11.0 FIRE SAFETY

11.1 Purpose of Review

The purpose of this review is to ensure that the applicant for a gaseous diffusion plant (GDP) has demonstrated that the proposed equipment, facilities, and procedures provide assurance of adequate fire safety sufficient to protect health and minimize danger to life or property, in accordance with stated regulatory requirements for those systems, structures, and components (SSCs) determined to be important to plant fire safety. This includes those areas that may not of themselves be important to plant fire safety, but that present a fire exposure to those areas identified as important, the result of which could compromise plant fire safety.

11.2 Responsibility for Review

Primary: Fire Protection Specialist

Secondary: Certification Project Manager

Supporting: Resident Inspector Staff

11.3 Areas of Review

The staff reviews the application by using the general and specific procedures provided in the following sections. The reviewer should examine the level of plant fire safety proposed or established by the applicant to evaluate the adequacy of plant fire safety to protect health and minimize danger to the life of both plant personnel and the public, to minimize damage to property relied on for safety, and to minimize any significant effect on the quality of the environment as a result of fire. Areas of review include: (1) organization and conduct of operations, (2) fire protection features and systems, (3) manual fire-fighting capability, and (4) fire hazard analysis/fire hazard survey.

11.4 Review Procedures

11.4.1 Acceptance Review

The staff review should start with the primary reviewer's determination that sufficient information has been provided in the contents of the application to satisfy the requirements in 10 CFR 76.35, "Contents of Application," and 10 CFR 76.36, "Renewals," with respect to fire safety for GDP facilities—see Standard Review Plan (SRP) Section 11.5.1, "Regulatory Requirements"—and that the topics discussed in SRP Section 11.3, "Areas of Review," have been addressed.

If significant deficiencies are identified in the application, the applicant should be requested to submit additional material before the staff resumes the application review.

11.4.2 Evaluation

The staff will review the application portions related to fire safety by comparing them to the acceptance criteria contained in SRP Section 11.5.

On the basis of its review, the staff may request that the applicant provide additional information or modify the submittal to meet the acceptance criteria in Section 11.5 of this SRP.

The final step in the review is the primary staff reviewer's writing of a Compliance Evaluation Report (CER) that summarizes the conduct of the review, identifies what material in the application forms the basis for a finding of reasonable assurance with respect to the acceptance criteria, and presents the bases for certificate conditions that may be necessary to conclude that reasonable assurance is achieved.

11.4.2.1 Organization and Conduct of Operations

The application will be reviewed by the staff fire protection specialist to verify that the applicant has established and implemented a comprehensive fire protection program throughout the facility to ensure safe operation. This review will address specific management controls related to fire protection activities, QA measures, and documentation and recordkeeping related to fire protection. Specific provisions related to the establishment and implementation of a comprehensive QA program should be reviewed in accordance with the provisions of Chapter 3.0 of this SRP.

The reviewer should examine the specific management functions identified as having responsibility for fire protection issues. Organization, qualifications, and training with respect to plant fire protection will be examined. The reviewer should evaluate the documentation describing the plant's administrative controls for fire prevention, including (1) the control of combustibles and ignition sources, and (2) a formal permit-to-work system.

The reviewer should ensure that the configuration management system established to control the engineering review of design changes and modifications considers the potential impact on fire protection.

The reviewer should ensure that the applicant is committed to maintaining documentation to evidence a functioning fire protection program. Such documentation includes technical qualifications and experience required of personnel; training; a permit-to-work system; design, installation, inspection, maintenance, and testing of fire protection features (both passive and active); manual fire-fighting capability; the fire hazard analysis or survey; fire incident records; and fire protection inspections and audits. Specific provisions related to the establishment and implementation of the comprehensive records management system for the facility should be reviewed in accordance with the provisions of Section 2.6 of this SRP.

11.4.2.2 Fire Protection Features and Systems

The application should be reviewed by the staff fire protection specialist to verify that the certificate holder's program will minimize danger to life or property through the provision of fire protection features and systems. This review should include plant layout and construction features; and the fire safety of facility processes, equipment, and storage; and installed fire protection features, including fire detection and alarm systems and fixed fire-suppression systems.

The staff should review the description of the fire protection aspects of the layout, design, and construction of the entire facility. The information described in Chapter 4.0 in this SRP may serve as the basis for the description of the site and facility. However, additional details may be necessary to evaluate the adequacy of fire protection. If necessary, the reviewer should evaluate plant documentation of architectural floor plan drawings of all buildings, including process, storage, office, and associated structures such as emergency power, cooling towers, and related facilities to the extent that fire involving any of these features could affect the safety of radioactive materials, details of combustible construction materials used throughout the site, fire doors, fire dampers, and barrier-penetration seals, details of the ventilation and drainage system related to fire protection, normal and emergency lighting systems, and means of access to and egress from each building compartment.

