



# Special Hazards Systems

## Level III Certification Content Outline

### Standard Model Program with Computer-Based Testing

*The candidate for NICET certification as a Level III Special Hazards Systems technician should have the knowledge and experience to:*

Design gaseous, dry, and wet agent systems; prepare submittals, estimates, and project reports; manage a special hazards project; and inspect, maintain, repair, install, and test complex systems.

**Note:** For each exam, the skills and knowledge listed under each task are suggestive of those involved in that task, but are not intended to constitute an exhaustive listing.

### 3.1 Inspection, Testing, and Maintenance Tasks

*(Approximately 2-8% of the exam)*

#### 3.1.1 Conduct a low-pressure CO<sub>2</sub> partial flow test.

**Knowledge:**

Frequencies for testing in NFPA 12  
Proper room ventilation techniques

**Skills:**

Follow test procedures in manufacturer specifications.  
Properly prepare area before testing, including identifying the agent exhaust pathway.  
Identify valves that must be adjusted during test.

### 3.2 Repair and Recharge Tasks

*(Approximately 15-21% of the exam)*

#### 3.2.1 Replace control panel components.

**Knowledge:**

Antistatic procedures as defined in NFPA 77  
Control panel components and their functions

**Skills:**

Interpret panel sequence of operations matrix.  
Confirm hardware and firmware compatibility.  
Confirm upward and/or backward compatibility of field devices with replaced components  
Obtain and follow manufacturers' procedures for replacing system components.  
Use VOM (volt-ohmmeter) to test control panel circuits.  
Perform functional testing of the control panel to verify proper operation.  
Perform functional testing in compliance with NFPA 72.  
Properly operate control panel components in accordance with manufacturer's instructions.  
Follow manufacturer's methods for uploading the panel's configuration into the CPU.  
Follow manufacturer's instructions for arming and disarming system controls.

#### 3.2.2 Re-load the original programming configuration to a control panel after a repair.

**Knowledge:**

Computer/device connections, interfaces, and I/O port assignments

**Skills:**

Connect a computer to the panel and use software to upload the panel configuration.  
Interpret manufacturers' design, operation, and maintenance manuals.  
Follow manufacturer's instructions for arming and disarming system controls.  
Conduct reacceptance testing of the system in compliance with NFPA 72: 14.4.2.

#### 3.2.3 Conduct a discharge investigation.

**Knowledge:**

Control panel functions  
Firmware-to-control panel interfaces  
Control panel programming

**Skills:**

Use manufacturer software to upgrade device firmware.  
Document firmware updates.  
Test system to ensure proper operation after firmware update.

### 3.3 Installation Tasks

*(Approximately 16-22% of the exam)*

#### 3.3.1 Perform complex programming for multi-zone, multi-hazard, networked systems with directional valves, soak systems, or remote access over internet.

**Knowledge:**

System signaling functions  
Internet terminology, access, and addressing

**Skills:**

Interpret sequence-of-operations matrices.  
Revise sequence-of-operations matrices as required for site conditions and complying with NFPA 72.

(Task 3.3.1 continued on next page)



(Task 3.3.1 Skills continued)

Determine compatibility of systems using network protocols such as BACNET, MODBUS, Token Ring, and manufacturers' proprietary protocols  
Set a static IP address for a device.  
Interface systems operating with different network protocols.  
Link various control panel types and nodes on a system.  
Access control panels remotely over the Internet.  
Interpret manufacturers' specifications for control panels.  
Use manufacturer's programming software.

### **3.3.2 Perform foam proportion accuracy test.**

#### **Knowledge:**

Test methods described in NFPA 11: Section 11.6, Annex A.3.3.2, Annex D  
Test methods described in NFPA 16: Chapter 8.4 and Annex B  
Types of foam and their characteristics  
Foam concentration requirements  
Foam system operation  
Environmental rules and regulations for collecting, containing, and disposing of foam solutions  
Alternative test methods used to prove proportioning accuracy  
Percent thresholds for various concentrates

