FAST FLUX TEST FACILITY
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PACIFIC NORTHWEST LABORATORY
RICHLAND, WASHINGTON
operated by
BATTelle MEMORIAl INSTITUTE
for the
UNITED STATES ATOMIC ENERGY COMMISSION UNDER CONTRACT AT(45-1)-1830
FAST FLUX TEST FACILITY

CONCEPTUAL SYSTEM DESIGN DESCRIPTION FOR THE PLANT FIRE PROTECTION SYSTEM No. 26

August 20, 1968

PACIFIC NORTHWEST LABORATORY
Richland, Washington 99352
Operated by Battelle Memorial Institute for the
U.S. Atomic Energy Commission under Contract No. AT(45-1)-1830
Incorporate Design Safety Criteria and editorial corrections.

Remove and destroy pages iii, 1-1, 1-2, 1-3, 2-5, 2-6, 2-7, A-1, A-2, B-1, and Distribution 1 through 3.

Add the attached pages iii, 1-1, 1-2, 1-3, 1-5, 2-5, 2-6, 2-7, A-1, A-2, B-1, and Distribution 1 through 3.

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PLANT FIRE PROTECTION SYSTEM

INTRODUCTION

The fire protection system for the FFTF is required for the safety of personnel and the protection of property.

Section 1.0, Functions and Design Requirements, of this CSDD is baseline data, the remainder is reference design.

The contents of this document support and expand the requirements established in the Overall Conceptual Systems Design Description. ¹

In order to develop the most satisfactory and proven fire protection system for use in a reactor facility which utilizes alkali metals, a review² of the state of the art was made. The results of this review of other sodium facilities is reflected in the fire protection methods selected for FFTF.

¹ Refer to References, Appendix A, Item 4.
² Refer to References, Appendix A, Items 9 and 10.
SECTION 1.0 FUNCTIONS AND DESIGN REQUIREMENTS

1.1 FUNCTIONS

The Plant Fire Protection System detects and annunciates fires and provides automatic or manual fire extinguishing capability. System functions include:

- detection of fires or incipient fires
- extinguishing fires
- actuation of local alarms and safety interlock circuits
- signalling fire station
- actuation of automatic fire extinguishing equipment
- indication of fire location.

1.2 DESIGN REQUIREMENTS

The design requirements for performing the functions outlined in Section 1.1 are listed below:

1.2.1 Basic Design Requirements

DDCN-1 A. Deleted
DDCN-1 B. Deleted
C. Provide products of combustion detectors in space locations where process requirements preclude the use of automatic water sprinklers. The detector must be compatible with the atmosphere in which they are located, including ionizing radiation atmospheres. Detector sensitivity, spacing, location and type to be used is the subject of a study.¹

D. Provide products of combustion detectors¹ in ventilation ducts or large plenums to supplement the fire protection system.

E. Provide gas or dry chemical extinguishing systems, where, because of the nature of materials in the contained space there is a hazard due to the use of water. The choice of a gas or vapor and dry chemicals or powder to be used is the subject of a study.²

F. Provide first aid fire extinguishers throughout the facility in accordance with NFPA recommendations. Mountings and cabinets shall be located to minimize the traffic hazard to personnel.

G. Emergency electrical power³ including a battery back-up system, shall be provided for local energy fire detection and alarm systems.

H. An adequate water supply⁴ for fire protection shall be provided.

I. Deleted

¹ Refer to Support Information Requirements, Appendix B, Item 1.
² Refer to Support Information Requirements, Appendix B, Items 2 and 4.
³ Refer to Interfaces, Appendix C, Item 1.
⁴ Refer to Interfaces, Appendix C, Item 5.
J. Where penetrations through biological shields are made by piping, the integrity of the shield shall be maintained.  

K. Where aqueous extinguishants are used, all floor or other penetrations must be constructed to preclude the entry of water into areas where water is a hazard.  

L. Both fire and incipient fire signals generated by the fire system shall be alarmed locally and also transmitted to the reactor control room and their origin identified. The alarms shall be consistent with Hanford Standard HWS-8210-S.  

M. Fire dampers are provided in the ventilation system based upon the Uniform Building Code and National Fire Codes as adapted to meet the radiological requirements of FFTF.  

N. A quality assurance program shall be provided and maintained in accordance with the requirements of BNWL-510, "Design and Development Quality Assurance Requirements for the FFTF" and BNWL-511, "Fabrication, Construction and Installation Quality Assurance Requirements for the FFTF"  

O. Provide testing capabilities of the entries fire protection system.  

P. All penetrations through containment vessel boundaries shall conform to the requirements of the Reactor Containment System.  

1. Refer to Interfaces, Appendix C, Items 4 and 8.  
2. Refer to References, Appendix A, Item 8.  
3. Refer to Interfaces, Appendix C, Item 7.  
4. Refer to References, Appendix A, Item 1.  
5. Refer to References, Appendix A, Item 3.  
7. Refer to Interfaces, Appendix C, Item 8.
Q. Provide sectionalizing capability of the fire protection system to permit maintenance. Consideration of fire areas and fire propagation shall be used in sectionalizing the system.

