

REPORT

# FIRE PROTECTION SYSTEM DESIGN BASIS

*Georgia Pool Chemical Warehouse*



## PREPARED FOR

United States Chemical Safety Board  
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## 1.0 Introduction

### 1.1 BACKGROUND

A fire occurred on September 29, 2024 at a pool chemicals warehouse in Conyers, Georgia. Records provided to Jensen Hughes indicate that the drawings depicting the proposed design of the space and the fire protection systems for its protection were submitted for a construction permit in April 2019.

### 1.2 PURPOSE

The purpose of this report was to summarize and discuss the fire protection requirements that were applicable to a pool chemicals warehouse designed and constructed in Georgia in 2019. The report identifies, interprets and weaves together the relevant sections and requirements from the applicable Georgia fire safety regulations and the relevant chapters of the then adopted building and fire codes and NFPA standards that together governed the design and construction of chemical warehousing facilities for pool chemicals.

### 1.3 SCOPE

The analysis was based around the known and/or suspected hazard category classifications of the chemicals that were stored in the warehouse, which are oxidizer classes 1 and 2, water reactive classes 1 and 2, and corrosive solid. The focus of the analysis is on design and effectiveness of the fire protection system, including but not limited to the automatic sprinkler system. The analysis aimed to show how a few material properties and building features drive which code requirements are applicable (i.e., required design basis), and then can ultimately impact the effectiveness of the fire protection systems in the event of a fire.

## 2.0 References

The following references were consulted and used in the development of this report.

### 2.1 APPLICABLE REGULATIONS, CODES AND STANDARDS

The following regulations, codes and standards were determined to be applicable to buildings designed and submitted for construction permits in Georgia in 2019. As relevant to this analysis, Georgia adopted and amended applicable codes and standards on a six-year frequency, which included January 1, 2014 and January 1, 2020. Therefore, in 2019 the codes and standards adopted in January 2014 (and as amended in the intervening years) were applicable.

- + The Official Code of Georgia Annotated (OCGA) Title 25, Section 25-2-13 includes Fire Safety Requirements for Buildings or Structures Presenting Special Hazards
- + The Department of Community Affairs (DCA) adopted and amended the following applicable codes:
  - 2012 Edition of the International Building Code (IBC)
  - 2012 Edition of the International Mechanical Code (IMC)
  - 2017 Edition of NFPA 70, National Electrical Code (NEC)

- + The Office of the Safety Fire Commissioner (SFC) published Georgia Rule 120-3-3, *Rules and Regulations for the State Minimum Fire Safety Standards*, including its amendments to the codes and standards listed below.
  - 2012 Edition of the International Fire Code (IFC)
  - 2013 Edition of NFPA 13, Installation of Sprinkler Systems
  - 2013 Edition of NFPA 72, National Fire Alarm and Signaling Code
  - 2012 Edition of NFPA 101, Life Safety Code (LSC)
  - 2013 Edition of NFPA 400, Hazardous Materials Code
- + Additionally, Rule 120-3-3.04 authorized use of these alternatives to the IFC and IBC for topics, as appropriate:
  - 2012 Edition of NFPA 1, Fire Code
  - 2012 Edition of NFPA 5000, Building Construction and Safety Code
- + SFC also published Georgia Rule 120-3-11, *Rules and Regulations for Flammable and Combustible Liquids*, which adopted and amended:
  - 2003 Edition of NFPA 30, Flammable and Combustible Liquids Code

## 2.2 OTHER DOCUMENTS

The following documents were also used as references in this report:

- + 2017 Edition of NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response
- + 2015 Edition of National Fire Code of Canada (NFCC)
- + United Nations (UN) Globally Harmonized System of Classification and Labeling of Chemicals (GHS), 7<sup>th</sup> Edition, 2017.
- + UN Recommendations on the Transport of Dangerous Goods, Rev. 20, 2017.
- + UN Manual of Tests and Criteria, Sixth Edition with Amendments, 2017.

