

G-420.1/B-0
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September 30, 1995

IMPLEMENTATION GUIDE

for use with

DOE ORDERS 420.1 AND 440.1

FIRE SAFETY PROGRAM



OFFICE OF WORKER HEALTH AND SAFETY

FINAL

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FINAL

FOREWORD

1. This Department of Energy (DOE) Implementation Guide is approved for use by the Office of Environment, Safety and Health and is available to all DOE components and their contractors.
2. Specific comments (recommendations, additions, deletions, and any pertinent data) to enhance this document should be sent to:

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3. DOE implementation guides are part of the DOE directives system and are issued to provide supplemental information regarding the Department's expectations for fulfilling its requirements as contained in rules, Orders, notices, and regulatory standards. The guides may also provide acceptable methods for implementing these requirements. Implementation guides are not substitutes for requirements, nor do they replace technical standards that are used to describe established practices and procedures for implementing requirements.
4. Applicable standards and additional guidance documents are listed in Section V.

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Section I. INTRODUCTION

The purpose of this Implementation Guide is to facilitate the development, implementation, and maintenance of a comprehensive fire protection program so as to achieve the policy objectives and fulfill the requirements delineated in DOE 420.1, "Facility Safety;" DOE 440.1, "Worker Protection Management for DOE Federal and Contractor Employees;" and their corresponding Contractor Requirements Documents (CRD).

This is done by explaining the interrelationship between these Orders, CRDs and the other related requirements, guidance and technical standards that, along with site-specific criteria, define an acceptable fire protection program.

Also included are supplementary guidance and procedures that will facilitate the implementation and maintenance of the program, its continuing evaluation, and potential future revision, update and enhancement.

Section II. APPLICATION

The Guide applies to all Departmental Elements as delineated in DOE 420.1 and DOE 440.1. Because the guidance contained herein does not offer precise suggestions for resolution of all fire safety issues, readers are expected to exercise informed judgment in the application of this Guide.

Nothing in the Guide prevents or discourages the implementation of alternate or innovative fire protection configurations and practices that will achieve a level of fire safety comparable to that attained by literal conformance with DOE fire safety criteria or those established by the fire protection industry through the consensus standards process. To the extent that an alternate configuration is proposed, it should be evaluated and approved as equivalent by the DOE Authority Having Jurisdiction (AHJ) for fire protection.

Section III. GENERAL INFORMATION

- 1.0. DOE 420.1, 440.1, and their corresponding CRDs establish minimum requirements for a comprehensive fire protection program, including site fire departments. The fire protection program requirements from these Orders and CRDs are repeated in this Section for expedient reference and application.
- 2.0. An acceptable fire protection program includes those fire protection policies, requirements, technical criteria, analyses, administrative procedures, systems and hardware, apparatus and equipment, plans, and personnel that comprehensively ensure that DOE objectives relating to fire safety are achieved. Such a program should be characterized by a level of fire protection sufficient to fulfill the requirements for the best

protected class of industrial risks ("Highly Protected Risk" or "Improved Risk") and should have protection to provide "defense-in-depth." This means that fire safety should be an integral part of all activities and that facilities should be designed with both active and passive fire protection features such that reliance will not be placed on only one means to ensure an acceptable level of fire safety. This is also characterized by the demonstration of a continuing, sincere interest on the part of management and employees in minimizing losses from fire and related hazards and the implementation of preventive features necessary to ensure the satisfaction of objectives related to fire safety. To achieve this level of fire protection, site operations and facilities should meet a minimum level of fire protection as further defined below.

- 3.0. An acceptable fire protection program should meet the minimum requirements established by the National Fire Protection Association (NFPA) and other referenced fire safety criteria (or exceed them when necessary to meet fire safety objectives), unless explicit relief has been granted by DOE.
- 4.0. Basic elements of an acceptable program include:
 - 4.1. A policy statement that incorporates the requirements of this Order, related DOE directives, and other applicable Federal, state and local fire protection requirements. The statement should affirm management's commitment to support a level of fire protection and fire suppression capability sufficient to minimize losses from fire and related hazards consistent with the best class of protected property in private industry.
 - 4.2. Comprehensive, written fire protection criteria that reflect additional site-specific aspects of the fire protection program, including: the organization, training and responsibilities of the fire protection staff; administrative aspects of the fire protection program; and requirements for the design, installation, operability, inspection, maintenance and testing of fire protection systems.
 - 4.3. Written fire safety procedures governing the use and storage of combustible, flammable, radioactive, and hazardous materials so as to minimize the risk from fire. Such procedures should also exist for fire protection system impairments and for activities such as smoking, hot work, safe operation of process equipment, and other fire prevention measures which contribute to the decrease in fire risk.
 - 4.4. A system to ensure that the requirements of the DOE fire protection program are documented and incorporated in the plans and specifications for all new facilities and for significant modifications of existing facilities. This includes a documented review by a qualified fire protection engineer of plans, specifications, procedures, and acceptance tests.
 - 4.5. Fire hazards analyses (FHA) for all nuclear facilities, significant new facilities and facilities that represent unique or significant fire safety risks. The FHA should be developed using a graded

approach. The conclusions of the FHA should be incorporated in the Safety Analysis Report (SAR) Accident Analysis and should be integrated into design basis and beyond design basis accident conditions.