R. The electrical wiring required for the fire protection system shall be provided in conformance with the building electrical power system.¹

S. Provide electrical supervision of fire protection system equipment in accordance with Hanford Standard Design Criteria, SDC 7.8² and the equipment manufacturers requirements. Supervisory signals will be separated from trouble signals.

T. The fire protection system shall be designed so as to minimize interactions with interfacing plant systems to prevent degradation of the overall plant availability goal of 75%.³

U. Provide a fire alarm loop which will connect to the nearest fire station. Fire alarm control equipment will be provided in the fire station to accommodate FFTF.

V. Provide manual override capability of each automatic fire protection system, where feasible, to permit manual actuation of the system.

1.2.2 Concept Related Design Requirements

Provide standpipes in accordance with NFPA No. 14 in lieu of the hose cabinet requirements of Hanford Standards and the Uniform Building Code.

1. Refer to Interfaces, Appendix C, Item 1.
2. Refer to References, Appendix A, Item 3.
3. Refer to References, Appendix A, Item 11.
1.2.3 Design Safety Criteria

The following are safety-related requirements which correspond directly to the italicized items in the Design Safety Criteria for the Fast Flux Test Facility.1

A. Fire protection for the FFTF shall be provided on the basis of the dual criteria of compatibility with the facility processes and compliance with the AEC requirement of "improved risk" level of fire protection as defined in AECM 0552-042 and the RL Appendix 0552 (DSC 1.1)1

B. The design, fabrication, and construction of the fire protection and alarm system shall conform to the requirements of the Uniform Building Code,3 National Fire Codes,4 Hanford Standard Design Criteria,5 and Hanford Standards.6 (DSC 1.2)1

C. Water sprinklers and associated piping shall not be used or located in areas which contain sodium or are within reactor containment. (DSC 1.3)1

D. Where a hazard exists due to use of water extinguishers, extinguishing means shall be provided that are compatible with the material or equipment located in the area of concern. (DSC 1.4)

E. Manually operated portable extinguishers shall be provided throughout the facility. (DSC 1.5)

1. Refer to References, Appendix A, Item 14, Section 10.
2. Refer to References, Appendix A, Item 5.
3. Refer to References, Appendix A, Item 1.
4. Refer to References, Appendix A, Item 2.
5. Refer to References, Appendix A, Item 3.
6. Refer to References, Appendix A, Items 6, 7, and 8.
SECTION 2.0 DETAILED DESCRIPTION OF THE SYSTEM

2.1 SUMMARY DESCRIPTION

The Plant Fire Protection System either detects or detects and extinguishes fire in its early stages to alarm building personnel and to limit the loss of property. The system is made up of water sprinklers (including spray), products of combustion detectors, gas and dry chemical extinguishing systems. The proposed fire protection treatment for each of the spaces is indicated, beginning on page 2-2.

Water is utilized where there is no hazard due to water, such as alkali metal reaction. In addition to extinguishing the fire, a signal is transmitted to alert building occupants and summon emergency assistance. Fire hydrants are provided by the Site Facility.¹

Products of combustion detectors are utilized in areas where the use of water is precluded because of the hazard involved. These hazards include nuclear considerations and alkali metal reactions. During the incipient stage of fire, large quantities of invisible particles are produced as a result of the breakdown of combustible material. This system, utilizing a sensing element, has the ability to detect fires in the "pre-smoke" as well as the smoke stages. When a fire is detected, a signal is transmitted which can be used to actuate extinguishing systems, actuate safety interlocks, alert building occupants, and to summon emergency assistance.

¹ Refer to Interfaces. Appendix C, Item 5.
A gas or vapor extinguishing system\(^1\) is used where water must be excluded. This system utilizes discharge nozzles connected to piping which in turn is connected to a gas supply. This system may be actuated manually or by a signal received from products of combustion detectors.

The operation of this system requires that the space be "readied" prior to application of the gas. This operation consists of a series of sequential steps beginning with audible alarms, transmission of the signal to the Control Room and Fire Station, isolation of the space (shutdown of the ventilation system), a sufficient time delay to permit personnel egress, and finally release of gas into the space.

Separate gas supply tanks are provided by the fire protection gas extinguishing systems. In addition, the Inert Gas System\(^2\) provides emergency back-up gas supply for these systems.

A dry chemical or powder system is used where water must be excluded and a personnel hazard may exist if a gas extinguishing system is used. This system utilizes discharge nozzles connected by piping to cylinders containing dry chemical or powder extinguishants. When activated, the dry extinguishant is propelled through the nozzles by high pressure nitrogen gas. This system is actuated manually or by a signal received from products of combustion detectors. The choice of the dry chemical or powder to be used is the subject of a study.\(^3\)

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1. Refer to Support Information Requirements, Appendix B, Item 2.
2. Refer to Interfaces, Appendix C, Item 18.
Portable extinguishers are located throughout the building for control of fires. Class A rated extinguishers are provided throughout the facility for building protection where there is no hazard due to an alkali metal reaction. In addition, Class B, C, and D rated extinguishers shall be provided as required to meet the fire potential present. A suitable portable extinguishing system is to be available for use in normally inert spaces, when they are on air atmosphere.

