition off site may not be proactively performed by the site's radiological response assets; these assets may be released at the plant's discretion in accordance with existing memoranda of understanding between the site and the counties/state. Pantex Plant radiological support personnel do not

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<sup>6</sup> The DOE Radiological Assistance Program (RAP) is a national emergency response asset that provides around-the-clock first-response capability to assess radiological emergencies, and has a team stationed in Amarillo, TX. This team may not be consistently available due to competing priorities and may not have sufficient local resources to support a response outside the Pantex Plant. DOE has not incorporated the RAP into the Pantex Plant's existing exercise program, leaving to question the capability of the RAP resources to provide off-site support. Additionally, there is potential that the RAP team could be deployed elsewhere at the time of an incident, precluding the use of that resource.

exercise this monitoring function during drills and exercises, and do not have processes in place to describe how off-site field monitoring would be executed.

There are limited requirements in DOE Order 151.1C that specify how the site will plan for these events and handle off-site radiological monitoring. The Board's staff team notes that the Pantex Plant has made agreements, via memoranda of understanding, with state and local authorities to create communication channels for much of this information. However, these existing mechanisms do not provide the proactive support from the plant to the local community that is necessary to ensure any release of contamination is accurately tracked in a timely manner to ensure the protection of the public. Given that the Pantex Plant is close to public roads and land, and has the potential to release radiological material off site within minutes of an initiating event, stronger requirements in the Order are needed to ensure the plant performs effective off-site monitoring until the necessary State of Texas resources arrive.

*Technical Planning Bases and Decision-making Tools*—The Board's staff team found that the technical planning bases and decision-making tools for the Pantex Plant's emergency management program are inadequate to demonstrate protection from time-sensitive events and do not consider all hazards at the site. For the set of hazards analyzed, the technical planning tools developed to respond to emergencies are inadequate to ensure timely notification of the need for protective actions to the workers and recommended protective actions to the public.

To meet DOE Order 151.1C emergency planning element requirements, a site must conduct an all-hazard analysis. From this survey, certain accident sequences are selected for additional consideration in the EPHA. The EPHA provides the basis for developing the site's EALs. EALs, which are also required by DOE Order 151.1C, are used during an emergency event to determine the categorization and level of classification of the emergency event. When using an EAL, emergency response decision-makers attempt to answer two questions. First, is the event an operational emergency? Second, if so, what is the potential area of impact and the degree of emergency response? The safety basis development process uses a similar hazard analysis process. When developing a safety basis, some infrequent accidents may be screened out of further analysis if they have a low probability of occurrence. However, for the purposes of EPHAs, low-probability, high-consequence events should be further analyzed to determine the magnitude of potential consequences and the expected level of response. Guidance is provided in DOE's Emergency Management Guide 151.1-1a, *Emergency Management Fundamentals and the Operational Emergency Base Program*. "The DOE approach requires some planning even for events whose severity exceeds the design basis for safety controls; the facility/site or activity must be prepared to take actions to limit or prevent adverse health and safety impacts to workers and the public" [11]. While these analyses of low-probability events may be less quantitative, they still need to be performed to ensure DOE and its contractors are cognizant of potential consequences and conduct an appropriate level of planning.

For events that Pantex Plant emergency management personnel have analyzed, the site uses EALs as a tool to determine if an operational emergency is occurring and the classification of the event, to notify site workers of the need for protective actions, and to notify the public of recommended protective actions. As currently developed, these EALs include a confirmatory step that may delay decision-makers providing these notifications and recommendations for

protective actions for several minutes, possibly up to 30 minutes. The ability to provide notifications and recommendations for protective actions to workers and the public in a timely manner significantly increases the safety of these groups during operational emergencies. DOE Order 151.1C specifies a 15-minute window to notify DOE Headquarters and the public of events in progress [1].

Pantex Plant emergency management personnel chose to use a decision tree model in their EALs, visually guiding an operator through decisions being made in response to an event on site. The example in Figure 3 below, taken from the Pantex EALs [12], shows the flow-path through decision making to action.