Many details of plant security are outside the scope of fire protection. However, the reviewer should evaluate plant documentation that demonstrates that security measures do not compromise important fire protection features, such as means of egress for site personnel and access to plant areas for fire-fighting personnel.

The staff should review for completeness the description of the process and operational features important to fire protection. The information described in Chapter 4.0 of this SRP may suffice as the basis for the facility process description. The reviewer should examine equipment-arrangement drawings showing location of SSCs important to safety (including power and instrumentation cable routing, where significant). The reviewer should examine the plant's listing of all flammable and combustible liquids and gases used in the facility, including quantities and location of materials. In addition, the reviewer should examine the plant's listing of radioactive and hazardous materials (including quantities and location) that could significantly affect health or the quality of the environment through a release in the event of fire.

The staff should review the description of the fire protection features designed to detect and suppress fires throughout the facility and to provide employee notification of fire conditions. The reviewer should examine the description of the water supply proposed for fire protection use, including related aspects of storage, pumping, and distribution-piping systems. The reviewer should examine the description of the fire detection and alarm system, including classification of alarm circuits, the specific equipment type and location in each fire area, local fire alarm means, remote alarm annunciation, and employee notification and evacuation means in the event of fire. Furthermore, the reviewer should examine the detailed description of fire-suppression systems, including specific equipment type and area of coverage within each fire area. System suppression design densities for water-based systems (or concentrations for CO_2

or Halon systems) should be compared with the applicable National Fire Protection Association (NFPA) code requirements.

The staff should review the listing of design-basis documents for all construction features and fire protection features (both passive and active). References to the codes of record for design of all fire protection systems, equipment, and components should be examined. Additional design-basis documents should be examined to evaluate compliance with standard building codes, where applicable.

The reviewer should evaluate the documentation describing the plant's procedures for the inspection, maintenance, and testing (where applicable) of fire protection features (both passive and active). Specific provisions related to the establishment and implementation of the inspection, maintenance, and testing program for fire protection features important to plant fire safety should be reviewed in accordance with the provisions of Chapter 6.0 of this SRP.

11.4.2.3 Manual Fire-Fighting Capability

The application should be reviewed by the staff fire protection specialist to verify the licensee's manual fire-fighting capability. The plant's provisions for the fire-fighting organization, manpower, training, equipment, and pre-fire emergency planning for both onsite and offsite resources should be examined, as applicable.

The reviewer should evaluate the description of the manual fire-fighting capability proposed for the facility. The description includes (1) the establishment and organization of the immediate action response team, (2) the onsite fire brigade team, (3) reliance on qualified offsite resources, or (4) a combination of these approaches, as appropriate for the facility. The reviewer should determine that the management position(s) identified have authority and responsibility for overall management, organization, and coordination of fire-fighting activities at the facility, including liaison with offsite resources, where appropriate. Where the fire-fighting response is provided from a designated offsite resource, the reviewer should examine the formal agreement(s) and any documents submitted to demonstrate that the manpower, equipment, and training provided are adequate to protect health and minimize danger to life or property in the event of a fire at the facility.

Where an onsite fire brigade is provided, the reviewer should evaluate the facility's documentation describing the minimum personnel available for fire-fighting, the fire-fighting equipment provided, the training regimen, and the qualifications required of personnel assigned to the fire brigade. The description of the initial training program and refresher training, classroom training sessions, subjects covered in the training program, live-fire (hands-on) training, medical qualifications, fire-drill practice sessions, and coordination of training between onsite and offsite resources (where applicable) should be examined.

The reviewer should evaluate the documentation describing the detailed pre-fire emergency plans developed for all areas of the facility that could compromise plant fire safety (including those plant areas that could expose areas important to fire safety). These pre-fire plans supplement the general emergency preparedness plan discussed in detail in SRP Chapter 9.0 of the Safety Program Description. The pre-fire emergency plans provide documentation of all

appropriate information needed by firefighters to use safe and effective fire-fighting techniques in each compartment or fire area. The pre-fire emergency plans also assign responsibility for specific actions such as shutting down processes and implementing personnel evacuation. The reviewer should evaluate the documentation describing the complete set of procedures for the inspection, maintenance, and testing of all manual fire-fighting equipment provided at the facility, as applicable.