#### **Skills:**

Analyze foam solution samples and test results using the methods outlined in NFPA 11: Annex D and NFPA 16: Annex B.  
Use graduated cylinders to accurately mix the reference samples.  
Use a handheld refractometer to measure solution's refractive index.  
Use a handheld conductivity meter to measure solution's electrical conductivity.  
Use a flow meter/pitot gauge.  
Use liquid measuring devices and scales.  
In absence of hydraulic placard, determine flow rate.  
Organize testing procedures and preparation of protected area to avoid damage during testing.  
Calculate flow rates in order to determine the quantity of discharge outlets, header size, hose size/quantity.  
Collect, contain, and dispose of test solution.  
Determine whether foam solution is within acceptable threshold range according to NFPA 16.  
Graph the solution concentration line as a relation of solution's percentage to its refractive index or conductivity according to NFPA 16: Figures Annex B.3 (a), (b), and (c).  
Interpret results.  
Prepare a test report.

### **3.3.3 Conduct clean agent discharge and concentration final acceptance tests.**

#### **Knowledge:**

Enclosure and pipe integrity procedures  
Significance of interlocks for system functioning

#### **Skills:**

Interpret system plans, specifications, and as-built drawings.  
Identify system interlocks.  
Use NFPA 12, 12A, and 2001 to determine system acceptance procedures.  
Use NFPA 12, 12A, and 2001 to determine flow testing and discharge testing requirements.  
Use NFPA 12, 12A, and 2001, along with AHJ requirements, to determine protected height, discharge duration, and required hold time (if total flood).  
Interpret a system sequence-of-operations matrix.  
Develop the test schedule, chain of command during testing, and attendance list.  
Verify notification occupants, monitoring company, and emergency responders prior to testing.  
Calibrate, use, and read an extinguishing agent concentration meter as per the manufacturer's instructions.  
Interpret manufacturers' literature to determine the timeframe for reconditioning and requirements for recharging or resupplying discharged agent.  
Document results.

## **3.4 System Design and Configuration Tasks**

*(Approximately 69-75% of the exam)*

### **3.4.1 Determine an appropriate system type and agent for the site's hazard(s).**

#### **Knowledge:**

Basic principles of fire ignition, and factors that affect the speed and direction of propagation  
Classes of fires  
Interactions (chemical and physical) between various extinguishing agents and fires, protected equipment and materials, and potential occupants  
Pressure venting requirements  
Hazardous materials, activities/processes, and conditions  
SNAP list, EPA, AHJ, and insurance restrictions

#### **Skills:**

Determine the applications and limitations of various agents specified in NFPA 11, 12, 12A 13, 16, 17, 17A, 68, 69, 79, 70, 72, 750, 2001, and 2010.  
Determine if the site conditions warrant the use of a particular system type.  
Identify relevant site features, hazards, and conditions that impact system/agent selection.  
Comply with allocated space and remote location requirements for agent storage containers as listed in the manufacturer's specifications.  
Perform pressure venting calculations.  
Identify protected process materials and quantities.  
Run simple hydraulic calculations to determine the infrastructure needs and determine the feasibility of using such system.

### **3.4.2 Select and lay out detection devices.**

#### **Knowledge:**

Detection device types, their functions and limitations

(Task 3.4.2 continued on next page)



(Task 3.4.2 Knowledge continued)

Impact of Underwriters Laboratory (UL) or National Recognized Testing Laboratory (NRTL) listings on device locations, spacing, and ratings  
Impact of heat, type of smoke, smoke movement, and stratification on device types, locations and spacing  
Impact of types of flame, as dictated by fueling agent, on detector selection

**Skills:**

Comply with detection device requirements in NFPA 72: Chapter 17, and requirements of the AHJ.  
Select device types, quantities, and placement.  
Obtain installation and design data from the manufacturer of the device.  
Determine device's area coverage.  
Confirm UL or NRTL listings of various detection devices.  
Select the proper device for the hazard(s) and conditions.

**3.4.3 Select and lay out power supply devices.**

**Knowledge:**

Formula for battery load calculations

**Skills:**

Apply system alarm and standby power requirements as defined in NFPA 72: 10.6.7, or as required by the local AHJ.  
Obtain relevant information from manufacturers' literature.  
Based on manufacturers' specifications, determine the current draw for each circuit.  
Understand the use of the battery calculation forms in NFPA 72.  
Determine the maximum power output supplied by the control panel.  
Determine the system alarm and standby power requirements of the local AHJ  
Select, size, and lay out power supply devices.  
Determine ADA candela ratings and quantities for each NAC circuit.  
Recognize when booster power is necessary.