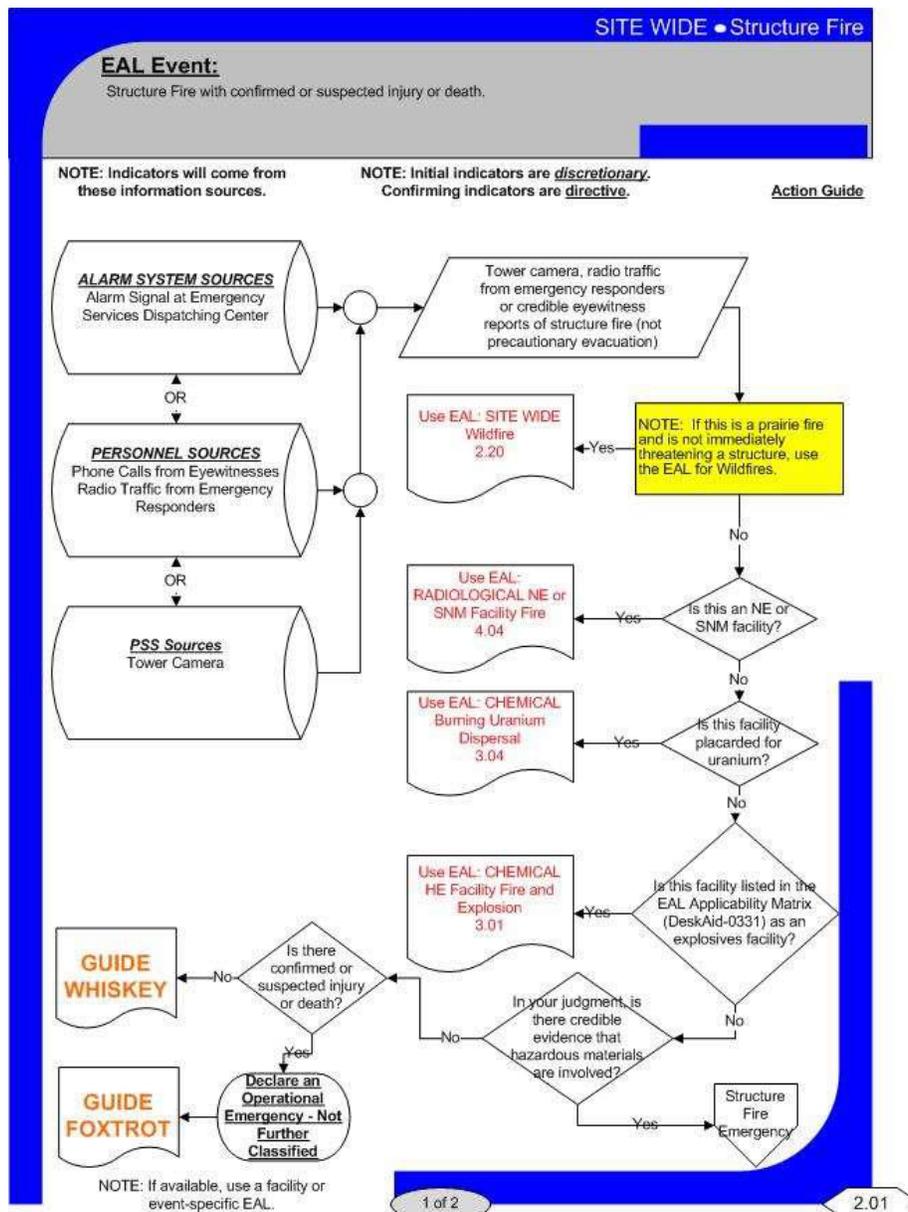


Figure 3. Structural Fire EAL

An operator—in the case of the Pantex Plant, the PSS—enters the EAL with relevant information concerning an emergency event. This leads the PSS to a conservative emergency categorization and classification. These classifications (Alert, Site Area Emergency, and General Emergency) ensure appropriate responses are taken given the anticipated magnitude of the accident consequences. In most radiological EALs at the Pantex Plant, the PSS receives initial information of emergency conditions from an instrumented signal. For example, coincident fire and radiation monitor alarms would indicate the presence of a possible fire with radioactive material release.