11.4.2.4 Fire Hazard Analysis/Fire Hazard Survey (FHA/FHS)

The application should be reviewed by the staff fire protection specialist to determine if specific certificate conditions are proposed that commit the certificate holder to conduct a comprehensive FHA (see SRP Chapter 5.0, "Hazard/Accident Analysis") as a means of documenting that the proposed facilities and equipment are adequate to protect health and minimize danger to life or property, including any significant effect on the quality of the environment.

The FHA may exist as a discrete, separate document specifically addressing fire protection and fire safety issues, but its essential information shall be integrated within the hazard/accident analysis (H/AA), a comprehensive document that addresses all hazards, including fires. The FHA consists of a systematic analysis of the fire hazards, an identification of specific areas and systems important to plant fire safety, the development of design-basis fire scenarios, an evaluation of anticipated consequences, and a determination of the adequacy of plant fire safety.

The reviewer should examine a listing of those SSCs identified as important to plant fire safety. The reviewer should examine samples of the plant's detailed analysis for each area containing these components as well as the analysis of each area that could present a fire exposure to an area identified as being important to plant fire safety.

The staff should determine if, for purposes of the facility's detailed FHA, the facility has been divided into designated fire areas along logical lines, such as functional areas divided by fire-rated barriers or defined spatial separation. The reviewer should examine the physical description, the postulated fire hazards, and a description of the fire protection features provided. The FHA provides a discussion of the design-basis fire scenario for each fire area and technical documentation indicating that fire protection features provided (including administrative or engineered controls) are adequate to protect health and minimize danger to life or property, including any significant effect on the quality of the environment. Adequacy is determined by the number and quality level of controls and is related to the accident consequences that the controls are intended to prevent or mitigate.

The reviewer should examine the specific compensatory measures that are identified which should be implemented on a temporary basis in the event that any identified fire protection feature, system, or component is inoperable. Both the compensatory measure to be implemented and the time schedule for its implementation should be examined. The reviewer should verify that where an FHA has not been performed, an FHS exists. The FHS will have much of the basic information contained in an FHA but will not include consequence analysis. The applicant reviews and upgrades the FHS, if necessary, on an annual basis, but the FHS is not expected to contain the level of analysis provided in an FHA. The staff should assure that

an FHA/FHS exists that reflects the current status of the facility and that concludes with a finding that there is no significant deficiency regarding fire protection at the facility.

11.5 Acceptance Criteria

The regulatory requirements, regulatory guidance, and regulatory review criteria applicable to this SRP are listed in the following sections:

11.5.1 Regulatory Requirements

The NRC regulations applicable to the areas of review in this SRP are found in 10 CFR Part 76.

11.5.2 Regulatory Guidance

The regulatory guidance applicable to the areas of review in this SRP is "Guidance on Fire Protection for Fuel Cycle Facilities" (*Federal Register*: Vol 57, No. 154, pps. 35607-35613, August 10, 1992), which presents the staff's position regarding fire protection for fuel cycle facilities.

NFPA standards and codes most appropriate for existing GDP applicants to use are listed below. Other codes may also be applicable for specific hazards or plant configurations, but they are not listed here. The reviewer does not need to check applicant compliance with all aspects of each standard. In cases where the reviewer considers the applicant's commitments to be deficient or missing, NFPA standards will set the acceptable minimum performance level.

NFPA 10	Portable Fire Extinguishers
NFPA 13	Installation of Sprinkler Systems
NFPA 15	Water Spray Fixed Systems for Fire Protection
NFPA 16	Deluge Foam-Water Sprinkler and Foam-Water Spray Systems
NFPA 20	Centrifugal Fire Pumps
NFPA 22	Water Tanks for Private Fire Protection
NFPA 24	Installation of Private Fire Service Mains and their Appurtenances
NFPA 25	Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
NFPA 30	Flammable and Combustible Liquids Code
NFPA 45	Fire Protection for Laboratories Using Chemicals
NFPA 51B	Fire Prevention in Use of Cutting and Welding Processes
NFPA 72	National Fire Alarm Code
NFPA 101	Life Safety Code
NFPA 220	Standard Types of Building Construction
NFPA 231	General Storage
NFPA 232	Protection of Records
NFPA 600	Private Fire Brigades
NFPA 780	Lightning Protection

The applicant may also use Occupational Safety and Health Administration (OSHA) regulations (29 CFR Part 1910) as criteria for various aspects of the facility fire protection program. The

applicant would clearly describe the basis (NFPA, OSHA, etc.) for specific numerical criteria in the facility fire protection program. Such criteria may include design parameters, inspection frequencies, and training frequencies.

Where the applicant has been certified or recertified based on partial commitments or no commitments to compliance with the above standards, the staff expects the applicant to periodically reevaluate its fire protection program in terms of compliance with the appropriate industry standards, identify nontrivial areas of noncompliance and document justifications.