**NOTE:** For the convenience of the reader, selected excerpts of IBC, IFC and NFPA 400 are included with this report as Appendices A, B and C. The complete texts are available for free read-only viewing by the public at the respective publishers' websites listed below:

- + <https://codes.iccsafe.org/content/IBC2012P13>
- + <https://codes.iccsafe.org/content/IFC2012>
- + <https://link.nfpa.org/free-access/publications/400/2013>

## 3.0 Key Definitions and Acronyms

The following definitions used in this report were copied from IBC §202 (and are identical in IFC §202), unless stated otherwise below:

- + **Approved:** Acceptable to the building official (or fire code official, as applicable).
- + **Authority Having Jurisdiction (AHJ):** An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.
- + **Commodity Classification:** Per NFPA 13 §A.5.6, the commodity classification is essentially an attempt to define the potential fire severity (of a product/commodity), based on its burning characteristics, so the fire can be successfully controlled by the prescribed sprinkler protection for the commodity class. Additionally, §A.5.6.1.1 states “Commodity classification is governed by the types and amounts of materials (e.g., metal, paper, wood, plastics) that are a part of a product and its primary packaging.”
  - NFPA 13 §5.6.3 through §5.6.4.4.2 define the levels of commodity classifications listed below, and the corresponding tables in NFPA 13 Appendix A provide example commodities for each classification level.
    - Class I: A Class I commodity shall be defined as a noncombustible product that meets one of the following criteria:
      - Placed directly on wood pallets,
      - Placed in single-layer corrugated cartons, with or without single-thickness cardboard dividers, with or without pallets,
      - Shrink-wrapped or paper-wrapped as a unit load with or without pallets
    - Class II: A Class II commodity shall be defined as a noncombustible product that is in slatted wooden crates, solid wood boxes, multiple-layered corrugated cartons, or equivalent combustible packaging material, with or without pallets.
    - Class III: A Class III commodity shall be defined as a product fashioned from wood, paper, natural fibers, or Group C plastics with or without cartons, boxes, or crates and with or without pallets. A Class III commodity shall be permitted to contain a limited amount (5 percent by weight or volume or less) of Group A or Group B plastics.
    - Class IV: A Class IV commodity shall be defined as a product, with or without pallets, that meets one of the following criteria:
      - Constructed partially or totally of Group B plastics
      - Consists of free-flowing Group A plastic materials
      - Contains within itself or its packaging an appreciable amount (5 percent to 15 percent by weight or 5 percent to 25 percent by volume) of Group A plastics

The remaining materials shall be permitted to be metal, wood, paper, natural or synthetic fibers, or Group B or Group C plastics.
  - Plastics, elastomers, and rubber shall be classified as Group A, Group B, or Group C.
    - Group A plastics are the highest hazard among the three plastic groups. As noted above, Group B and Group C plastics are included among the Class III and IV commodities.
    - Group A plastics are further subdivided as either expanded or nonexpanded. The subdivision, in order of increasing hazard, is as follows:
      - Cartoned, Unexpanded Group A Plastic (aka CUP)

- Exposed (or Uncartoned), Unexpanded Group A Plastic (aka UUP)
- Cartoned, Expanded Group A Plastic (aka CEP)
- Exposed (or Uncartoned), Expanded Group A Plastic (aka UEP)

+ *Construction Type: Per IBC §602, the various construction types from the highest (Type IA) to the lowest (Type VB) are defined by IBC Table 601 and the following accompanying provisions:*

- IBC §602.2: Types I and II construction are those types of construction in which the building elements listed in Table 601 are of noncombustible materials, except as permitted in Section 603 and elsewhere in this code.
- IBC §602.3: Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. Fire-retardant-treated wood framing complying with Section 2303.2 shall be permitted within exterior wall assemblies of a 2-hour rating or less.
- IBC 602.4: Type IV construction (Heavy Timber, HT) is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid or laminated wood without concealed spaces. The details of Type IV construction shall comply with the provisions of this section. Fire-retardant-treated wood framing complying with Section 2303.2 shall be permitted within exterior wall assemblies with a 2-hour rating or less. Minimum solid sawn nominal dimensions are required for structures built using Type IV construction (HT). For glued-laminated members the equivalent net finished width and depths corresponding to the minimum nominal width and depths of solid sawn lumber are required as specified in Table 602.4.
- 602.5: Type V construction is that type of construction in which the structural elements, exterior walls and interior walls are of any materials permitted by this code.