In order to meet the functions outlined in Section 1.1, it is necessary that the fire protection system be coordinated with the functions performed in the various spaces in the building. A tentative schedule of the fire protection treatment for the major functional areas is indicated below for the reference building concept and is graphically shown in Appendix D, Figures 1 through 8. In addition, general interfaces are defined and are to be expanded as more information is available.

<table>
<thead>
<tr>
<th>ELEVATION</th>
<th>SPACE FUNCTION</th>
<th>FIRE PROTECTION TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>+65'0&quot;</td>
<td>Containment Work Area</td>
<td>Products of combustion detectors</td>
</tr>
<tr>
<td></td>
<td>Elevator and Stairway within containment</td>
<td></td>
</tr>
<tr>
<td>+56'0&quot;</td>
<td>Secondary Sodium Pump Room</td>
<td>Gas extinguishing system operated by products of combustion detectors</td>
</tr>
<tr>
<td>+47'0&quot;</td>
<td>Access Gallery</td>
<td>Automatic Water Sprinklers</td>
</tr>
<tr>
<td>+40'0&quot;</td>
<td>Secondary Sodium Piping</td>
<td>Gas extinguishing system operated by products of combustion detectors</td>
</tr>
</tbody>
</table>

1. Refer to Interfaces, Appendix C, Item 4.
2. Refer to Interfaces, Appendix C, Items 3, 9-17.
3. Refer to Interfaces, Appendix C, Item 19.
<table>
<thead>
<tr>
<th>ELEVATION</th>
<th>SPACE FUNCTION</th>
<th>FIRE PROTECTION TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>+35'0&quot;</td>
<td>Personnel Access Gallery Stairwell &amp; Elevator Shaft from Access Gallery</td>
<td>Automatic Water Sprinklers</td>
</tr>
<tr>
<td></td>
<td>Elevator Shaft &amp; Stairwell within containment Containment Work Area Personnel Air Locks</td>
<td>Products of combustion detectors</td>
</tr>
<tr>
<td>+30'0&quot;</td>
<td>Closed Loop Cells</td>
<td>These areas are normally under inert gas cover except during air purging operations. Fire protection requirements for this condition of operation will be determined by a study.¹</td>
</tr>
<tr>
<td>+20'0&quot;</td>
<td>Secondary Sodium Cleanup and NaK System</td>
<td>Gas extinguishing system operated by products of combustion detectors</td>
</tr>
<tr>
<td>+18'0&quot;</td>
<td>Rupture Monitor Equipment Service Gallery</td>
<td>Products of combustion detectors</td>
</tr>
<tr>
<td>0'0&quot;</td>
<td>Sodium Laboratory Equipment Air Lock Reactor Control Room</td>
<td>Products of combustion detectors To be determined¹</td>
</tr>
<tr>
<td></td>
<td>Secondary Sodium Storage and Auxiliary Equipment</td>
<td>Gas extinguishing system operated by products of combustion detectors</td>
</tr>
<tr>
<td></td>
<td>Conference Room Lunch Room Offices Shop Change Room Elevator Shafts &amp; Stairwells Personnel Air Lock Personnel Decon</td>
<td>Automatic Water Sprinklers</td>
</tr>
</tbody>
</table>

¹ Refer to Support Information Requirements, Appendix B, Items 2 and 5.
<table>
<thead>
<tr>
<th>ELEVATION</th>
<th>SPACE FUNCTION</th>
<th>FIRE PROTECTION TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-)8'0&quot;</td>
<td>Decay Storage Cell</td>
<td>This area is normally under inert gas cover except during air purging operations. Fire protection requirements for this condition of operation will be determined by a study.</td>
</tr>
<tr>
<td>(-)14'6&quot;</td>
<td>Instrument &amp; Electrical Equipment &amp; Auxiliary Equipment</td>
<td>To be determined¹</td>
</tr>
<tr>
<td>DDCN-1</td>
<td>(-)20'0&quot;</td>
<td></td>
</tr>
<tr>
<td>Radioactive Waste &amp; Contaminated Gas System &amp; Sodium Storage</td>
<td>Products of combustion detectors</td>
<td></td>
</tr>
<tr>
<td>Reactor Cavity</td>
<td>Primary Pumps and HX Cells</td>
<td>These areas are normally under inert gas cover except during air purging operations. Fire protection requirements for this condition will be determined by a study.</td>
</tr>
<tr>
<td>DDCN-1</td>
<td>Operating Galleries &amp; Stairwells</td>
<td>Automatic Water Sprinklers</td>
</tr>
</tbody>
</table>