11.5.3 Regulatory Review Criteria

The staff should use the following regulatory review criteria or information demonstrating acceptable alternatives in its review of the application. Acceptability should be based on the following:

11.5.3.1 Organization and Conduct of Operations

The reviewer should find a detailed discussion in the Safety Program Description providing the following information:

1. Organization and Management

    a. The specific responsibilities, and required skills and knowledge, of all facility positions involved in plant fire safety functions and activities are clearly identified in a formal, documented plant policy that includes a functional organization chart showing the position and authority of personnel involved in fire safety in relation to the overall plant organization.

    b. A single, senior management plant position is assigned the overall responsibility for plant fire safety. This position is not necessarily a full-time fire safety position only. In an organization where this position does not include responsibility for manual fire-fighting activities, a formal means of effective liaison and communication is established to coordinate fire safety efforts of all groups (both onsite and offsite, as appropriate).

2. Training and Qualifications

    a. Qualifications and experience are specified for all positions involved in fire protection functions and activities that affect plant fire safety.

    b. All site personnel are suitably trained and instructed in the general fire safety program of the plant.

    c. Specialized fire safety training is provided for plant personnel involved in operations and maintenance work at the facility.

    d. Specialized fire protection and fire-fighting training is provided for emergency response team members.

3. Fire Prevention Program

   a. Administrative procedures are established and implemented for control of combustible materials. The procedures establish controls for storage, handling, transport, and use of combustible solids, liquids, and gases. For areas identified as important to plant fire safety, the procedures establish controls for combustible construction materials and interior finish, *in-situ* and transient combustible materials, combustibles associated with normal facility processes and operations, and combustibles introduced during maintenance or modification activities.

   b. Controls are established to minimize the accumulation of transient combustibles, particularly packaging materials. Transient combustible materials are removed as soon as the activity is completed (or at regular intervals) or are temporarily stored in suitable containers. Accumulation of combustible materials is not permitted in areas identified as important to plant fire safety. Maintenance, contamination control, or other activities that can introduce significant transient combustibles into areas important to safety are approved by the facility fire safety organization.

   c. A detailed permit-to-work system is established and implemented to control activities that could introduce combustible materials or sources of ignition or that could degrade fire protection features (passive or active) important to plant fire safety. These controls include specific provisions for hot-work activities (e.g., welding and cutting) and trained fire-watch personnel.

11.5.3.2 Fire Protection Features and Systems

The reviewer should find a summary discussion, in the Safety Program Description, providing the following information:

1. Lightning protection for plant buildings determined to be important to plant fire safety is provided in accordance with the applicable provisions of NFPA Standard 780.

2. A reliable means of liquid containment and/or drainage is provided for all plant facilities, or manual actions by emergency responders will be used to contain liquid releases.

3. An automatic fire detection system covers areas of the plant important to safety. The appropriate choice of fire-detector type (smoke, heat, flame, or gas), location of equipment, area of coverage, and electrical circuit supervision are determined in accordance with the applicable provisions of NFPA Standard 72. A sprinkler system, designed and maintained in accordance with NFPA 13 and NFPA 25, may be considered an automatic fire detection system.

4. A reliable fire alarm system designed and installed in accordance with the applicable provisions of NFPA Standard 72 is provided in the facility.

5. An adequate and reliable water supply system, designed in accordance with NFPA standards, is provided for fire protection use. The system consists of the water source,

dedicated storage facilities, fire pumps, a distribution-piping network, sectional isolation valves, and fire hydrants, as applicable to the facility. The design and installation of the fire pumps, where provided, are in accordance with the applicable provisions of NFPA Standard 20. The design and installation of the distribution piping, valves, and fire hydrants are in accordance with the applicable provisions of NFPA Standard 24.

6. Fire-suppression systems and equipment are provided to protect areas determined to be important to safety. The design and installation of fire-suppression systems and equipment are in accordance with the applicable provisions of appropriate NFPA standards.

11.5.3.3 Manual Fire-Fighting Capability

The reviewer should find a detailed discussion in the Safety Program Description providing the following information:

1. Plant documentation provides a clear description of the manual fire-fighting capability proposed. Manual fire-fighting capability may be provided solely by a well-trained and fully equipped onsite fire emergency response team, by qualified offsite resources, or by a coordinated combination of the two approaches, as appropriate for the facility.

2. A specific plant position is identified to provide coordination and liaison with offsite fire-fighting resources and to establish a clear line of authority at the fire scene, when any reliance is placed on offsite response.