- 4.6. Access to a qualified and trained fire protection staff, including a fire protection engineer(s), technicians and fire-fighting personnel to implement the requirements of this Order.
 - 4.7. A "baseline" needs assessment that establishes the minimum required capabilities of site fire-fighting forces. This includes minimum staffing, apparatus, facilities, equipment, training, fire pre-plans, off-site assistance requirements, and procedures. Information from this assessment should be incorporated into the site Emergency Plan.
 - 4.8. Written pre-fire strategies, plans, and standard operating procedures to enhance the effectiveness of site fire-fighting forces, where provided. Such procedures include those governing the use of fire-fighting water or other neutron-moderating materials to suppress fire within or adjacent to moderation controlled areas. Restrictions on the use of water should be fully justified on the basis of criticality safety.
 - 4.9. A comprehensive, documented fire protection self-assessment program, which includes all aspects (program and facility) of the fire protection program. Assessments should be performed on a regular basis at a frequency established by DOE.
 - 4.10. A program to identify, prioritize and monitor the status of fire protection-related appraisal findings/recommendations until final resolution is achieved. When final resolution will be significantly delayed, appropriate interim compensatory measures should be implemented to minimize the fire risk.
 - 4.11. A process for reviewing and recommending approval of fire safety "equivalencies" and "exemptions" to the DOE AHJ for fire safety.
 - 4.12. Access to a fully equipped, staffed and trained emergency response force that is capable of effectively responding to a fire and other emergencies in a timely manner.
- 5.0. DOE facilities and sites should meet the applicable building code and National Fire Protection Association Codes and Standards, unless explicit written relief has been granted by DOE. The applicable codes and standards are those in effect when facility design commences ("code of record"). When significant modifications to a facility occur, the current edition of the code or standard should apply to the modification.

- 6.0. DOE Elements and contractors should develop, implement and maintain a comprehensive fire protection program for facilities that includes:
- 6.1. A reliable water supply of adequate capacity for fire suppression.
 - 6.2. Noncombustible or fire-resistive construction, where appropriate. Complete fire-rated barriers that are commensurate with the fire hazard to isolate hazardous occupancies and to minimize fire spread and loss potential consistent with defined limits as established by DOE.
 - 6.3. Automatic fire extinguishing systems throughout all significant facilities and in all areas subject to loss of safety class systems, significant life safety hazards, unacceptable program interruption, or fire loss potential in excess of defined limits.
 - 6.4. Redundant fire protection systems in areas where safety class systems are vulnerable to fire damage and where no redundant safety capability exists outside the fire area. In new facilities, redundant safety class systems should be in separate fire areas. Redundant fire protection systems should also be provided in areas where the maximum possible fire loss (MPFL) exceeds limits established by DOE.
 - 6.5. A means to summon the fire department in the event of a fire, such as a fire alarm signalling system.
 - 6.6. A means to notify and evacuate building occupants in the event of a fire, such as a fire detection or fire alarm system and illuminated, protected egress paths.
 - 6.7. Physical access and appropriate equipment to facilitate effective intervention by the fire department, such as an interior standpipe system(s) in multi-story or large facilities with complex configurations.
 - 6.8. A means to prevent the accidental release of significant quantities of contaminated products of combustion and fire-fighting water to the environment, such as ventilation control and filter systems and curbs and dikes. Such features would only be necessary if required by the FHA or SAR in conjunction with other facility or site environmental protection measures.
 - 6.9. Fire and related hazards that are unique to DOE and are not addressed by industry codes and standards should be protected by isolation, segregation or use of special fire control systems, such as inert gas or explosion suppression, as determined by the FHA.
 - 6.10. Fire protection systems should be designed such that their inadvertent operation, inactivation or failure of structural stability will not result in the loss of vital safety functions or inoperability of safety class systems as determined by the SAR.

Section IV. GUIDELINES

1.0 CRITERIA

- 1.1. DOE Order 420.1, paragraphs 4.2.1.1 through 4.2.1.3; DOE Order 440.1, Attachment 1, Section 2; and the corresponding CRDs require DOE elements and contractors to develop site-specific criteria as part of a comprehensive fire protection program.
- 1.2. The technical basis of an acceptable program is a body of policies, requirements, codes, standards, guidelines, and interpretations that define as completely as possible the minimum expectations regarding all aspects of the fire protection program.
- 1.3. DOE has in the past and will continue to promulgate fire safety-related criteria if a need for such criteria exists and that need is not being met by the fire protection industry through the model building code and consensus standard development process.
- 1.4. To the extent that DOE fire safety criteria may not in themselves define a comprehensive technical basis for an acceptable fire protection program based on site-specific considerations, it is the Department's expectation that its contractors develop and/or adopt site-specific criteria that, combined with DOE criteria, establish an acceptable technical basis for the program. Such a need should be identified by the contractor fire protection staff. Promulgation of such supplementary criteria should be thoroughly coordinated within the contractor's technical staff and should be reviewed and approved by the DOE AHJ for fire protection. Because fire protection is a mature and generally successful program within the Department, it is not expected that wholesale program enhancements related to criteria are necessary.
- 1.5. It is expected that fire protection criteria will need to evolve to reflect technological and other developments. The Department expects that the technical basis for the fire protection program will change by the adoption of new or revised codes and standards. Implementation plans for these Orders should reflect a commitment to adopt the most recent version of codes or standards. If a pending code or standard represents an unnecessary burden on the Department, DOE will promulgate a Department-wide implementation plan (based on recommendations by the DOE Fire Safety Committee) that reflects the Department's perspective. Such implementation plans have been developed in the past for fire department operations and for testing and maintenance programs.