**TABLE 601**  
**FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)**

| BUILDING ELEMENT                                                      | TYPE I             |                   | TYPE II           |                | TYPE III          |   | TYPE IV | TYPE V            |   |
|-----------------------------------------------------------------------|--------------------|-------------------|-------------------|----------------|-------------------|---|---------|-------------------|---|
|                                                                       | A                  | B                 | A <sup>e</sup>    | B              | A <sup>e</sup>    | B | HT      | A <sup>e</sup>    | B |
| Primary structural frame <sup>a</sup> (see Section 202)               | 3 <sup>a</sup>     | 2 <sup>a</sup>    | 1                 | 0              | 1                 | 0 | HT      | 1                 | 0 |
| Bearing walls                                                         |                    |                   |                   |                |                   |   |         |                   |   |
| Exterior <sup>c, d</sup>                                              | 3                  | 2                 | 1                 | 0              | 2                 | 2 | 2       | 1                 | 0 |
| Interior                                                              | 3 <sup>a</sup>     | 2 <sup>a</sup>    | 1                 | 0              | 1                 | 0 | 1/HT    | 1                 | 0 |
| Nonbearing walls and partitions                                       | See Table 602      |                   |                   |                |                   |   |         |                   |   |
| Exterior                                                              |                    |                   |                   |                |                   |   |         |                   |   |
| Nonbearing walls and partitions                                       |                    |                   |                   |                |                   |   | See     |                   |   |
| Interior <sup>e</sup>                                                 | 0                  | 0                 | 0                 | 0              | 0                 | 0 | Section | 0                 | 0 |
| 602.4.6                                                               |                    |                   |                   |                |                   |   |         |                   |   |
| Floor construction and associated secondary members (see Section 202) | 2                  | 2                 | 1                 | 0              | 1                 | 0 | HT      | 1                 | 0 |
| Roof construction and associated secondary members (see Section 202)  | 1 1/2 <sup>b</sup> | 1 <sup>b, c</sup> | 1 <sup>b, c</sup> | 0 <sup>c</sup> | 1 <sup>b, c</sup> | 0 | HT      | 1 <sup>b, c</sup> | 0 |

For SI: 1 foot = 304.8 mm.

- Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
- Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
- In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.
- An approved automatic sprinkler system in accordance with Section 903.3.1.1 shall be allowed to be substituted for 1-hour fire-resistance-rated construction, provided such system is not otherwise required by other provisions of the code or used for an allowable area increase in accordance with Section 506.3 or an allowable height increase in accordance with Section 504.2. The 1-hour substitution for the fire resistance of exterior walls shall not be permitted.
- Not less than the fire-resistance rating required by other sections of this code.
- Not less than the fire-resistance rating based on fire separation distance (see Table 602).
- Not less than the fire-resistance rating as referenced in Section 704.10

**Figure 1: Table 601 from Chapter 6, IBC 2012 Edition**

**TABLE 602**  
**FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE<sup>a, b</sup>**

| FIRE SEPARATION DISTANCE = X (feet) | TYPE OF CONSTRUCTION | OCCUPANCY GROUP H <sup>f</sup> | OCCUPANCY GROUP F-1, M, S-1 <sup>g</sup> | OCCUPANCY GROUP A, B, E, F-2, I, R, S-2 <sup>g</sup> , U <sup>h</sup> |
|-------------------------------------|----------------------|--------------------------------|------------------------------------------|-----------------------------------------------------------------------|
| X < 5 <sup>c</sup>                  | All                  | 3                              | 2                                        | 1                                                                     |
| 5 ≤ X < 10                          | IA                   | 3                              | 2                                        | 1                                                                     |
|                                     | Others               | 2                              | 1                                        | 1                                                                     |
| 10 ≤ X < 30                         | IA, IB               | 2                              | 1                                        | 1 <sup>d</sup>                                                        |
|                                     | IIB, VB              | 1                              | 0                                        | 0                                                                     |
|                                     | Others               | 1                              | 1                                        | 1 <sup>d</sup>                                                        |
| X ≥ 30                              | All                  | 0                              | 0                                        | 0                                                                     |

For SI: 1 foot = 304.8 mm.

- Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
- For special requirements for Group U occupancies, see Section 406.3.
- See Section 706.1.1 for party walls.
- Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
- The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
- For special requirements for Group H occupancies, see Section 415.5.
- For special requirements for Group S aircraft hangars, see Section 412.4.1.
- Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.

**Figure 2: Table 602 from Chapter 6, IBC 2012 Edition**

- + **Control Area:** Spaces within a building where quantities of hazardous materials not exceeding the maximum allowable quantities per control area are stored, dispensed, used or handled.
  - A control area can be one room or a contiguous block of rooms.
  - Per IBC §414.2.1, control areas shall be separated from each other by fire barriers and/or horizontal assemblies constructed in accordance with IBC Chapter 7.
  - Per IBC Table 414.2.2, a total of four control areas separated by one-hour fire barrier walls is the maximum allowed in a one-story warehouse building.
  - Per IBC §307.1, control area and high-hazard Group H spaces (aka “Protection Level” storage per NFPA 400) are mutually exclusive since a space with hazardous materials quantities above the MAQ must be classified as high-hazard Group H, not as a control area.
- + **Detached Building:** A separate single-story building, without a basement or crawl space, used for the storage or use of hazardous materials and located an approved distance from all structures.
  - Even though a fire wall is used to create a separate building, by definition a detached building is separated by distance rather than by a fire wall.
  - IBC Table 415.5.2 and NFPA 400 Table 5.3.7 both include the quantity limits above which a hazardous material must be located in a detached building. For a detonation hazard, the quantity limit triggering required detached storage is anything above the MAQ (see NFPA 400 §6.2.2.2.1). For the other materials, the quantity limit triggering detached storage is a different number higher than the MAQ. In either case, the detached storage building must be classified as Group H (aka Protection Level storage in NFPA 400), since it is always above the MAQ.
  - Per NFPA 400 §6.2.4.4.1 and the additional discussion in §A.6.2.4.4.1, the only non-storage accessory uses that are allowed within the detached building are control rooms, restrooms and ancillary electrical and mechanical rooms directly associated with the actual purpose of the building. Other spaces like conference rooms, offices for the staff, cafeteria, etc. are explicitly prohibited in the detached building.
  - Per NFPA 400 §6.2.4.4.2, a Protection Level 3 (i.e., IBC Group H-3) detached building (such as is applicable for Class 2 oxidizers or Class 2 water reactive materials) is allowed to store other hazardous materials, provided they are separated in accordance with other applicable requirements of the code (i.e., incompatible materials requirements).
  - Per NFPA 400 §15.3.2.3.5 and IFC Table 6304.1.2, a detached building for storage of Class 2 oxidizers must be located a minimum of 35 feet from other buildings and cannot contain the following:
    - Flammable or combustible liquid storage
    - Flammable gas storage
    - Combustible material in the open (NOTE: this would include spare packaging materials)
- + **Fire Barrier Wall:** A fire-resistance-rated wall assembly of materials designed to restrict the spread of fire in which continuity is maintained.
  - The minimum fire resistance rating of the fire barrier wall is specified by IBC Table 707.3.10, in accordance with the two occupancy classifications that are separated by the fire barrier wall.
  - For occupancy groups S-1 and H-3 the minimum fire resistance rating is 3-hours, and for H-4 it is 2-hours.