**3.4.4 Select and lay out cables, conduit, and raceways.**

**Knowledge:**

Raceway materials and their applications  
Ohm's law

**Skills:**

Apply NFPA 70: Article 760, and NFPA 72: Chapter 12 and Annex F to the layout of cables, conduit, and raceways.  
Select cable and wire types appropriate for the application.  
Calculate the maximum anticipated current loads and voltage drops.  
Select, size, and lay out conduit, junction boxes, and raceways to suit the application and environment.  
Select appropriate and NEC-approved support methods for conduits, junction boxes, and raceways.  
Read and interpret wiring schematics.  
Determine total length and type of wire used for each notification appliance circuit (NAC) from project plans and specifications.

Use NFPA 70: Chapter 9, Table 8, or the wire manufacturer's specifications to determine a wire's DC resistance value.  
Perform basic electrical calculations to determine the voltage drop of each NAC.  
Lay out electrical pathways for hazardous and non-hazardous classifications.  
Apply intrinsically safe barriers where appropriate.  
Use an architectural scale to determine wire lengths between devices.  
Maintain fire ratings at wiring penetrations.  
Determine requirements for electrical classifications per NFPA 70: Chapter 5.

**3.4.5 Develop a programming matrix for a special hazards system.**

**Knowledge:**

Role of protocols in the communication with other fire protection and building control systems  
Control panel components and their functions  
System interfaces and their functions  
Types of detection/releasing schemes

**Skills:**

Develop and format sequence-of-operations matrices in accordance with NFPA 72: Annex A.14.6.2.4.  
Select required components for controls and interfaces.  
Ensure interface compliance with NFPA 72: Chapter 21.  
Develop a list of control panel components.  
Interpret manufacturers' specifications to determine which detection/releasing scheme will satisfy the application parameters.

**3.4.6 Select and lay out discharge devices.**

**Knowledge:**

Types of discharge devices appropriate for various extinguishing agents  
Ambient conditions that could affect the discharge device  
Types of clearance required for various types of discharge devices

**Skills:**

Use a site survey report and NFPA 11, 12, 12A, 16, 17, 17A, 750, 2001, and 2010 to determine discharge device layout requirements.  
Determine manufacturer and listing requirements for discharge device.  
Read and interpret flow calculation results pertaining to the discharge devices.  
Select number of discharge devices based on pounds-per-second requirements.  
Calculate volumetric discharge rate for high-expansion foam generators.  
Interpret manufacturer specifications to determine maximum and minimum discharge device coverage heights and throws.  
Determine minimum number of foam chambers based on the diameter of the flammable liquid storage tank per NFPA 11: Chapter 5.  
Apply spacing requirements for discharge devices per NFPA 11: Chapter 5.

(Task 3.4.6 continued on next page)



(Task 3.4.6 Skills continued)

Mitigate potential facility impacts of a discharge with a particular device, including sound, agent velocity, and pressure.

Select, size, and lay out discharge devices.

### **3.4.7 Select and lay out actuating/releasing devices.**

#### **Knowledge:**

Actuating/releasing device types their functions, and limitations

#### **Skills:**

- Determine type of actuation/releasing device the system requires.
- Determine whether the actuation/releasing device is to be manually or automatically activated.
- Determine whether an automatic device requires a separate manual override.
- Determine actuating/releasing devices' compatibility (by type and quantity) with control equipment.
- Comply with actuation device requirements in NFPA 11, NFPA 12, NFPA 12A, NFPA 16, NFPA 17, NFPA 17A, NFPA 750, NFPA 2001, and NFPA 2010.
- Interpret manufacturer specifications to determine requirements for releasing components.