- 1.6. With regard to facilities, the fire protection-related codes and standards in effect when facility design commences (code of record) remain in effect for the life of the facility. An exception would be if there is a significant hazard that endangers building occupants or the public as determined by the AHJ. In such cases, the facility should be upgraded to the requirements of the current edition of the code or standard to mitigate that hazard. When modifications of a substantial nature occur, the current edition of the code will apply to the modification. For older facilities for which the code of record may be unknown, the current edition of the code or standard should be applied with judgment in the assessment of the adequacy of fire protection.
- 1.7. The Department encourages a rational and flexible approach to the implementation of fire safety criteria. When a complete and comprehensive technical analysis concludes that an alternate approach achieves a comparable level of safety to that attained by literal conformance with a particular aspect of DOE fire safety criteria, DOE would conclude that the alternate approach satisfies its overall fire safety policy. The content and conclusions of such an analysis would have to be reviewed by the DOE AHJ for fire protection, after consultation with the cognizant DOE fire protection engineer(s). Concurrence by the AHJ would constitute a determination of technical "Equivalency."

2.0. DOCUMENTATION

- 2.1. DOE Order 420.1, Section 4.2.1 and the corresponding CRD establish requirements for fire protection program documentation.
- 2.2. The program should be completely documented (such as in the Standards Requirements Identification Document). This includes a description of applicable fire safety requirements in contracts and leases, where appropriate.
- 2.3. Documentation should also include a description of the fire protection organization and its roles and responsibilities in relation to other organizational entities. It is preferable, although not always essential, to have all fire protection-related line activities under a single line manager to avoid unnecessary duplication and costs.

- 2.4. Training and qualification records of individuals having fire protection program responsibilities should be readily available and in an auditable form.
- 2.5. Appropriate fire protection documentation includes copies of all fire hazards analyses and at least the two most recent facility assessment reports in a continually updated filing system. The fire hazards analyses and facility assessment reports may be combined, provided that they address all essential elements as defined below. (The DOE Fire Protection Resource Manual (Handbook) contains copies of "models" of separate and combined FHAs and assessment reports.) Facility documentation should also include copies of any Exemptions and Equivalencies that have been approved by DOE.
- 2.6. Construction projects should feature a file in which all significant decisions and reports concerning fire protection can be found. Critical documents in this file should be maintained for future reference.
- 2.7. The organization(s) responsible for inspection, testing, and maintenance of fire protection features should maintain records of recent (not less than one year) activities as well as a file(s) of all inspection, testing and maintenance procedures. Unnecessary duplication of procedures is discouraged. A single governing procedure with unique system- or facility-specific conditions highlighted is considered acceptable.
- 2.8. Site fire departments and other related emergency response organizations (such as brigades or emergency squads) should maintain a current file with all Standard Operating Procedures and fire pre-plans. A program should be in place to ensure that this documentation is updated at appropriate intervals. Pre-plans should be developed on the basis of input from the site fire protection engineering staff as well as emergency responders.
- 2.9. Emergency response records should conform with DOE reporting requirements and should be based on national standards of fire incident reporting (NFPA 902M) in lieu of site-specific reporting formats. This will facilitate consistent reporting across the Department.
- 2.10. Nothing in this section prevents or discourages the use of computerized information management techniques for the creation, maintenance and dissemination of relevant documentation pertaining to

the fire protection program.

3.0. INSPECTION, TESTING, AND MAINTENANCE

- 3.1. DOE Order 420.1, paragraph 4.2.1.2 and the corresponding CRD require the development of site criteria for inspection, testing and maintenance of fire protection systems.
- 3.2. The inspection, testing and maintenance program for fire protection features, apparatus and equipment should be based on industry standards, such as those established by the NFPA. To the extent that an adequate technical basis exists to justify deviations from the inspection and test frequencies delineated in these standards, DOE would accept well-documented alternatives, provided that operability was reasonably assured.
- 3.3. Minimum requirements to establish "operability" should be developed for fire protection features, including fire detection and suppression systems, fire doors and dampers, and fire protection water supplies. "Model" operability requirements and technical specifications are contained in the DOE Fire Protection Resource Manual (Handbook). Periodic inspections and tests at an appropriate frequency should be conducted to verify operability. When fire protection systems are inoperable for a significant period of time, interim compensatory measures, such as fire watchers, should be implemented in accordance with established procedures until operability is restored.
- 3.4. Data on fire protection system performance should be continually collected and maintained so as to be able to provide a sound technical basis for the fire protection inspection, testing and maintenance program. Trends in system performance should be monitored so as to be able to determine if significant degradation of system performance is occurring over time. Such degradation would justify revising the inspection, testing, and maintenance program to feature more conservative frequencies.

4.0. FIRE HAZARDS ANALYSES

- 4.1. DOE Order 420.1, paragraph 4.2.1.5 and the corresponding CRD require the development of an FHA for select facilities under certain circumstances. Examples of facilities for which an FHA should be performed are nuclear and high-hazard facilities (as defined by DOE), buildings in which significant quantities of hazardous materials are stored or processed, and structures featuring equipment of considerable value. These examples encompass new facilities as well as significant renovations to

existing facilities. Examples of facilities not generally requiring an FHA include small utility buildings, trailers, and office buildings.