- + **Fire Wall:** A fire-resistance-rated wall having protected openings, which restricts the spread of fire and extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall.
  - Per IBC §706.1, the portions of the building on either side of the fire wall are considered a separate building.
  - The minimum fire resistance rating of the fire wall is specified in IBC Table 706.4, based on the two occupancy classifications that are separated by the fire wall.
  - For occupancy groups S-1, H-4 and H-3, the minimum fire resistance rating of the fire wall is 3-hours.
- + **Hazardous Materials:** Those chemicals or substances that are physical hazards or health hazards as classified in IBC Section 307 and the International Fire Code, whether the materials are in usable or waste condition.
  - **Corrosive:** A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact. A chemical shall be considered corrosive if, when tested on the intact skin of albino rabbits by the method described in DOT 49 CFR, Part 173.137, such chemical destroys or changes irreversibly the structure of the tissue at the point of contact following an exposure period of 4 hours. This term does not refer to action on inanimate surfaces.
  - **Oxidizer:** A material that readily yields oxygen or other oxidizing gas, or that readily reacts to promote or initiate combustion of combustible materials and, if heated or contaminated, can result in vigorous self-sustained decomposition.
    - Class 1: An oxidizer that does not moderately increase the burning rate of combustible materials.
    - Class 2: An oxidizer that will cause a moderate increase in the burning rate of combustible materials with which it comes in contact.
    - Class 3: An oxidizer that causes a severe increase in the burning rate of combustible materials with which it comes in contact.
    - Class 4: An oxidizer that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock and that causes a severe increase in the burning rate of combustible materials with which it comes into contact. Additionally, the oxidizer causes a severe increase in the burning rate and can cause spontaneous ignition of combustibles.
  - **Water Reactive:** A material that explodes; violently reacts; produces flammable, toxic or other hazardous gases; or evolves enough heat to cause autoignition or ignition of combustibles upon exposure to water or moisture. Water-reactive materials are subdivided as follows:
    - Class 1: Materials that react with water with some release of energy, but not violently.
    - Class 2: Materials that react violently with water or have the ability to boil water. Materials that produce flammable, toxic or other hazardous gases or evolve enough heat to cause autoignition or ignition of combustibles upon exposure to water or moisture.
    - Class 3: Materials that react explosively with water without requiring heat or confinement.
- + **High-Piled (Combustible) Storage (IFC §202):** Storage of combustible materials in closely packed piles or combustible materials on pallets, in racks or on shelves where the top of storage is greater than 12 feet (3658 mm) in height. When required by the fire code official, high-piled combustible storage also includes

certain high-hazard commodities, such as rubber tires, Group A plastics, flammable liquids, idle pallets and similar commodities, where the top of storage is greater than 6 feet (1829 mm) in height.

- + IBC: International Building Code
- + ICC: International Code Council, the publisher of the IBC, IFC, IMC, etc.
- + IFC: International Fire Code
- + *Incompatible Materials*: Materials that, when mixed, have the potential to react in a manner that generates heat, fumes, gases or byproducts which are hazardous to life or property.
- + MAQ: Maximum Allowable Quantity per Control Area
  - A space or building that contains above the MAQ of one or more hazardous material(s) is no longer a control area but is instead classified as a Group H High-hazard occupancy (aka Protection Level storage per NFPA 400).
  - The High-hazard occupancy (i.e., Protection Level storage) can be either a room separated from the rest of the building by a suitable fire rated boundary, or it can be a detached building.
- + NFPA: National Fire Protection Association
- + *Occupancy Classification* (Per IBC §302.1): Structures or portions of structures shall be classified with respect to occupancy in one or more of the groups listed in this section. A room or space that is intended to be occupied at different times for different purposes shall comply with all of the requirements that are applicable to each of the purposes for which the room or space will be occupied. Structures with multiple occupancies or uses shall comply with (IBC) Section 508. Where a structure is proposed for a purpose that is not specifically provided for in this code, such structure shall be classified in the group that the occupancy most nearly resembles, according to the fire safety and relative hazard involved.
  - *High-hazard Group H* (Per IBC §307.1): High-hazard Group H occupancy includes, among others, the use of a building or structure, or a portion thereof, that involves the manufacturing, processing, generation or storage of materials that constitute a physical or health hazard in quantities in excess of those allowed in control areas complying with Section 414, based on the maximum allowable quantity limits for control areas set forth in Tables 307.1(1) and 307.1(2). Hazardous occupancies are classified in Groups H-1, H-2, H-3, H-4 and H-5 and shall be in accordance with this section, the requirements of Section 415 and the International Fire Code. Hazardous materials stored, or used on top of roofs or canopies shall be classified as outdoor storage or use and shall comply with the International Fire Code.
  - High-hazard Occupancies include:
    - **Group H-2 (or Protection Level 2 in NFPA 400)**: Buildings and structures containing materials that pose a deflagration hazard or a hazard from accelerated burning shall be classified as Group H-2. Such materials shall include, but not be limited to, the following:
      - Class I, II or IIIA flammable or combustible liquids which are used or stored in normally open containers or systems, or in closed containers or systems pressurized at more than 15 pounds per square inch gauge (103.4 kPa)
      - Combustible dusts where manufactured, generated or used in such a manner that the concentration and conditions create a fire or explosion hazard based on information prepared in accordance with Section 414.1.3 of the *International Building Code*