¹ Refer to Support Information Requirements, Appendix B, Items 2 and 5.
<table>
<thead>
<tr>
<th>ELEVATION</th>
<th>SPACE FUNCTION</th>
<th>FIRE PROTECTION TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-)25'0&quot;</td>
<td>Equipment Transfer Cell, Examination Cell</td>
<td>These areas are normally under inert gas cover, except during air purging operations. Fire protection requirements for this condition will be determined by a study.¹</td>
</tr>
<tr>
<td></td>
<td>Cell Operating Area, Auxiliary Equipment &amp; Ramp, Elevator Shaft &amp; Stairwells</td>
<td>Automatic Water Sprinklers</td>
</tr>
<tr>
<td>(-)40'0&quot;</td>
<td>Fuel Receiving, Assembly and storage Equipment Transfer Room, Cell Service Level</td>
<td>Products of combustion detectors</td>
</tr>
<tr>
<td></td>
<td>Cell Operating Area, Operating Galleries, Auxiliary Equipment, Elevator Shafts &amp; Stairwells</td>
<td>Automatic Water Sprinklers</td>
</tr>
<tr>
<td>(-)55'0&quot;</td>
<td>Fuel Transfer Cell (Inert)</td>
<td>This area is normally under gas cover, except during air purging operations. Fire protection requirements for this condition will be determined by a study.¹</td>
</tr>
<tr>
<td></td>
<td>Fan Room (including plenums), Cell Operating Area, Operating Gallery &amp; Ramp, Elevator Shaft &amp; Stairwells</td>
<td>Automatic Water Sprinklers</td>
</tr>
</tbody>
</table>

¹ Refer to Support Information Requirements, Appendix B, Items 2 and 5.
<table>
<thead>
<tr>
<th>ELEVATION</th>
<th>SPACE FUNCTION</th>
<th>FIRE PROTECTION TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDCN-1</td>
<td>(-)65'0&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintenance &amp; Decontamination</td>
<td>This area is normally under gas cover, except during air purging operations. Fire protection requirements for this condition will be determined by a study.</td>
</tr>
<tr>
<td></td>
<td>Interim Examination Cell</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operating Galleries</td>
<td>Automatic Water Sprinklers</td>
</tr>
<tr>
<td>Unattached Structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exhaust Filter Vault</td>
<td>To be determined&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Air Blast Heat Dump</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emergency Power Generators</td>
<td>Dry chemical or gas extinguishing system operated by products of combustion detectors</td>
</tr>
<tr>
<td></td>
<td>Switchgear Building</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outdoor Transformers</td>
<td>Automatic water spray</td>
</tr>
<tr>
<td></td>
<td>Reactor Heat Transport Building</td>
<td>Gas extinguishing system operated by products of combustion detectors</td>
</tr>
<tr>
<td></td>
<td>Radioactive Waste Disposal Facility</td>
<td>Products of combustion detectors</td>
</tr>
<tr>
<td></td>
<td>Sodium Receiving</td>
<td>Portable First Aid Extinguishers</td>
</tr>
<tr>
<td></td>
<td>Steam Plant Maintenance &amp; Materials Storage Building Solvents &amp; Oil Storage Building Electrical Tunnels</td>
<td>Automatic Water Sprinklers</td>
</tr>
<tr>
<td></td>
<td>Engineering Operations Bldg.</td>
<td></td>
</tr>
</tbody>
</table>

1. Refer to Support Information Requirements, Appendix B, Items 2 and 5.
2.2 DETAILED DESCRIPTION

Fire protection of plant personnel and facilities is accomplished utilizing conventional equipment. Major system components are listed below.

2.2.1 Components

A. Automatic Water Sprinkler Systems. The required components for this system are described in detail in Volume 6, National Fire Codes (NFPA No. 13).\(^1\)

The components listed below are included in each system in the FFTF.
- Main control valves
- Fire department connections
- Test connections
- Sprinkler heads
- Supervisory devices
- Local alarm and fire department signalling device.

B. Automatic Water Spray Systems. The components required by code may be found in Volume 7, National Fire Codes (NFPA No. 15).\(^1\) The components listed below are included in each system in the FFTF.
- Main control valves
- Fire department connections
- Spray nozzles
- Supervisory devices
- Local alarm and fire department signalling device.

C. Products of Combustion Detector System. Major components include:
- Detector heads

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1. Refer to References, Appendix A, Item 2.
• Zone indicating cabinets
• Power supply cabinet
• Miscellaneous supplementary controls and alarms
• Local alarm and fire department signalling device
• Supervisory devices.

D. Gas Extinguishing System. Major components include:
• Gas storage facilities
• Time delay device
• Pre-discharge alarm
• Main discharge valve
• Remote manual system activating device
• Local alarm and fire department signalling device
• Supervisory devices.

E. Dry Chemical Extinguishing System. Major components include:
• Extinguishant pressure cylinders
• Time delay device
• Pre-discharge valve
• Main discharge valve
• Remote manual system activating device
• Local alarm and fire department signalling devices.
• Supervisory devices.