- 4.2. The purpose of an FHA is to comprehensively and qualitatively assess the risk from fire within individual fire areas in a DOE facility so as to ascertain whether the DOE fire safety objectives, which are delineated in the above referenced Orders, are met. This must include an assessment of the risk from fire and related hazards (direct flame impingement, hot gases, smoke migration, fire-fighting water damage, etc.) in relation to existing or proposed fire safety features to ensure that the facility can be safely controlled and stabilized during and after a fire. To the extent that this analysis completely addresses the following issues, an FHA will satisfy the requirements for a traditional "Fire Protection Safe Shutdown Analysis." In accordance with the "graded approach" concept, the level of detail necessary for an acceptable FHA is directly related to the complexity of the facility and the potential risk to the public and facility operators. The scope and content of an FHA should be limited to only those issues that are relevant to the facility. To facilitate the development of graded fire hazards analyses, "model" FHAs have been developed. These models can be found in the DOE Fire Protection Resource Manual (Handbook).
- 4.3. A preliminary FHA should be performed for all significant new facilities early in the design phase to ensure that an acceptable level of protection is being incorporated in the evolving design. It should be updated when significant changes occur within an individual fire area and should form the basis for the post-construction facility FHA.
- 4.4. An FHA should be performed under the direction of a qualified fire protection engineer, with support from systems, electrical, and mechanical engineers, as well as operations staff, as needed.
- 4.5. An FHA should contain, but not be limited to, a conservative assessment of the following fire safety issues:
 - . Description of construction
 - . Description of critical process equipment
 - . Description of high-value property
 - . Description of fire hazards
 - . Description of operations

- . Potential for a toxic, biological and/or radiation incident due to a fire
 - . Natural hazards (earthquake, flood, wind) impact on fire safety
 - . Damage potential: Maximum Possible Fire Loss (MPFL)
 - . Fire protection features
 - . Protection of essential safety class systems
 - . Life safety considerations
 - . Emergency planning
 - . Fire Department/Brigade response
 - . Recovery potential
 - . Security and Safeguards considerations related to fire protection
 - . Exposure fire potential and the potential for fire spread between two fire areas
 - . Effect of significant fire safety deficiencies on fire risk
- 4.6. The FHA should assume and evaluate the consequences of a single, worst-case automatic fire protection system malfunction. This could be a detection system that also functions to activate a pre-action type sprinkler system.
- 4.7. In determining the value of the MPFL, which is used in part to assess the need for fire protection systems, the basic assumption should be that there is no automatic or manual fire suppression. This loss determination should include all direct and indirect costs associated with the fire and clean-up operations.
- 4.8. If redundant automatic fire protection systems (as defined by DOE) are provided in the area, only the system that causes the most vulnerable condition is assumed to fail. Passive fire protection features, such as blank fire-rated walls or continuous fire-rated cable wraps, are assumed to remain viable for their rated fire endurance period to the extent that they are properly constructed and maintained.
- 4.9. The focus of the FHA should be the individual fire areas that comprise the facility. A fire area is defined as a location bounded by fire-rated construction, having a minimum fire resistance rating of 2 hours, with openings protected by equivalently-rated fire doors, dampers or penetration seals. The boundaries of exterior fire areas (yard areas) should be as determined by the AHJ or delegated

authority. Where a facility is not subdivided by fire-rated construction, the fire area should be defined by the exterior walls and roof of the facility.

- 4.10. An important element of an acceptable FHA for nuclear facilities is an inventory of all safety class systems within the fire area that are susceptible to fire damage. This includes those primary and supporting mechanical and electrical systems that must function effectively during and after a fire event to ensure safety, including safe shutdown where applicable. For example, loss of the building ventilation system in a fire (due to damage to power cables) may result in an ambient air temperature rise, which may cause the failure of sensitive electrical safety class components, such as relays. Such safety class systems may include, but are not limited to, process monitoring instrumentation, instrument air, the facility hydraulic system, and emergency lighting system.
- 4.11. All credible fire-related failure modes of safety class systems should be considered. For example, it is insufficient to assume that fire will merely cause the loss of function of safety class equipment when power cables to that equipment are within the fire area. It is also necessary to consider the potential for spurious signals which may cause the maloperation of such equipment. Similarly, fire-induced electrical faults may trip upstream electrical disconnect devices in such a way as to render inoperable other safety class systems that may not even be located within the fire area. In addition, the effects of combustion products, manual fire-fighting efforts, and the activation of automatic fire suppression systems should be assessed.
- 4.12. Fire propagation and the potential for fire-induced radiological dispersal through the facility air distribution system should be considered. These effects should be considered for the normal operating mode of the air distribution system as well as alternate modes, such as shutdown, that may result from the fire.
- 4.13. A tool that may be used in the development of an FHA is a fire model, such as those developed by the National Institute of Standards and Technology, as applied by qualified fire protection engineers. However, the use of such models is predicated on their being conservative and validated. As of this date, DOE has not sanctioned the use of any one model for use in an FHA. DOE acceptance of individual models will be considered on a case-by-case basis. Alternately, an assumption can be made that all potentially vulnerable systems will be damaged within the fire area. Acceptable

exceptions to this assumption are water-filled steel pipes, tanks, and similar components of superior structural integrity with welded fittings and adequate pressure relief.