The Pantex Plant EALs also include confirmatory indicators as an explicit step in the decision-making process before classification can be performed. These are typically in the form of personnel providing eyewitness confirmatory statements about the nature of an event. From the EAL front matter [12], page 8:

The PSS or Emergency Manager must rely on information resulting from communication with whoever is in command at the emergency scene, emergency responders, and plant personnel to supply confirmatory information necessary to make emergency classification decisions.

From page 11:

Using the appropriate EAL, the PSS or Emergency Manager follows the decision tree and attempts to identify initial and confirmatory indicators of an actual emergency event while simultaneously continuing to gather information on the situation from Incident Command, emergency responders, and plant personnel. [If these resources are not already there, they are dispatched.] During this time, *initial protective actions may be implemented* [emphasis added] to protect plant personnel.

If EAL confirmatory indicators are present and detected, the PSS or Emergency Manager follows the decision-tree to the classification area. This section may require retrieval of information on the quantity and type of material involved in the incident from the Move Right System or use of inserted tables. Once determined, the PSS or Emergency Manager classifies the emergency based on the EAL information.

These classification decisions allow the PSS to determine what, if any, protective actions are necessary for personnel on site and recommended protective actions for the public off site. Waiting for confirmation from first responders, if not provided by some other source, may cause a delay in the PSS issuing notifications and recommendations for protective actions to the workforce and the public. For example, in the following EAL, if no confirmatory information is provided, someone must be dispatched to confirm if an explosion truly occurred [12].

**EAL Event:**

Explosion in a Nuclear Explosive (NE) or Special Nuclear Material (SNM) facility.

NOTE: Indicators will come from these Information Sources

NOTE: Initial Indicators are *discretionary*.  
Confirming Indicators are *directive*.