- Cryogenic fluids, flammable
- Flammable gases
- Organic peroxides, Class I
- Oxidizers, Class 3, that are used or stored in normally open containers or systems, or in closed containers or systems pressurized at more than 15 pounds per square inch gauge (103.4 kPa)
- Pyrophoric liquids, solids and gases, nondetonable
- Unstable (reactive) materials, Class 3, nondetonable
- Water-reactive materials, Class 3
- **Group H-3 (or Protection Level 3 in NFPA 400):** Buildings and structures containing materials that readily support combustion or that pose a physical hazard shall be classified as Group H-3. Such materials shall include, but not be limited to, the following:
  - Class I, II or IIIA flammable or combustible liquids that are used or stored in normally closed containers or systems pressurized at 15 pounds per square inch gauge (103.4 kPa) or less
  - Combustible fibers, other than densely packed baled cotton
  - Consumer fireworks, 1.4G (Class C, Common)
  - Cryogenic fluids, oxidizing
  - Flammable solids
  - Organic peroxides, Class II and III
  - Oxidizers, Class 2
  - Oxidizers, Class 3, that are used or stored in normally closed containers or systems pressurized at 15 pounds per square inch gauge (103 kPa) or less
  - Oxidizing gases
  - Unstable (reactive) materials, Class 2
  - Water-reactive materials, Class 2
- **Group H-4 (or Protection Level 4 in NFPA 400):** Buildings and structures which contain materials that are health hazards shall be classified as Group H-4. Such materials shall include, but not be limited to, the following:
  - Corrosives
  - Highly toxic materials
  - Toxic materials
- Per IBC §311: *Storage Group S occupancy* includes, among others, the use of a building or structure, or a portion thereof, for storage that is not classified as a hazardous occupancy.
  - **Moderate-hazard storage, Group S-1.** Buildings occupied for storage uses that are not classified as Group S-2, including, but not limited to, storage of the following:

- Aerosols, Levels 2 and 3
- Aircraft hangar (storage and repair)
- Bags: cloth, burlap and paper
- Bamboos and rattan
- Baskets
- Belting: canvas and leather
- Books and paper in rolls or packs
- Boots and shoes
- Buttons, including cloth covered, pearl or bone
- Cardboard and cardboard boxes
- Clothing, woolen wearing apparel
- Cordage
- Dry boat storage (indoor)
- Furniture
- Furs
- Glues, mucilage, pastes and size
- Grains
- Horns and combs, other than celluloid
- Leather
- Linoleum
- Lumber
- Motor vehicle repair garages complying with the maximum allowable quantities of hazardous materials listed in Table 5003.1.1(1) (see Section 406.8 of the *International Building Code*)
- Photo engravings
- Resilient flooring
- Silks
- Soaps
- Sugar
- Tires, bulk storage of
- Tobacco, cigars, cigarettes and snuff
- Upholstery and mattresses