F. Fire Alarm Loop (Municipal)
• Control Console
• Power Supply.

2.3 INSTRUMENTS AND CONTROLS

Instrumentation, controls, and fire alarm signalling systems\(^1\) for the Plant Fire Protection System conform to the

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1. Refer to Support Information Requirements, Appendix B, Item 2.
2. Refer to Interfaces, Appendix C, Item 2.
specific requirements set forth in the applicable National Fire Codes¹ and Hanford Standards.²

2.3.1 Instrumentation and Controls

A. Low pressure water supply sensor and alarm are installed on each main automatic sprinkler system valve.

B. Electrical power loss sensors and alarms are installed in each power supply cabinet.

2.3.2 Plant Fire Alarm Signalling Systems

The Plant Fire Alarm Signalling System consists of several auxiliary systems connected to a new Hanford fire alarm loop for FFTF. Since the FFTF complex occupies a large area and contains a number of separate buildings and facilities (see Appendix D, Figure 8) the fire alarm signalling system must provide master boxes and separate signalling systems for specific buildings and areas. Each of the separate auxiliary systems sends a signal to the fire station and to the reactor control room to annunciate fire or trouble.

The signalling system for the reactor building complex includes a master control panel, local energy master box and annunciation panels located at the main entrance of the building and in the reactor control room.

Auxiliary buildings such as the Electrical Switchgear Building, have systems similar to that described for the reactor building, but less complex.

Outside facilities that do not have structures, but handle materials such as sodium, are provided with municipal type fire alarm boxes.

¹ Refer to References, Appendix A, Item 2.
² Refer to References, Appendix A, Items 3, 6, 7, and 8.
SECTION 3.0 SAFETY CONSIDERATIONS

3.1 HAZARDS

A. Water from automatic sprinklers in areas adjacent to spaces containing alkali metals is a hazard because of the fire and explosion potential.

B. Loss of the ability to transmit a fire emergency signal to the fire department because of electrical failure is a hazard to the building.

C. Loss of water supply during a fire emergency voids the capabilities of the automatic sprinklers resulting in a hazard to the building.

D. The use of gas extinguishing systems presents a life hazard to building occupants.

E. Rupture of water lines in areas containing alkali metals is a hazard because of the fire and explosion potential.

F. Failure of the gas extinguishing system to function results in the loss of ability to extinguish fires in areas where it is used.

G. Personnel injury resulting from burns, smoke inhalation and impaired visibility.

3.2 PRECAUTIONS

The following items correspond with items in Section 3.1 above.

A. Curbs or other positive devices are provided to preclude the entry of water used to fight conventional fires into areas containing alkali metals.

B. Emergency electrical power is provided to operate the fire alarm system. In addition, a battery backup system is provided.
C. Continuity of adequate sanitary water supply to fight fires during times of maximum demand on the system is assured by a water supply loop of adequate size supplied from two separate sources.¹ In the event of a fire during the loss of water supply, water for fire fighting purposes is supplied by the Fire Department tank truck.

D. Areas or spaces where gas extinguishing systems are used are provided for containment of the gas² and personnel alarm notification. Warning alarms as required in appropriate codes and standards are installed in these spaces.

E. Water pipes are not routed through areas which contain alkali metals.

F. Since the most probable cause of failure is a loss of gas supply, a backup supply of inert gas is provided by the Inert Gas System.³ Failures other than inert gas supply are remote; however, several first aid extinguishers are provided which may be used to assure life safety and to contain the fire.

G. Protective clothing is provided for personnel protection during alkali metal fire conditions. The requirement for this clothing is the subject of a study.⁴

¹ Refer to Interfaces, Appendix C, Item 6.
² Refer to Interfaces, Appendix C, Item 4.
³ Refer to Interfaces, Appendix C, Item 18.
⁴ Refer to Support Information Requirements, Appendix B, Item 3.
SECTION 4.0 PRINCIPLES OF OPERATION

4.1 STARTUP

This system is independent of normal plant startup operations. Placing the fire protection system in service includes the inspection, testing and acceptance of the various zone systems. Other FFTF Systems (Sanitary Water, Electrical, Communications, Sewer) will be involved at this point as well as during normal operation.

4.2 NORMAL OPERATION

This system is independent of normal plant operations. A description of the various equipment used follows:

4.2.1 Water Sprinklers

Automatic -- A system employing heat sensitive sprinkler heads attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by the heat from a fire. In addition to extinguishing the fire, a signal is transmitted to alert building occupants and summon emergency assistance.

4.2.2 Automatic Water Spray

This system consists of systems of open spray nozzles connected to and controlled by a quick-opening valve which is operated by heat sensing devices so that water discharges immediately when the heat sensors detect an abnormal temperature increase. In addition to extinguishing the fire, a signal is transmitted to alert facility occupants and summon emergency assistance.

4.2.3 Products of Combustion Detectors

During the incipient stage of fire, large quantities of invisible particles are produced as a result of the
breakdown of the combustible material. This system has the ability to detect fires in the "pre-smoke" as well as the smoke stages. When a fire is detected, a signal is transmitted which can be used to initiate extinguishing system, alert building occupants and summon emergency assistance. Detector sensitivity, spacing and location is the subject of a study.¹

4.2.4 Gas Extinguishing System

This system utilizes discharge nozzles connected to piping which in turn is connected to a gas supply. This system may be actuated manually or by a signal received from products of combustion detectors.

4.2.5 Dry Chemical Extinguishing System

This system utilizes discharge nozzles connected by piping to cylinders containing dry chemical extinguishants. When activated, the dry chemical is propelled through the nozzles by high pressure nitrogen gas. This system may be actuated manually or by a signal received from products of combustion detectors.