Active Guide

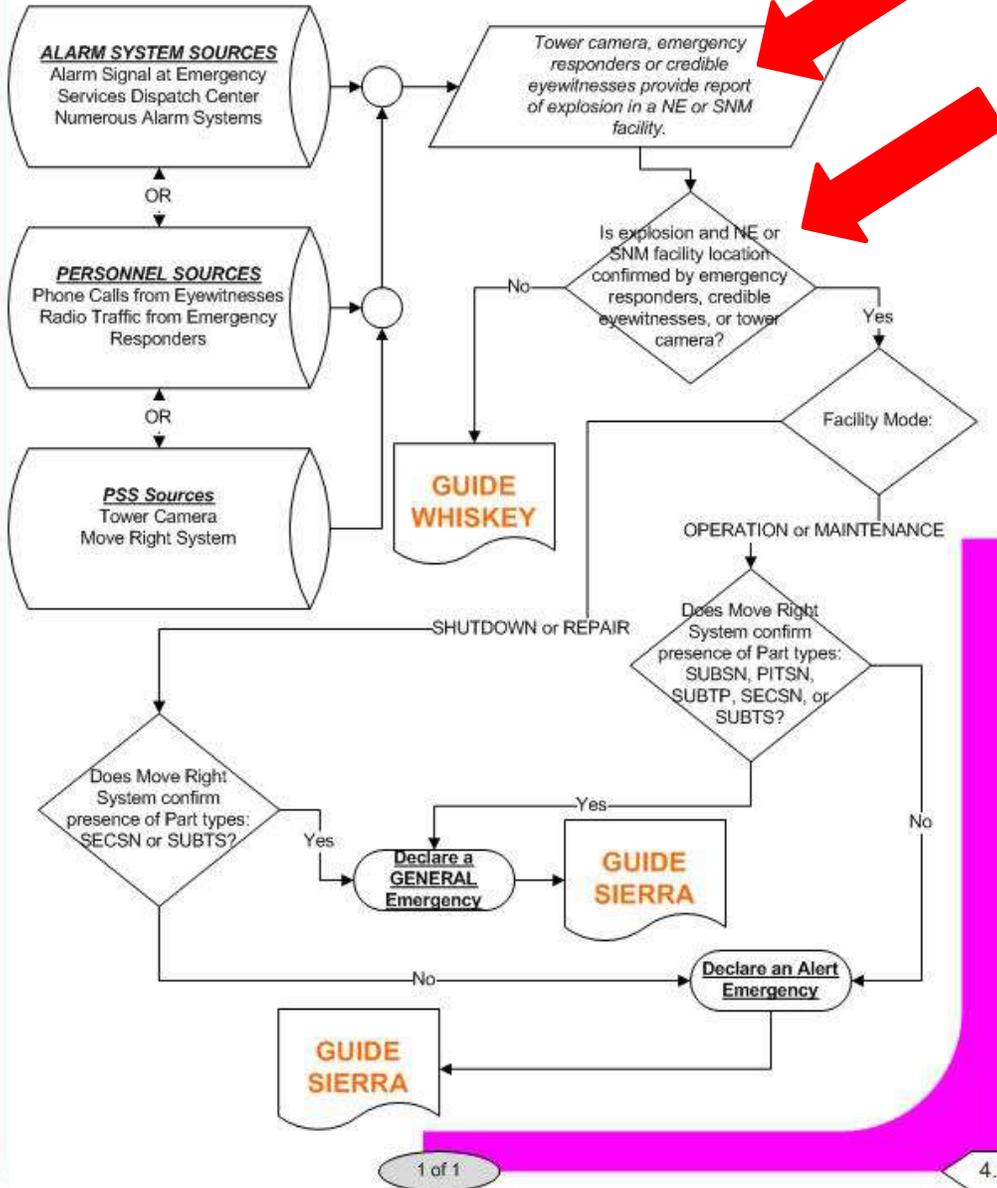


Figure 4. NE or SNM Facility Explosion

Similarly, note the reliance on personnel observations and inferences to assist the decision maker through appropriate classification of a fire in a nuclear explosive or special nuclear material facility [12].