- Wax candles
- **Low-hazard storage, Group S-2** includes, among others, buildings used for the storage of noncombustible materials such as products on wood pallets or in paper cartons with or without single thickness divisions; or in paper wrappings. Such products are permitted to have a negligible amount of plastic trim, such as knobs, handles or film wrapping. Storage uses shall include, but not be limited to, storage of the following:
  - Asbestos
  - Beverages up to and including 16-percent alcohol in metal, glass or ceramic containers
  - Cement in bags
  - Chalk and crayons
  - Dairy products in non-waxed coated paper containers
  - Dry cell batteries
  - Electrical coils
  - Electrical motors
  - Empty cans
  - Food products
  - Foods in noncombustible containers
  - Fresh fruits and vegetables in non-plastic trays or containers
  - Frozen foods
  - Glass
  - Glass bottles, empty or filled with noncombustible liquids
  - Gypsum board
  - Inert pigments
  - Ivory
  - Meats
  - Metal cabinets
  - Metal desks with plastic tops and trim
  - Metal parts
  - Metals
  - Mirrors
  - Oil-filled and other types of distribution transformers
  - Parking garages, open or enclosed

- Porcelain and pottery
  - Stoves
  - Talc and soapstones
  - Washers and dryers
- + *Pile* (per NFPA 400 §3.3.74): Material in a single contiguous storage area, including any material not properly separated by appropriate distance.
  - NOTE: The distance between piles is commonly known as an aisle.
- + *Protection Level* (per NFPA 400 §3.3.75): A term used to describe a tier of building safety that exceeds the construction requirements for control areas to accommodate quantities of hazardous materials in excess of those permitted using the control area concept.
- + *Segregated*: Storage in the same room or inside area but physically separated by distance from *incompatible materials*.
- + *Unlimited Area Building*: Per IBC §507.1, the size of a building is not limited to the maximum floor area listed in IBC §503, when the construction type, occupancy and configuration meet the provisions of IBC §507. Per IBC §507.3, this includes a one-story, sprinkler protected building of Type I, II, III or IV construction in which the primary occupancies are Groups B, F, M and S, and the configuration of hazardous materials storage and use comply with IBC §507.8. A typical use of this code provision is for Group S warehouse buildings.

## 4.0 Assumptions and Limitations

The following assumptions and limitations were incorporated in this analysis:

1. The scope was limited to the state of Georgia only.
2. The scope was limited to warehouse storage of solid pool chemicals, and did not include storage of hazardous gases (e.g., chlorine gas in cylinders), since the impetus was better understanding of the regulation of the warehousing of pool chemicals.
3. The scope was limited to bulk indoor warehousing facilities and did not include the following:
  - a. Outdoor storage of pool chemicals,
  - b. Mercantile occupancies or retail consumer packaging, and
  - c. Manufacturing facilities, R&D, or other facilities that process or use the chemicals.
4. The scope was limited to the aspects of the regulations, codes and standards that are explicitly impacted by the presence, chemical classification and quantity of hazardous materials. Aspects of the building and fire codes that are somewhat agnostic to the chemicals were excluded.
5. This report did not discuss how the written codes and standards are enforced by state and local code officials, which does vary across jurisdictions and individual code enforcers.
6. While fire and life safety code compliance reviews can address a wide variety of topics, the focus of this study are those topics that have the potential to impact the design and effectiveness of the fire protection system, including the automatic sprinklers themselves and other building features and systems that impact fire ignition, development, spread, detection and mitigation.

7. The permissible increased MAQ's associated with storage of non-combustible hazardous materials in a Group S-1 occupancy per IFC Table 5003.11.1 were not applicable to this facility. Whereas all the pool chemicals are non-combustible and potentially qualify for the increased MAQ, one of the contingent limitations in IFC §5003.11.3 is a maximum container size of 100 lbs., which has the effect of disqualifying the super sacks. Therefore, the applicable MAQ's were those included in IFC Tables 5003.1.1(1) and 5003.1.1(2).
8. The design basis for all sprinkler systems includes a defined minimum remote design area (or minimum number of sprinklers flowing at the design pressure), which indicates the maximum number of sprinkler heads that were assumed to be flowing in the fire protection water supply design. If a sprinkler system experiences a greater number of sprinkler heads flowing simultaneously than were included in the design area (e.g., due to a single large fire or multiple fires remote from each other, or due to sprinkler heads remote from the fire being activated), then the performance of the sprinkler system could be seriously degraded by lower water pressure and under-developed spray patterns.
9. The scope of this report did not include a discussion of emergency response procedures, such as when to secure the sprinkler system control valve and fire pump during/after a fire event.