4.3 SHUTDOWN

Normal inspection and maintenance of these systems requires periodic disability. When they are shutdown, building occupants will be advised and appropriate administrative measures taken to assure that temporary fire protection capabilities are instituted.

4.4 SPECIAL OR INFREQUENT OPERATION

None

¹ Refer to Support Information Requirements, Appendix B, Item 1.
4.5 EMERGENCY

The failure of a part of this system would result in a "trouble" signal which would alert appropriate personnel to action. "Trouble" signals are separated from supervisory signals.

Loss of electrical power to the Plant Fire Protection System would not immediately impair the ability of the system to carry out its function because of battery backup to the detection system, local alarms, and signal transmission to the fire department. However, all electrical portions of this system are provided an emergency power supply.\(^1\)

Failure of the gas extinguishing system to function results in the loss of ability to extinguish fires where it is used. Since the most probable cause of failure is a loss of or exhausting the gas supply, a backup supply of inert gas is provided by the Inert Gas System.\(^2\) Failures other than gas supply are remote; however, several first aid extinguishers are provided which may be used to assure life safety and contain the fire.

---

1. Refer to Interfaces, Appendix C, Item 1.
2. Refer to Interfaces, Appendix C, Item 18.
SECTION 5.0 MAINTENANCE PRINCIPLES

5.1 PREVENTIVE MAINTENANCE

5.1.1 Automatic Water Sprinklers

The automatic water sprinklers system will be maintained in accordance with the recommendations of HEPA No. 13A, "Care and Maintenance of Sprinkler Systems."

5.1.2 Automatic Water Spray Systems

On a semi-annual basis perform the following:

- Examine nozzles and any protective caps for evidence of corrosion, internal plugging and external loading.
- Make a waterflow test of the system. Where flow tests are not practical, make an operating test of the automatic control valves and heat responsive system.
- Flush underground mains under maximum flow conditions. Examine strainer and clean if necessary.
- If the system has operated since the last test, remove several spray nozzles and examine for internal obstruction. The presence of foreign material will call for examination and cleaning of all spray nozzles.

5.1.3 Automatic Gas Extinguishing Systems

The automatic gas extinguishing systems will be inspected and maintained as follows:

- On a monthly basis the extinguishant storage supply will be measured to assure an adequate extinguishant supply. Valve packing glands, relief valves and screwed connections under pressure will be checked for leakage.
On a semi-annual basis, inspect and test all actuating and operating devices.

On a semi-annual basis, the extinguishant pressure alarm switch and operation of the alarm bell will be tested. (If applicable, cylinders will be weighed and those showing 10 percent loss will be replaced).

On a yearly basis, pressure gages and similar devices will be checked for accuracy.

Every five years frangible discs on storage tanks should be replaced.

Refrigeration equipment, if applicable, should be maintained in accordance with the manufacturer's recommendations.

5.1.4 Automatic Dry Chemical or Powder Extinguishing System

The automatic dry chemical or powder extinguishing system shall be inspected and maintained as follows:

On a monthly basis, inspect the nozzles to assure that they are clear and in proper position.

On a semi-annual basis inspect and test all actuating and operating devices.

On a semi-annual basis, inspect the powder or chemical to assure that it is free-flowing and without lumps.

On a semi-annual basis, check the expellant gas container to assure that the proper amount of expellant gas is available.

Immediately after use, all hand hose lines should be blown clear of dry chemical to prevent the possibility of plugging upon subsequent operation.
5.1.5 Products of Combustion Detector System

The products of combustion detectors shall be inspected and maintained as follows:

. Inspect and clean detector heads on a quarterly basis.

. On a semi-annual basis, test all detector heads and associated actuating devices.

5.1.6 Portable Fire Extinguishers

Portable fire extinguishers will be inspected and maintained on a semi-annual basis in accordance with the recommendations of NFPA No. 10A-"Portable Fire Extinguishers - Maintenance and Use."

5.2 UNSCHEDULED MAINTENANCE

Maintenance of equipment which fails in service is facilitated by provisions for isolating portions of the systems and administratively controlling those areas when that portion of the system is out of service.
APPENDIX A

REFERENCES
APPENDIX A

REFERENCES


3. HWS-10006, Hanford Standard Design Criteria
   SDC 1.2, Standard Design Criteria for Codes, Standards and Specifications.