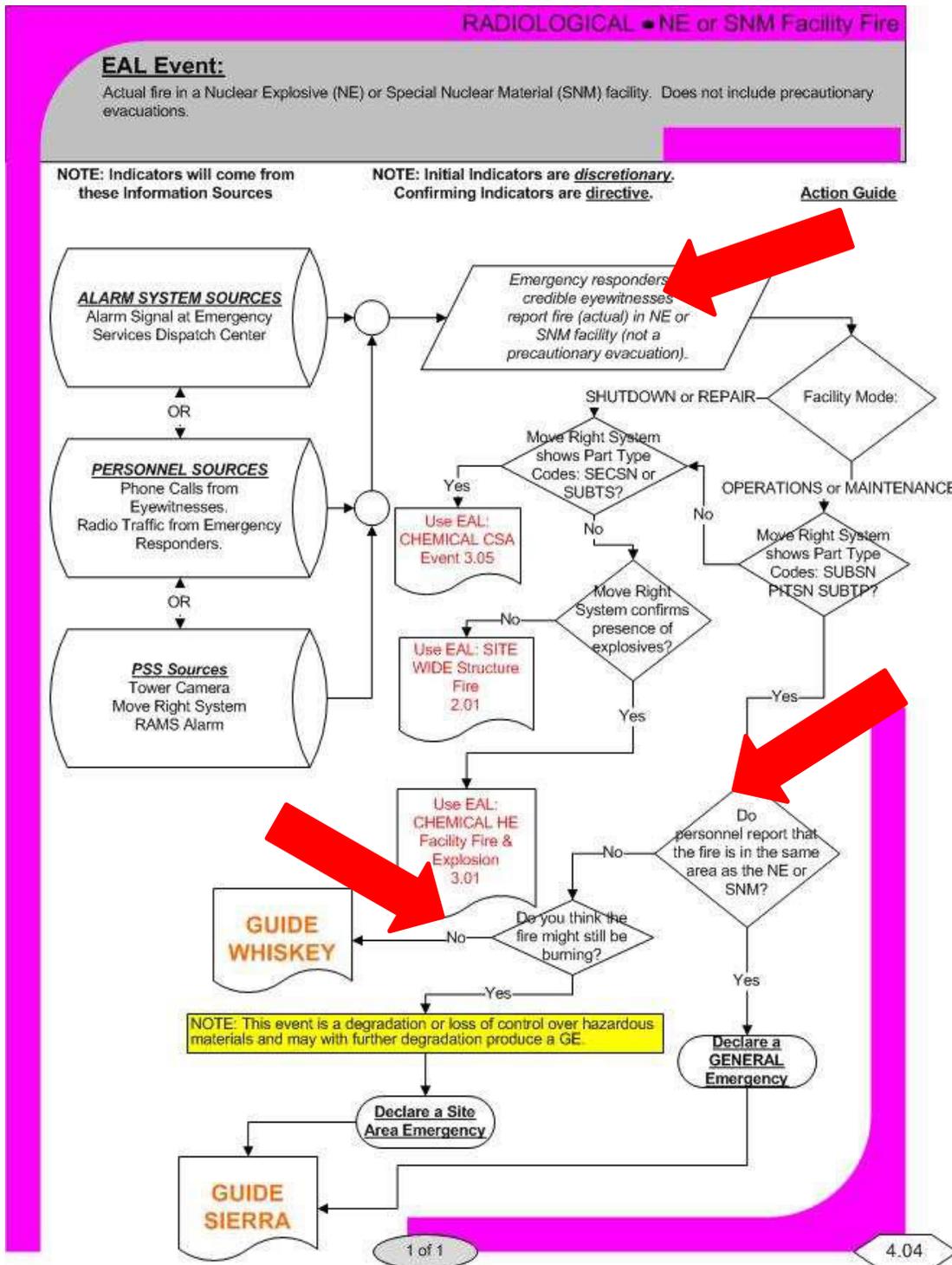


Figure 5. NE or SNM Facility Fire EAL

In the following example, radiological support personnel must be dispatched, if not immediately available at the scene, to confirm the validity of a tritium release alarm before the appropriate emergency classification and protective actions are determined [12].