### **3.4.8 Select and lay out agent storage equipment.**

#### **Knowledge:**

Various schemes for storage/distribution  
Factors that impact the required storage capacity  
Storage tank location and loading requirements  
Formulas for volumetric, concentration, and leakage calculations

#### **Skills:**

- Read and interpret project drawings, specifications, and site survey data to confirm mounting locations.
- Obtain relevant information from the manufacturer's design manual for the extinguishing agent.
- Perform simple volumetric, concentration, and leakage calculations and apply temperature and altitude corrections to determine agent quantity.
- Determine the type of storage equipment, the capacity required, and the storage distribution scheme.
- Select, size, and lay out the storage units.
- Determine storage temperature limitations from the manufacturer's specifications.
- Determine the feasibility of storage tank installation and service.
- Locate storage containers in compliance with NFPA 11, 12, 12A, 16, 17, 17A, 750, 2001, and 2010.

### **3.4.9 Layout and calculate air sampling systems.**

#### **Knowledge:**

Factors that influence airflow

#### **Skills:**

- Interpret manufacturers' installation, design, and testing recommendations.
- Interpret system drawings, specifications, and sequence of operations matrix to determine system configuration/setting thresholds.
- Use air sampling detector manufacturer's software to perform calculations.

Manipulate pipe configuration and hole balance to meet transport time requirements.

Lay out an air sampling system in accordance with NFPA 72 Chapter 17.7.3.6.

### **3.4.10 Use software to calculate system flow for gaseous agents (including high-pressure CO<sub>2</sub>).**

#### **Knowledge:**

Geometry  
Trigonometry of right triangles  
Significant New Alternatives Policy (SNAP) list, Lowest Observable Affect Level (LOAL), and No Observed Affect Level (NOAL) limitations  
One-, two-, and three-phase flow and its effect on agent delivery  
Fittings' orientation and flow-split ratio requirements

#### **Skills:**

- Apply NFPA 12, 12A, 17, and 2001 to system flow.
- Use project plans and specifications to determine distribution/delivery system limitations, desired flow per nozzle, and quantity of nozzles per hazard.
- Determine pressure loss for system valves, selectors, checks, lockouts, hoses, and other accessories.
- Use system manufacturer software to calculate agent distribution and discharge time.
- Use system manufacturer design data to determine system nozzle coverage, heights, and limitations.
- Interpret software output to establish minimum pressure vent area.
- Confirm that calculation results meet system design requirements.

### **3.4.11 Use software to hydraulically calculate low-expansion foam water systems.**

#### **Knowledge:**

Factors that influence waterflow and their relationships to each other  
Supply and demand calculations and their variables.  
Normal, total, and velocity pressures and their impact on calculations  
Hydraulic calculation formulas for density-area and orifice-pressure as defined in NFPA 13, Chapters 11 and 22.

#### **Skills:**

- Interpret UL listings and manufacturing specifications to determine minimum and maximum discharge device operating pressures.
- Determine the hydraulically most demanding area or most remote devices.
- Determine the minimum required water/low-expansion foam flow based on a density/area method or k-factor/pressure method.
- Operate a calculator or a software package to perform hydraulic calculations.
- Interpret thresholds and results on graphs.
- Confirm that calculation results meet system design requirements.





### 3.5 Work Management Tasks

*(Approximately 27-33% of the exam)*

#### 3.5.1 Procure materials for a special hazards system installation.

**Knowledge:**

Material take-off procedures

**Skills:**

Read and interpret suppression system plans and specifications to determine the types and quantities of devices, pipe, conduit, wire, etc. that will be required for the project.

Obtain technical, pricing, and ordering information from the manufacturer or supplier.

Prepare material procurement forms.

#### 3.5.2 Prepare project documentation.

**Knowledge:**

Cost factors in special hazards work

Contract structure and terminology as defined in AIA standard forms

**Skills:**

Interpret project contracts to determine project requirements.

Identify site conditions that contradict the original contract documents—or previous changes—and that are likely to impact costs and project completion timeline.

Document proposed system modifications to accompany the change order request.

#### 3.5.3 Plan acceptance testing and prepare associated documentation.

**Knowledge:**

System commissioning/acceptance test procedures, including pipe integrity pressure, room integrity, and flow, coverage and concentration test methods

Safety requirements for acceptance tests

**Skills:**

Create a commissioning plan based on the requirements in NFPA 11, 12, 12A, 13, 16, 17, 69, 72, 90A, 101, 170, 750, 2001, and 2010.

Obtain and read manufacturers' recommendations and guidelines.

Research any unique testing requirements of the local AHJ.