5. AECM-0552 and RL Supplement - Industrial Fire Protection

6. HWS-10000 - Hanford Architectural and Civil Standards

7. HWS-10001 - Hanford Mechanical Standards

8. HWS-10002 - Hanford Electrical Standards


APPENDIX B

SUPPORT INFORMATION REQUIREMENTS
## APPENDIX B

### SUPPORT INFORMATION REQUIREMENTS

<table>
<thead>
<tr>
<th>Item</th>
<th>Information Required</th>
<th>Type of Effort</th>
<th>Information Source</th>
<th>When Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Evaluate type of products of combustion detectors and application for the various building areas.</td>
<td>Design Effort</td>
<td>AE</td>
<td>Preliminary Design</td>
</tr>
<tr>
<td>2</td>
<td>Determine type of gas (or gases), required flow rates, and application of gas extinguishing systems for the various building areas.</td>
<td>Design Effort</td>
<td>AE</td>
<td>Preliminary Design</td>
</tr>
<tr>
<td>3</td>
<td>Develop fire protective clothing for use in fighting alkali metal fires.</td>
<td>Design Effort Prototyped Development</td>
<td>PNL (189 task to be written)</td>
<td>Final Design</td>
</tr>
<tr>
<td>4</td>
<td>Evaluate types of dry chemical extinguishants commercially available and application for various building areas.</td>
<td>Design Effort</td>
<td>AE</td>
<td>Preliminary Design</td>
</tr>
</tbody>
</table>
| 5    | Determine type of fire protection system to be used in the following location:  
  - Reactor Control Room  
  - Deleted  
  - Deleted  
  - Exhaust Filter Vault  
  - Air Blast Heat Dump  
  - Inert Atmosphere Cells (Refer to Item 2 above)  
  - New Areas Identified during Preliminary Design | Design Effort | AE | Preliminary Design |
APPENDIX B

SUPPORT INFORMATION REQUIREMENTS

1. PRODUCTS OF COMBUSTION DETECTORS STUDY

Objective
The objective of this study is to evaluate various types of products of combustion detectors available for fire detection in the various areas in FFTF and to prepare a design criteria for the recommended type(s).

Description of Work
Review the process and atmospheric conditions throughout FFTF relative to fire protection requirements. Where conditions preclude the use of conventional automatic fire protection methods, evaluate the need for fire detection and recommend the type of detection system for each area, specifically considering the following:

1. Compatibility of detector head with regard to type of atmosphere and the ionizing conditions under normal and accident conditions.
2. Normal and transient temperature conditions.
3. Detector sensitivity requirements and potential adjustment features.
4. Detector spacing and location for each application.
5. Proven reliability of the detector recommended.

2. GAS EXTINGUISHING SYSTEM STUDY

Objective
The objective of this study is to evaluate potential gas or vapor extinguishing systems for the various areas in FFTF
and to prepare a design criteria for the recommended type. Also evaluate air purging operations for normally iner ted cells.

Description of Work

A. For air contained spaces where process requirements or other conditions preclude the use of conventional automatic fire protection equipment, compatible equipment must be provided. For these areas, evaluate the potential use of a gas or vapor extinguishing system, considering the following points:

1. Review the structural and architectural features of the space involved and determine the requirements necessary to permit the use of a gas or vapor extinguishant.

2. Review potential gases and vapors available and the potential source of supply. Select a gas (or vapor) and determine the amount needed for the application.

3. Recommend method of distribution and dispersion within the space.

4. Define the recommended method for removal of contaminated gas and/or smoke.

5. Recommend method of actuating the extinguishing system including detectors, time delays and other limiting controls and alarms.

6. Indicate restrictions and limitations which are imposed by implementation of a gas system.

7. Provide a criteria for an inert gas or vapor extinguishing system for FFTF.
B. For the air purged condition in normally inerted cell locations, define the fire protection requirements considering the following:

1. Investigate feasibility of using the source of gas provided for maintaining the normally inert condition, and define required modifications.


3. Recommend a method of actuating the system.

4. Provide a criteria for the proposed system (if applicable).

3. DEVELOP FIRE PROTECTIVE CLOTHING FOR USE IN FIGHTING ALKALI METAL FIRES

This task is a development item and not a study and is included in this document for reference purposes only.

4. DRY CHEMICAL FIRE EXTINGUISHING SYSTEM STUDY

Objective

The objective of this study is to evaluate potential dry chemical or powder extinguishing systems for the various areas in FFTF and to prepare a design criteria for the recommended system.

Description of Work

In areas where process requirements or other conditions preclude the use of conventional automatic fire protection methods, compatible equipment must be provided. For areas where a gas extinguishing system is not recommended, evaluate the potential use of a dry chemical or powder extinguishing system considering the following points:
1. Review the potential effectiveness and compatibility of an automatic dry chemical or powder system for the proposed application.

2. Make a survey of commercially available extinguishants for each proposed application. Consider the use of calcium carbonate, dry foundry sand, Met-L-X*, soda ash, graphite, graphite and Pyrene G-1**; and recommend an extinguishant.

3. Recommend a method of distribution and dispersion, including the supply source and size.

4. Recommend a method of actuating the extinguishing system including detectors, time delays and other limiting controls and alarms.

5. **FIRE PROTECTION METHODS STUDY**

**Objective**

Evaluate various methods of fire detection and extinguishing systems, and select a system compatible with FFTF conditions for identified areas.

**Description of Work**

1. For the locations indicated below, review the fire hazard potential.

2. Determine the fire detection and protection methods which are compatible for each of the locations.

3. Recommend the type of fire protection to be used for each of the following locations:

---

* Met-L-X is a dry powder composed of sodium chloride with additives including tricalcium phosphates and metal stearates and is manufactured by the Ansul Co.