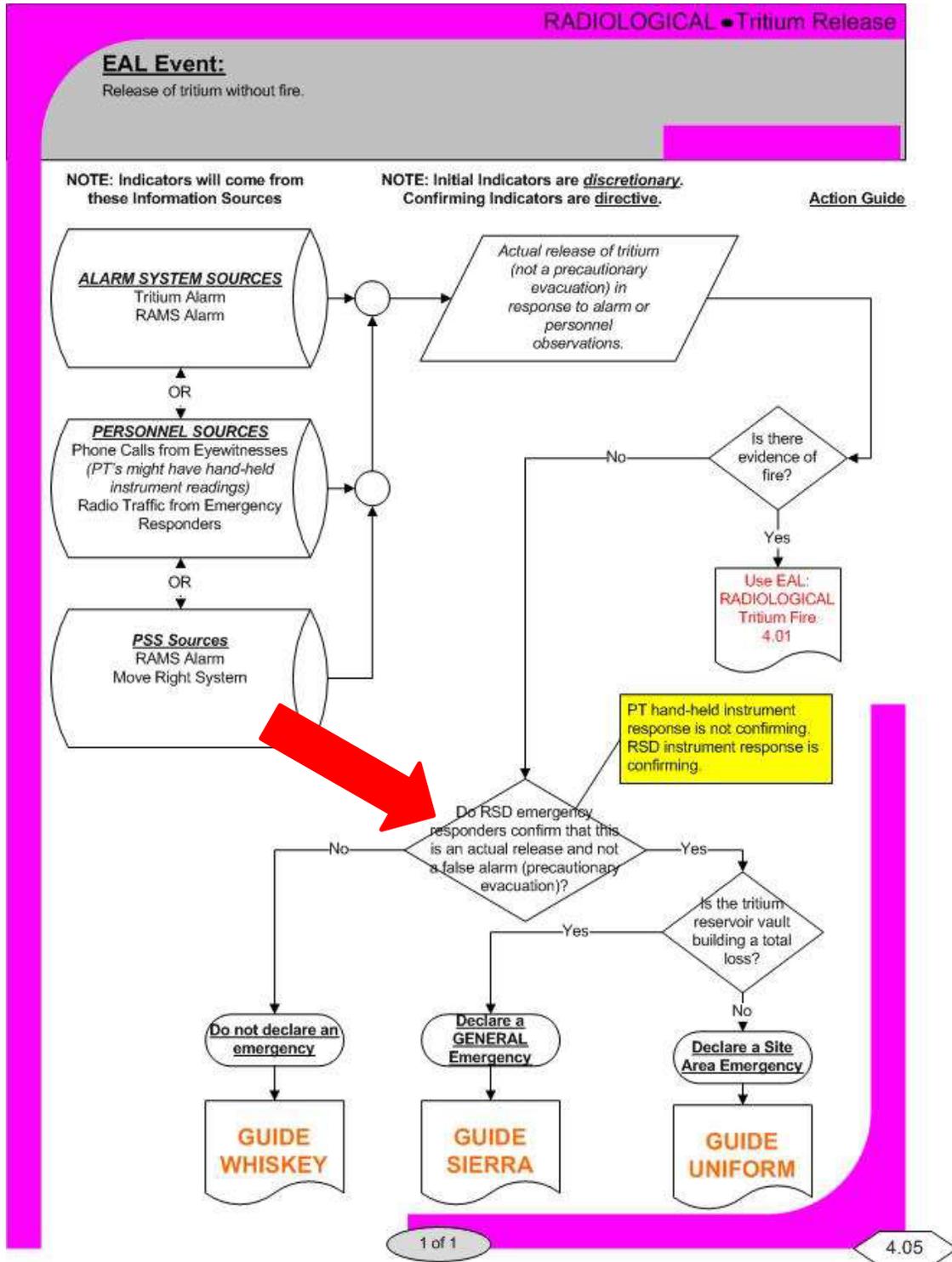


Figure 6. Tritium Release EAL

In the following example, it is not clear what a “Convincing Report” or combination of fire indicators is without further training or guidance on expectations for those who may report such events [12].