Coordinate with other trades to schedule personnel, resources, and facility access for testing activities.

Prepare a punch list.

Interpret results of preliminary acceptance test; adjust acceptance test procedures as necessary.

Determine what forms and test data must be retained for records and where.

Plan for facility/occupant impact.

Develop the test schedule, attendance list, etc.

Notify occupants and monitoring company

Plan for safety precautions for a discharge.

#### 3.5.4 Evaluate final acceptance test results.

**Knowledge:**

System commissioning/acceptance test procedures, including pipe pressure, room integrity, and flow, coverage and concentration test methods

**Skills:**

Interpret system plans, specifications, and as-built drawings.

Interpret sequence-of-operations matrix.

Interpret the results of enclosure/hazard integrity tests.

Compare test results with project objectives.

Communicate clearly and accurately, both verbally and in writing.

Report test data from the field on appropriate forms and retain for records.

#### 3.5.5 Develop, coordinate, and monitor a project schedule.

**Knowledge:**

Major roles on a large special hazards project

Factors that affect expected and actual completion times for various tasks

Gantt charts

Critical path method

**Skills:**

Use scheduling software to develop a project schedule. Create, read, and interpret Gantt Charts.

Schedule special hazards system work as part of a larger project.

Forecast labor and material requirements at various times during a project.

Obtain data from the field and organize to measure project progress.

Design forms for data gathering and reporting.

Communicate work schedule information with job site contractors.

Manage subcontractors and attend project meetings.

Use electronic media to communicate with project team members while coordinating and documenting tasks.

Prepare work progress reports.

#### 3.5.6 Prepare maintenance plans.

**Knowledge:**

Frequencies for inspection, testing, and maintenance tasks in NFPA 25, NFPA 72, and system-specific standards

Cost factors in periodic inspection, testing, and maintenance activities

Role of the inspector according to NFPA standards

**Skills:**

Communicate clearly and accurately, both verbally and in writing.

Interpret inspection, testing, and maintenance summary tables and charts in NFPA standards.

Estimate costs and itemize recurring inspection, testing, and maintenance tasks specific to various types of systems.

Analyze risks and potential liabilities.

Prepare cost estimates based on site equipment and conditions.

Complete simple contract forms requiring frequencies and cost estimates.

**3.5.7 Conduct end-user training.****Knowledge:**

Written and verbal communication skill

**Skills:**

Present technical information clearly, accurately, and professionally to technical or non-technical audiences, either individually or in groups.

Prepare and conduct end-user and operator training.

Interpret owner's requirements for end-user training and O&M documentation.

Create proof-of-training records.

**3.6 Safety Tasks**

*(Approximately 2-8% of the exam)*

**3.6.1 Prepare and implement project-specific safety plans based on site conditions.****Knowledge:**

OSHA workplace safety regulations

Powered Platforms for Building Maintenance -

Operations Training 1910.66(i), (ii) and (ii)(A) through (E), and (iii) through (v)

Hearing Protection Training Program 1910.95(k)(1) through (3)(i) through (iii)

Personal Protective Equipment 1910.132(f)(1)(i) through (v); (2), (3)(i) through (iii) and (4)

Respiratory Protection 1910.134(k)(1)(i) through (vii); (2), (3), and (5)(i) through (iii)

Permit Required Confined Spaces 1910.146(g)(1) and (2)(i) through (iv)(3) and (4) and (k)(1)(i) through (iv)

The Control of Hazardous Energy (lockout/tagout) 1910.147(a)(3)(ii); (4)(i)(D); (7)(i)(A) through (C); (ii)(A) through (F); (iii)(A) through (C)(iv) and (8)

OSHA record keeping requirements

Sources of information about CO<sub>2</sub> suppression systems.

**Skills:**

Obtain and implement the owner and/or contractor's workplace safety plan for the facility.

Identify the work-site-specific safety hazards that may impact the work planned for the facility.

Plan training, PPE and safety related equipment requirements, and work procedures to avoid accidents.

Identify other site contractors' hazards that will impact the safety plan.

Train employees to recognize work site safety hazards and follow the reporting procedures.

Monitor adherence to the safety plan by team members.

Apply NFPA 70E requirements to the worksite safety plan.