** Pyrene G-1 powder consists of screened graphitized foundry coke containing an organic phosphate. It is commercially available from the Pyrene Mfg. Co.
BNWL-500
Volume 26

- FFTF Reactor Control Room
- NPTF Control Room & Equipment Spaces
- Instrument and Electrical Equipment
- Exhaust Filter Vault
- Air Blast Heat Dump
- Inert Atmosphere Cells (Refer to Item 2 as above).
APPENDIX C

INTERFACES
## APPENDIX C

### INTERFACES

<table>
<thead>
<tr>
<th>Item</th>
<th>System No.</th>
<th>System Title</th>
<th>Interface Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>Building Electrical Power System/Lighting System</td>
<td>Normal and emergency power supply control, signal &amp; alarm device wiring.</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>Communications System</td>
<td>Fire zone annunciation in reactor control room</td>
</tr>
<tr>
<td>3</td>
<td>16</td>
<td>Lighting System</td>
<td>Fire protection provided by Plant Fire Protection System</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>Structures</td>
<td>Facilities for fire protection &amp; dump retainers for sodium tanks</td>
</tr>
<tr>
<td>5</td>
<td>22</td>
<td>Site Facilities</td>
<td>Outside Fire Hydrants&lt;br&gt;Space for fire protection system equipment&lt;br&gt;Outside Water Supply System</td>
</tr>
<tr>
<td>6</td>
<td>23</td>
<td>Service Piping System</td>
<td>a. Process Water&lt;br&gt;b. Floor drains in automatic sprinkler areas connected to process sewer.</td>
</tr>
<tr>
<td>7</td>
<td>25</td>
<td>Heating and Ventilation System</td>
<td>Building air control during fire&lt;br&gt;within the building&lt;br&gt;Location of product of combustion detectors in ducts</td>
</tr>
<tr>
<td>8</td>
<td>27</td>
<td>Reactor Containment System</td>
<td>Containment vessel penetrations.&lt;br&gt;Space for fire protection equipment</td>
</tr>
<tr>
<td>9</td>
<td>33</td>
<td>Reactor Nuclear Control Component</td>
<td>Fire Protection provided by Plant Fire Protection System</td>
</tr>
<tr>
<td>10</td>
<td>34</td>
<td>Nuclear Proof Test Facility</td>
<td>Fire Protection provided by Plant Fire Protection System</td>
</tr>
</tbody>
</table>
## APPENDIX C (Contd)

### INTERFACES

<table>
<thead>
<tr>
<th>Item</th>
<th>System No.</th>
<th>System Title</th>
<th>Interface Description</th>
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</thead>
<tbody>
<tr>
<td>11</td>
<td>41</td>
<td>Reactor Refueling System</td>
<td>Fire Protection provided by Plant Fire Protection System</td>
</tr>
<tr>
<td>12</td>
<td>42</td>
<td>Nonirradiated Fuel Handling System</td>
<td>Fire Protection provided by Plant Fire Protection System</td>
</tr>
<tr>
<td>13</td>
<td>43</td>
<td>Irradiated Fuel Handling System</td>
<td>Fire Protection provided by Plant Fire Protection System</td>
</tr>
<tr>
<td>14</td>
<td>44</td>
<td>Radioactive Maintenance</td>
<td>Fire Protection provided by Plant Fire Protection System</td>
</tr>
<tr>
<td>15</td>
<td>51</td>
<td>Reactor Heat Transport System</td>
<td>Fire Protection provided by Plant Fire Protection System</td>
</tr>
<tr>
<td>16</td>
<td>71</td>
<td>Inert Gas Cell Examination Facility</td>
<td>Fire Protection provided by Plant Fire Protection System</td>
</tr>
<tr>
<td>17</td>
<td>72</td>
<td>Underwater Cell Examination Facility</td>
<td>Fire Protection provided by Plant Fire Protection System</td>
</tr>
<tr>
<td>18</td>
<td>82</td>
<td>Inert Gas Receiving and Processing System</td>
<td>Emergency inert gas supply</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>All other systems</td>
<td>To be determined</td>
</tr>
</tbody>
</table>
(see Figure 7 for Legend)

FIGURE 6
FIRE PROTECTION ZONES
PLAN @ EL -40'-0"
FIGURE 7
FIRE PROTECTION ZONES
PLAN & EL -55'-0" and noted
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Components Br, RDT:PE
Instrumentation & Control Br, RDT:PE
Liquid Metal Systems Br, RDT:PE
Asst Dir for Program Analysis, RDT
Asst Dir for Project Mgmt, RDT
Liquid Metals Project Br, RDT:PM
FFTF Project Manager, RDT:PM (3)
Asst Dir for Reactor Engrg, RDT
Control Mechanisms Br, RDT:RE
Core Design Br, RDT:RE (2)
Fuel Engineering Br, RDT:RE
Fuel Handling Br., RDT:RE
Reactor Vessels Br, RDT:RE
Asst Dir for Reactor Tech, RDT
Coolant Chemistry Br, RDT:RT
Fuel Recycle Br, RDT:RT
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3 Battelle Memorial Institute

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