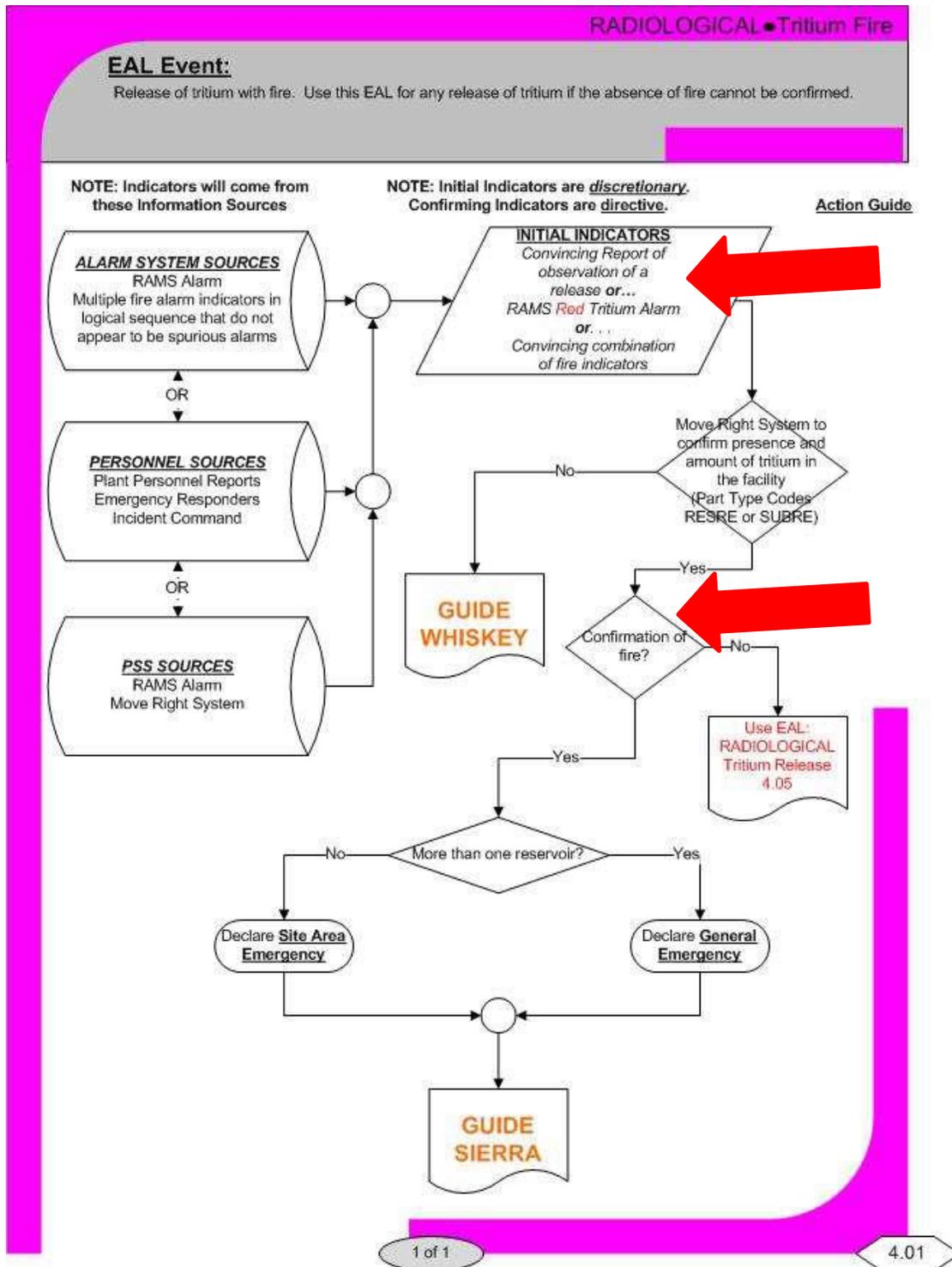


Figure 7. Tritium Fire EAL

The specific examples provided, which are not intended to be all encompassing, demonstrate that the Pantex Plant emergency management strategy is reliant on confirmatory indicators and does not always provide sufficient guidance on how to accomplish the required confirmation. Immediate (or precautionary) protective actions, which protect the site workers in the short-term, would be delayed while additional assessment is performed. Such additional assessment would also delay notifying the off-site public of protective action recommendations. The Board's staff team believes changes to these procedures, or incorporation of additional instrumentation of adequate reliability, would provide the level of protection necessary to ensure a time-sensitive response to radiological accidents while minimizing false alarms.

**Conclusions.** The Board's staff team considers the concerns described above to be significant and concludes that the Pantex Plant's emergency management program will require Board action to influence DOE to address these deficiencies. The plant has made changes to specific programmatic elements; however, significant improvements have not yet been realized. Focused effort at addressing the concerns will substantially ensure protection of the workers and public at the Pantex Plant. Some specific actions to address these concerns include:

- Ensure the Pantex Plant drill and exercise programs comprehensively demonstrate proficiency in responding to emergencies for all hazards, all facilities, and all responders, consistent with the technical planning bases and any updates to them, over a five-year period in accordance with DOE Order 151.1C (or subsequent revisions). As part of this demonstration of proficiency:
  - Develop and institute a basis for conducting the drill program in support of emergency operations.
  - Strengthen the exercise program to provide an adequate number of challenging scenarios per year, including at least one full-scale site-wide exercise, in order to maintain qualifications and ensure proficiency of the emergency response organization and first responders.
  - Conduct a comprehensive assessment of the drill and exercise programs bases, schedule, and execution against a risk-ranked set of:
    - All hazards;
    - All facilities; and
    - All response elements.
  - Evaluate and improve the effectiveness of the NPO and contractor processes used to critique drills and exercises.
- Develop and implement processes and demonstrate the capabilities to:
  - Ensure the timeliness and accuracy of notifications to state and local authorities is commensurate with the initiation of off-site release of radioactive material at the Pantex Plant.