- 4.14. The quantity and associated hazards of flammable and combustible materials that can be expected to be found within the fire area should be factored into the analyses. Consideration should also be given to the presence of transient combustibles associated with storage and maintenance activities. Averaging combustible loading as a means to characterize the fire severity is not considered an acceptable technique.
- 4.15. FHAs for high-bay locations should consider the effects of smoke/hot gas stratification that may occur at some intermediate point below the roof or ceiling. Similarly, the effect of smoke movement through doors and dampers held open by fusible links needs to be addressed.
- 4.16. The fire hazards analysis, including all assumptions, should be documented. When both an FHA and a SAR are developed for a facility, the developmental effort should be coordinated to the maximum extent possible to avoid duplication of effort. It is recognized, however, that because an FHA is based on the premise that a fire will occur and considers fire safety issues (property loss and program discontinuity potential) that are not normally considered in the SAR, the conclusions of the FHA may be more conservative than would normally be developed by a SAR alone. Nevertheless, the FHA and its conclusions should be addressed in the facility SAR in such a manner as to reflect all relevant fire safety objectives as defined in Paragraph 4.2.0.1 of DOE 420.1 and Section 2 of Attachment 1 of DOE 440.1.

5.0. PERSONNEL

- 5.1. DOE Order 420.1, Paragraph 4.2.1.6; DOE Order 440.1, Attachment 1, Section 2; and the corresponding CRDs require DOE elements and contractors to have access to a qualified and trained fire protection staff.
- 5.2. A sufficient number of qualified fire safety professionals (fire protection engineers, fire department personnel and technicians) should be on staff to develop, implement and maintain the fire protection program. Staffing levels should be based on a "needs assessment," "work load analysis" or similar analysis that provides a technical basis for the fire safety staff. In those instances where a site is of

insufficient size to warrant a fire protection staff or emergency response force, such capability should be achieved by other means, such as reliance on off-site fire departments or fire brigades and fire protection engineering support contractors.

6.0. FIRE DEPARTMENT OPERATIONS

- 6.1. DOE Order 440.1, Attachment 1, Section 2 and the corresponding CRD require access to a fully staffed, equipped and trained fire department.
- 6.2. Responsibilities of DOE fire-fighting forces include:
 - Fire Suppression
 - HAZMAT Response (where assigned)
 - Training
 - Search and Rescue
 - Inspection, Testing and Maintenance (where applicable)
 - Emergency Medical Services (where assigned)
 - Confined Space Entry
 - Off-Site Assistance
- 6.3. The actual organization of site emergency response forces to accomplish the above responsibilities should be determined on the basis of a "Needs Assessment," "Operational Basis Document," or equivalent analysis. This analysis should be based on conformance with applicable industry standards, such as those promulgated by the NFPA, the Department of Defense (DOD Instruction 6055.6), as well as supplementary guidance developed by DOE. It should include organizational responsibilities, collateral duties, facility hazards, response time requirements, personnel levels, required apparatus and equipment. In addition, the document should describe the organization's various programs which support its personnel. This should include training, physical fitness and medical programs relating to emergency responders. To facilitate this effort, a DOE "model" baseline needs assessment was developed and is contained in the DOE Fire Protection Resource Manual (Handbook).
- 6.4. In developing a comprehensive needs assessment, the basic assumption should be that there is only one emergency incident (such as a fire) occurring on site, with a casualty requiring emergency medical assistance. However, the document should also describe how the fire department would respond if a second

incident occurred while the first was underway. The second response capability could be based on documented mutual aid agreements and utilization of some percentage of off-duty personnel over time. To the extent that an unacceptable response capability would exist for this second emergency, a basis would exist to supplement existing emergency response forces to be able to deal effectively with it.

- 6.5. A critical factor in any such analysis is the minimum response time necessary to begin active fire suppression activities. The determination of a minimally acceptable response time should be based on risk and should reflect "alarm handling," "travel time," and "access time." In the absence of explicit DOE criteria for response time, Department of Defense fire safety criteria may be used, with provisions for deviations with justification.
- 6.6. The minimum number of trained fire fighters necessary to begin interior structural fire-fighting should be five, in line with longstanding DOE policy. (It is recognized that, where lives may be at risk, the on-scene commander has the authority and responsibility to effect rescue with less than this minimum if, in his judgment, it is safe to do so.) Additional emergency response personnel will be necessary where multiple hose lines are required to effectively suppress a fire and to support other fire ground activities such as search and rescue.
- 6.7. The minimum number of personnel required for exterior fire-fighting, hazardous material incidents, specialized rescue or other related events should be based on DOE fire protection criteria (see Section V, Appendix), pre-planning where possible, and the judgment of trained and experienced fire department officers.
- 6.8. When no site fire department or brigade exists and when reliance will be placed on off-site fire departments, a plan should be developed that details how such forces will be expected to respond in conjunction with the site emergency plan and how appropriate training and site familiarization will be provided to ensure that the off-site fire departments will be prepared for fires that occur on site. Appropriate drills should be performed periodically to verify the effectiveness of the plan.
- 6.9. Training of emergency responders should be based on existing requirements such as those delineated in 29 CFR Parts 1910 and 1926, as well as criteria developed by the NFPA. In addition, emergency responders should be provided with sufficient site-specific training and familiarization to enable them to deal

effectively with the unique conditions which characterize DOE facilities. As part of this effort, regular facility tours should be conducted utilizing current pre-plans.