3. Where reliance for manual fire-fighting capability is placed on offsite resources (either for a partial or full response), a formal agreement is executed that documents the assistance provided by the offsite organization(s). The agreement provides a description of the minimum fire-fighting manpower and equipment to be provided during fire emergencies and the estimated response time.

4. Where manual fire-fighting capability is provided by an onsite fire emergency response team, the team is identified as being established, equipped, and trained to achieve one of the following objectives, as defined in NFPA Standard 600:

    a. Incipient-stage fire-fighting.

    b. Advanced exterior fire-fighting.

    c. Interior structural fire-fighting.

    d. Advanced exterior and interior structural fire-fighting.

5. A pre-fire plan is developed for each area of the facility determined to be important to plant fire safety. The pre-fire plan supplements the information provided in the emergency preparedness plan. At a minimum, the pre-fire plan identifies access and egress routes, location of SSCs determined to be important to plant fire safety, special radiological and toxic hazards, automatic and manually operated fire-suppression measures provided in

each fire area, restrictions on the use of specific fire-suppression agents because of nuclear criticality or other concerns, and location of vital heat-sensitive components or equipment. Pre-fire plans need not be included in the application for certification but should be available for onsite review.

11.5.3.4 Fire Hazard Analysis/Fire Hazard Survey

If an FHA or FHS is provided to support the hazard/accident analysis (H/AA), the reviewer should find a summary discussion in the fire safety program description providing the following information:

1. A comprehensive, systematic FHA/FHS should be integral with the H/AA (Chapter 5.0 of this SRP). The FHA/FHS reflects current conditions throughout the facility and is reviewed and updated as necessary at defined, regular intervals to document that fire protection measures are adequate to ensure plant fire safety. In addition, the FHA/FHS is revised to incorporate significant changes and modifications to the facility, processes, or inventories, as needed. The level of detail provided in the FHA/FHS reflects the complexity of the facility and the anticipated consequences from fire events (an FHS will normally not contain consequence analysis).

2. For the purpose of the FHA/FHS, the facility is divided into designated fire areas along logical lines, such as functional areas defined by fire-rated barriers or clearly defined spatial separation. Compartmentalization of the facility is identified on drawings showing the locations and fire-resistance ratings of passive fire protection measures, such as fire barriers, closures in fire-barrier openings, and locally applied separating elements.

3. At a minimum, for each designated fire area, the following fire hazards should be evaluated for potential fire severity and consequent damage:

    a. Fire load from solid combustible materials (both quantity and configuration), including those materials of construction, *in-situ* materials, and anticipated transient combustible materials.

    b. Flammable and combustible liquids and gases used in the process (quantities or flow rates). The FHA describes the lubricating and hydraulic oil systems, including layout, capacities, operating and emergency procedures, and special fire protection features.

    c. Process chemicals and materials (both quantity and location) that could present a toxic or radiological hazard or that could significantly affect health or the quality of the environment through a release as a result of a fire emergency.

    d. Potential ignition sources.

4. For each designated fire area determined to be important to plant fire safety, the FHA/FHS provides evaluations of the postulated accident sequences caused or aggravated by fire. Either quantitative or qualitative methods may be used. Where quantitative analytical methods are used, all input data and assumptions are documented.

5. The FHA/FHS defines those fire protection measures that provide reasonable assurance that the defined consequences of an accident sequence will not occur or will be mitigated. For the identified fire protection measures, the applicant specifies compensatory measures to be implemented on a temporary basis in the event the identified measures do not work. Both the compensatory measure(s) and the time schedule for implementation are established in the application.

11.6 Evaluation Findings

The staff's review should verify that sufficient information has been provided in the application to satisfy the intent of requirements in 10 CFR 76.35, "Contents of Application," and 10 CFR 76.36, "Renewals," with respect to fire safety and that the information provided is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete.

The staff could document the evaluation of the application as follows:

> *The staff has reviewed the fire safety program for [name of facility] according to SRP Sections 11.3, 11.4, and 11.5. In addition, the applicant has [the reviewer will describe the bases for this conclusion, addressing areas that were reviewed and a discussion of how the acceptance criteria have been met. The Compliance Evaluation Report should state that the applicant's proposed equipment, facilities, and procedures provide a reasonable level of assurance that adequate fire protection is provided and maintained for those SSCs determined to be important to plant fire safety, including protection of site personnel, the public, and any significant effect on the quality of the environment.]*
>
> *On the basis of its review, the NRC staff has concluded that the fire safety program is acceptable to support recertification.*

11.7 Reference

Code of Federal Regulations, *Title 29, Labor,* Part 1910, "Occupational Safety and Health Standards."