- Provide consistent radiological monitoring support if an accident releases radiological material off-site, until state resources arrive and can assume responsibility for off-site monitoring.
- Evaluate, incorporate, and validate (correctness, completeness, and effectiveness), the following changes to the Pantex Plant decision-making tools and notification processes:
  - Evaluate the emergency action level (EAL) process for those accident scenarios identifiable solely via instrumented systems to reduce delays in determining and implementing protective actions.
  - For those accident scenarios that are not identifiable solely via instrumented systems, evaluate the range of emergency conditions and potential indicators, and identify where new monitoring systems can be added or existing administrative controls can be modified to improve timeliness of response.
  - For all scenarios, evaluate if some protective actions should be initiated based solely on initial indicators (i.e., a precautionary evacuation) while confirmatory indicators are sought.
  - Upon completion of these evaluations, incorporate new guidance and training for any changes made to the EAL decision-making tools and notification processes into the drill and exercise program.

The Board's staff team believes these problems will not be adequately addressed by Board's Recommendation 2014-1, *Emergency Preparedness and Response* [13]. Recommendation 2014-1 identifies specific concerns with DOE as a regulator, including a failure to maintain an adequate requirement set, which led to inconsistent implementation across DOE, as well as a lack of rigor in federal and contractor oversight that let problems persist. While some of DOE's actions to address Recommendation 2014-1 may provide a framework for the Pantex Plant to improve its emergency preparedness and response, the staff team believes the concerns noted above exist due to inadequate implementation of the current requirements. As a result, the staff team believes that timely resolution of these concerns requires separate Board action.

**Risk Assessment for Recommendation 2015-1**  
***Emergency Preparedness and Response at the Pantex Plant***

The recommendation addresses vulnerabilities in the Pantex Plant's implementation of Department of Energy (DOE) requirements for emergency preparedness and response. In accordance with the Defense Nuclear Facilities Safety Board's (Board) enabling statute and Policy Statement 5 (PS-5), *Policy Statement on Assessing Risk* [14], this risk assessment was conducted to support the Board's Recommendation 2015-1, *Emergency Preparedness and Response at the Pantex Plant*. As stated in PS-5,

The Board's assessment of risk may involve quantitative information showing that the order of magnitude of the risk is inconsistent with adequate protection of the health and safety of the workers and the public ... the Board will explicitly document its assessment of risk when drafting recommendations to the Secretary of Energy in those cases where sufficient data exists to perform a quantitative risk assessment.

DOE's hazards assessments address initiating events, preventive and mitigative controls, and consequences. Initiating events in these assessments include operational and natural phenomena events. Preventive and mitigative controls are design basis controls identified in safety analysis documents. Consequences cover a wide spectrum, ranging from insignificant to catastrophic effects.

The emergency management program exists at the Pantex Plant because the risk associated with its facilities is acknowledged by DOE and is required by law. Emergency response provides the "last line of defense in the event of ... [an] accident" [15]. Therefore, the emergency management program needs to function effectively to protect the workers and the public.

This recommendation is focused on improving the effectiveness of the Pantex Plant's emergency management program. A quantitative risk assessment on the effectiveness of this program requires data on probability and consequences. Detailed data on the probability of failure in emergency management program elements are not available for the Pantex Plant, nor do effective comparisons exist. Therefore, it is not possible to do a quantitative assessment of the risk of these elements to provide adequate protection of the workers and the public.<sup>1</sup>

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<sup>1</sup> Members of the Board's staff conducted research on other sources of risk information related to emergency management programs and noted the U.S. Nuclear Regulatory Commission (NRC) evaluates commercial nuclear production and utilization facilities against a set of sixteen "standards," similar to DOE's concept of fifteen program elements found in DOE Order 151.1C, Comprehensive Emergency Management System. Of the sixteen NRC standards, four are considered "risk significant" and are weighted differently in the application of the NRC's reactor oversight process, a regulatory scheme applied to certain licensees to characterize the severity of findings [16, 17]. Under this scheme, findings identified within these standards are considered more significant. Three of the four standards, "Classification," "Notification," and "Protective Action Recommendations," parallel the nature of the concerns with elements of the Pantex Plant's emergency management program stated by the Board in this recommendation.

The Board believes that more robust implementation of existing requirements would reduce the risk associated with the spectrum of accidents postulated at the plant, regardless of the cause, including process upsets, the effects of natural phenomena, and man-made initiating events, as well as provide additional margin to respond to those events considered beyond the design basis.

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