- 6.10. Drills and exercises should be structured to emphasize realistic scenarios and feature standard fire department tactical evolutions. Such drills should also be scheduled, as appropriate, during weekends and evening shifts when normal activities are reduced.
- 6.11. Emergency radio communication should be compatible with other organizations involved with emergency response and should be designed to be effective in areas subject to structural interference.
- 6.12. The "fleet" of fire department apparatus should reflect all site-specific response requirements including those delineated in the first paragraph above. Other examples include rough terrain rescue and wild land fire response. Periodic replacement programs for apparatus should be structured to avoid excessive "down time" and repair costs and should reflect the industry norm of useful life cycles (e.g., 20 years).
- 6.13. Fire stations, where provided, should be designed to provide sufficient capacity for mobile apparatus, including maintenance functions. Living quarters should provide a comfortable, private and safe environment for personnel, consistent with industry norms. This includes adequate sleeping quarters, kitchen facilities, training rooms, physical fitness areas and other ancillary needs. To the extent that related occupancies such as alarm rooms, maintenance rooms, and personnel areas are co-located within the same facility, appropriate fire-rated physical separation, ventilation and exhaust, and other fire protection features should be provided to prevent interference and to ensure the viability of individual areas in the event of a fire.
- 6.14. Fire stations should be "centrally" located to the facilities protected so as to minimize response time. Station location should also reflect prevailing traffic patterns, railroad tracks and other sources of delay.
- 6.15. Consistent with the training needs identified above, adequate facilities should be provided for training. This includes "live fire" training, confined space entry, vehicle extrication, hazardous material response, and other site-specific conditions. Where on-site training facilities are unavailable, arrangements should be made for appropriate training for fire department personnel off-site.

7.0. FIRE SAFETY ASSESSMENTS

- 7.1. DOE Order 420.1, paragraph 4.2.1.9 and the corresponding CRD require a comprehensive fire protection self-assessment program.
- 7.2. The principal objective of a fire safety assessment is to identify significant fire safety deficiencies that would prevent the achievement of DOE's fire safety policy objectives.
- 7.3. Facility and programmatic assessments should be performed by a fire protection engineer with an appropriate level of knowledge and experience in the application of fire safety codes and standards to diverse facilities. Fire department assessments should be performed by an individual with an appropriate level of knowledge and experience in all facets of fire department organization, equipment, and operations. Assessments should encompass the following elements of the fire protection program:
 - 7.3.1. Program-related:
 - Comprehensiveness of the fire protection program
 - Procedures for engineering design and review
 - Procedures for maintenance, testing, and inspection
 - Fire protection engineering staff (number, qualifications, training)
 - Fire suppression organization (personnel and training)
 - Emergency medical response organization
 - Hazardous material release containment and emergency cleanup organization
 - Fire suppression mutual aid agreements
 - Management support
 - Exemptions and documented equivalencies
 - 7.3.2. Facility-related:
 - Fire protection of safety class equipment

- Life safety considerations
- Fire protection of vital programs
- Fire protection of high-value property
- Fire suppression equipment
- Water runoff
- Pre-fire plans
- Fire apparatus accessibility
- Completeness of fire hazards analyses
- Fire barrier integrity
- Completeness of fire loss potential (MPFL) determinations
- Fire safety training

7.3.3. Combined Aspects (Program and Facility):

- Conformance with applicable Orders, codes and standards
- Inspection, testing, and maintenance reports
- Adequacy of facility appraisal reports
- Tests, inspections, procedures, and records for maintaining fire protection systems and features
- Administrative controls
- Temporary protection and compensatory measures
- Status of findings from previous assessments

7.4. Conformance with applicable but outdated consensus standards may not, in itself, justify a conclusion that a facility has achieved an acceptable level of safety. The code of record may be significantly nonconservative in terms of current design requirements, such as seismic design criteria. In such instances, the most recent code or standard may be applied selectively in the assessment as a basis for drawing conclusions regarding the adequacy of fire protection.

7.5. The frequency of assessments should be as follows:

7.5.1. Annual fire protection assessments should be made of facilities valued in excess of \$100 million, facilities considered to be a high hazard, or those in which vital programs are involved as defined by DOE.

7.5.2. Remaining facilities should be assessed at least every 3 years or at frequencies determined by the AHJ.

7.5.3. Comprehensive assessments of fire protection program elements should be made every 2 years.

7.6. Assessment reports should include a description of what was done during the effort (areas toured, documents reviewed, people interviewed). It should feature a "baseline" description of the facility, hazards and other occupancy considerations, and fire protection features. In addition, the report should document changes of significance that have occurred within the facility since the last assessment that affect fire safety, and it should list all noted deficiencies, along with a recommendation for remediation and interim compensatory measures, if necessary, pending resolution. A "model" assessment report is contained in the DOE Fire Protection Resource Manual (Handbook).

8.0. FIRE SAFETY EXEMPTIONS AND EQUIVALENCIES

8.1. DOE 420.1, paragraph 4.2.1.11 and the corresponding CRD require the development of a process for reviewing and approving fire safety "exemptions" and "equivalencies."

8.2. An "Exemption" is the approved deviation from an Order, non-statutory code or standard. An "Equivalency" is a determination by the DOE AHJ that a code or standard has been met by alternate means.

8.3. The process begins with a determination that a basis for an exemption or equivalency determination exists. This could be done by either DOE or the contractor. An analysis is then developed to evaluate its potential acceptability. This is usually prepared by the contractor for submittal to DOE.

8.4. The level of documentation necessary to support an exemption or equivalency will vary, depending on the issue. As a minimum, DOE would expect that each analysis identify the specific site location or condition at issue; the paragraph/section of the code or standard which addresses the issue; a discussion as to why the literal requirements of the code or standard cannot be met; and a discussion which justifies the conclusion that the alternate configuration is acceptable or equivalent from a safety perspective to what is stipulated in the code or standard.

- 8.5. When a positive determination is made in support of the exemption or equivalency, the documentation should reflect the signatures of all those involved in the decision, including that of the cognizant DOE fire protection engineer.

9.0. FIRE PROTECTION DESIGN BASIS

- 9.1. DOE 420.1, Section 4.2.2; DOE Order 440.1, Attachment 1, Section 2; and the corresponding CRDs establish fire protection design requirements for DOE facilities.
- 9.2. Design aspects of new DOE facilities as well as modifications to existing facilities should be based on the provisions of the applicable requirements of the Code of Federal Regulations (CFR), the local building and fire code, and the applicable NFPA Codes and Standards. Where conflicts arise in the application of these criteria, the most cost-effective solution should be adopted. The design process should include appropriate oversight by a qualified fire protection engineer of plans, specifications, and testing of fire protection features.
- 9.3. Life safety provisions should be provided for all facilities in accordance with the Life Safety Code (LSC), NFPA Standard 101. The methods outlined in NFPA 101A, "Alternate Approaches to Life Safety," may be applied with judgment to all facilities to obtain an equivalent level of life safety where strict compliance with the LSC is not cost-effective. Additional or modified exit requirements for toxic and explosive environments should be as determined by the DOE AHJ. In addition, for explosives environments, exits should reflect the criteria contained in the DOE Explosives Safety Manual (DOE/EV 06194). Where noncompliance with some LSC provisions may be required for public safety, as in some containment structures, additional fire protection features and personnel limits should be maintained. Compliance with the LSC is considered by DOE to satisfy the exit requirements of the applicable building code and 29 CFR 1910.
- 9.4. Many unique aspects of DOE facilities are not addressed or are insufficiently addressed by the CFR and other applicable codes. DOE has developed or adopted supplemental fire safety criteria as listed in Section V. as an Appendix. These include fire protection design criteria. The design criteria are considered guidance. Alternate design configurations may be adopted when justified.
- 9.5. A fundamental precept of the DOE Fire Protection Program is that all facilities of significance (new

and existing), including facilities where a fire could cause unacceptable off-site or on-site consequences to health and safety, should be protected by automatic fire suppression systems (usually sprinkler systems).

- 9.6. The need for an automatic fire suppression system may be revealed on the basis of conclusions resulting from a fire hazards analysis or SAR. The FHA should be predicated on the assumption that a fire will occur. The nature of that fire depends on the hazards present at any given time within the facility. The resulting protection should be designed to ensure that a fire will be successfully controlled until such time that emergency response forces arrive to complete extinguishment.
- 9.7. Because the Department does not benefit from or pay premiums for insurance coverage as does private industry, DOE has an obligation to provide protection for its facilities such that a fire will not result in an unacceptable program delay or property loss. Consequently, the Department considers any facility in excess of 5,000 square feet in ground floor area and any facility with a MPFL of \$1 million as warranting protection by an automatic fire suppression system. This is consistent with building code requirements and insurance industry practice. Additionally, when the MPFL exceeds \$50 million, a redundant fire protection system should be provided that, despite the failure of the primary fire protection system, will limit the loss to below \$50 million. Such redundant protection could be a fire-rated barrier system or a smoke detection system in conjunction with a fully capable fire department, among other options. A decision not to provide protection for such facilities would need to be thoroughly justified and approved by the DOE AHJ.
- 9.8 It may be necessary to exceed or supplement the requirements of the applicable NFPA code or standard when designing fire protection systems designated as safety class in the SAR, or whose loss of structural integrity could jeopardize such systems. Such additional design requirements would only be required when justified on the basis of the conclusions of the SAR.

10.0. PROTECTION FOR ABANDONED FACILITIES

- 10.1. DOE 420.1, Section 4.2.2; DOE 440.1, Attachment 1, Section 2; and the corresponding CRDs

establish fire protection requirements for DOE facilities. All of these requirements may not be appropriate for abandoned facilities and facilities undergoing decontamination and decommissioning (D&D) and safe shutdown. Decisions relating to fire safety of such facilities should be made on the basis of the following principles.

- 10.2. The evaluation of fire risks in relation to the need for fire safety features can be accomplished through a graded fire hazards analysis (FHA).
- 10.3. The need for fire protection features in these facilities is governed by the fire risks to the public, workers, fire fighters and the potential release of hazardous and radiological materials to the environment. Property protection and program continuity are not normally factors to consider unless the facility possesses a definable value and/or mission as determined by the DOE AHJ or if a fire would significantly increase the cost of clean-up.
- 10.4. Fire hazards within these facilities may change over time. Fire protection must be adequate to deal with these changes. The FHA should be revised as appropriate when significant changes in occupancy or hazard occur that affect fire safety.
- 10.5. Fire safety features that have been required by DOE may be rendered inoperable or considered no longer needed if justified by the FHA. Such features may be abandoned in place until they are dismantled as part of planned demolition activities.
- 10.6. The decision to deactivate automatic fire suppression systems in large facilities must reflect the possibility that the fire department may not be able to safely enter the facility to effect manual fire suppression. A "stand off and protect" tactical approach, which features exterior fire attack and protection of exposures, should be approved by DOE as part of the fire department pre-plans or their standard operating procedures. This approach necessitates additional emphasis on maintaining communication and cooperation between facility personnel and the fire department to include updating fire pre-plans and being aware of changes in occupancy and fire protection system status.
- 10.7. Retained fire protection features in these facilities are not required to comply with all of the design and installation criteria of the governing NFPA standard if the DOE AHJ concurs that the system will

function adequately during a fire in its current design mode. Concurrence should be documented in an appropriate manner after consultation with the cognizant DOE fire protection engineer.

- 10.8. Retained fire protection features should be inspected, tested and maintained in a manner sufficient to ensure that the features will function adequately during fire incidents.
- 10.9. Abandoned, safe shutdown and D&D facilities and related procedures should be routinely inspected and reviewed by representatives of the fire department and fire protection engineering staffs consistent with established standard operating procedures and fire protection program criteria. Tours of the D&D facilities should also be conducted by the fire department to familiarize them with existing conditions and to revalidate fire pre-plans. Drills and training exercises should also be conducted at these locations at an appropriate frequency commensurate with the fire risks and complexity of the facility.
- 10.10. Prior to commencement of D&D activities, appropriate procedures should be approved and implemented (including worker training) governing the control of potentially hazardous operations including, but not limited to, cutting and welding, handling of combustibles, and smoking.
- 10.11. The fire risks associated with materials and processes used as part of the D&D process should be evaluated by a fire protection engineer. Fire protection features must be adequate to minimize these risks to an acceptable level.
- 10.12. The deactivation of process lines containing hazardous materials as well as flammable or combustible liquids should be preceded by an analysis or performed under a work plan which addresses the methods used to control related hazards during the deactivation process. Appropriate safeguards need to be in place to minimize the accidental release of residual materials that may remain in piping and tanks.
- 10.13. Building emergency egress features are required to be maintained consistent with the requirements for buildings under construction, as a minimum, as modified by the FHA. These include emergency lighting and exit signs. Locked and abandoned facilities where there is no human occupancy would not need to maintain emergency egress features. Literal conformance with the provisions of the Life

Safety Code (NFPA Standard 101) is not required for conditions that have no significant impact on the ability of occupants during D&D to safely evacuate a building during a fire.

- 10.14. Where no automatic system exists, an effective means for manually summoning the fire department and for communicating with personnel inside of a building is required. This can take the form of an exterior fire alarm pull station or call box, telephone (fixed or mobile), radio or some combination of the above based on the accessibility of the devices to personnel and their reliability.
- 10.15. All retained interior fire protection systems should be maintained operational to the extent possible while interior D&D activities are taking place. Verification of operable status should include appropriate inspection and testing in accordance with established procedures. Complete deactivation is anticipated at such time as shell demolition occurs. Temporary deactivation of fire protection features should be treated as an impairment, with appropriate interim compensatory measures implemented until such time as the feature is returned to full operational mode.
- 10.16. The site and facility fire water distribution system, including hydrants, siamese connections to sprinkler systems, and interior standpipe systems, must be maintained in an operable mode. Access for mobile apparatus for emergency response should be maintained. (Refer to fire department pre-fire plans.)
- 10.17. To the extent that the FHA validates the need to maintain fire protection features during D&D activities, such features should be inspected, tested and maintained, consistent with established procedures, sufficient to ensure that they will function effectively during a fire. This implies that defects or design deficiencies that are not critical to effective performance, as determined by the AHJ, may remain as is.

11.0. IMPLEMENTATION PLAN

- 11.1. The implementation plan for fire protection should include a commitment to comply with DOE 420.1 and 440.1 (for contractors, the corresponding CRDs) and to conform with the other fire safety criteria that DOE has established as its basis for a comprehensive program (see Section V. Appendix). This should also include a commitment to develop site-specific policies, programs, practices and procedures as necessary to address any aspect of the program that is not encompassed by DOE

criteria.

- 11.2. When aspects of a comprehensive program are not currently in place, the plan should clearly identify existing deficiencies, specify the measures that will be implemented to address these deficiencies, identify the resources necessary to fulfill the commitment, and identify appropriate interim compensatory measures that will be put in place to ensure an acceptable level of fire safety.

Section V. ADDITIONAL INFORMATION

Appendix. DOE REFERENCED FIRE PROTECTION CRITERIA

- . Code of Federal Regulations (CFR) 29, Part 1910, Occupational Safety & Health Standards
- . CFR 29, Part 1926, Safety & Health Regulations for Construction
- . National Fire Protection Association (NFPA) Codes and Standards
- . Other DOE Orders and statutory requirements, not listed above, that contain requirements of a more limited extent relating to the DOE Fire Protection Program
- . DOE-STD-1088-95, "Fire Protection for Relocatable Structures"
- . DOE-STD-1061-XX, "Fire Protection Design Criteria" (in draft)
- . DOE Explosives Safety Manual, DOE/EV/06194
- . Uniform Building Code or local building code (if the local code is enforced on site) and the companion fire code for the governing building code
- . DOE Fire Protection Resource Manual (Handbook), DOE-HDBK-1060-XX
- . Department of Defense Instruction Number 6055.6, December 15, 1994, "Fire and Emergency Services Program"
- . National Fire Protection Association Handbooks, Guides and Recommended Practices
- . Factory Mutual Loss Prevention Data Sheets
- . Society of Fire Protection Engineers (SFPE) Handbook
- . American Petroleum Institute Guidelines
- . USNRC Guidelines on Fire Protection for Fuel Cycle Facilities, (Vol.) 57 Federal Register, (Pages) 35607-13, August 10, 1992