## 5.0 Methodology

Fire protection systems' basis of design is developed as part of a fire and life safety code analysis for a building. A typical fire and life safety code analysis for a new building, addition or change of occupancy classification is developed through integrated application of the various relevant regulations, codes and standards. The hierarchy of the application of these regulations, codes and standards is set by the State and Local Codes and by the various scope statements, cross references, and exclusions articulated throughout the adopted fire safety codes and standards. The adopted Building Code is the driving document for the overall design of a new space/building and it is designed to be used in direct conjunction with the adopted Fire Code to articulate the full intent of the fire safety regulations. The Building and Fire Codes reference other topical codes and standards for greater details and technical requirements on many topics, including several relevant to the design of chemical warehouses. The result is that specific chapters and sections and referenced standards must be read and interpreted together to properly apply the regulator's intent on each topic.

The preface to the 2024 Edition of IBC includes a section entitled "Effective Use of the International Building Code" that provides a summary table with the IBC Chapter/Section and IFC Chapter/Section for various key subjects regulated by the codes and highlighting how the IBC and IFC are coordinated with each other. For hazardous materials, IBC Sections 307, 414 and 415, and IFC Chapters 50 to 67 are listed. IBC Section 414.1.3 is at the heart of the hazardous materials provisions of the code, and includes a requirement to develop and submit a technical report to the Building Code AHJ identifying the proposed hazardous materials in storage and use, their maximum expected quantities, hazard category classifications, and the proposed methods of protection from their hazards.

Experience in the application of these requirements to various buildings storing and using pool chemicals and other hazardous materials has shown that application of all the relevant provisions leads to seeming "conflicts" between multiple applicable requirements. IFC Section 102.10 is a key provision to undo the conflicts and it states:

*Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable. Where, in a specific case, different sections of*

*this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.*

As explained by the IFC Commentary to the section, the application of IFC §102.10 to hazardous materials warehouses includes the following practical effects:

- + Where a hazard classification specific requirement in IFC Chapters 51 to 67 conflict with the general hazardous materials requirement in IFC Chapter 50, the hazard category specific requirement governs; and
- + Where multiple hazard category specific chapters apply to a material that has multiple chemical classifications, the most restrictive requirement governs.

This requirement to address all requirements for all the applicable hazard categories of each chemical is also stated in NFPA 400 §4.4. Furthermore, Georgia has the additional consideration that OCGA §25-2-13(g) states the following:

*Notwithstanding any other provision of law or any local ordinance to the contrary, in the event of a conflict between any code or standard of the National Fire Protection Association (National Fire Code and National Electric Code) and of the Standard Building Code Congress (Southern Standard Building Code), the code or standard of the National Fire Protection Association (National Fire Code and National Electric Code) shall prevail. The order of precedence established by this subsection shall apply to all buildings and structures whether or not such buildings and structures are covered under this Code section.*

Therefore, in the context of this analysis, wherever there is a conflict between the requirements included in IBC/IFC and NFPA 400, the requirements of NFPA 400 are required to take precedence regardless of whether it is more or less restrictive. The overall hazard and risk mitigation paradigm of the IBC/IFC and NFPA 400 are essentially identical and most of the requirements are very similar. One notable difference is that NFPA 400 provides more specifics for sprinkler system design criteria for some hazard categories, including for Class 1 oxidizers.

Once a building is in operation with an approved fire protection system, if changes are made to the materials being stored or the manner in which they are stored, then IFC (§102.2 and §102.3) and NFPA 400 (§1.3) both include provisions to require the re-examination of the fire protection systems to confirm adequacy for the new materials and/or arrangements. The adequacy of the fire protection system to protect the new material and/or storage arrangements must be evaluated against the then current adopted version of IFC and NFPA 400, not the original construction version. For example, if a warehouse is approved in April 2019 as a Group S-1 occupancy to store Class 1 oxidizers, then the sprinkler system design basis would be determined through analysis of the 2012 IFC/IBC and 2013 Editions of NFPA 400 and NFPA 13. The introduction of above-the-MAQ storage of a Class 2 oxidizer or a corrosive solid into the same warehouse in 2021 would necessitate re-analysis under the codes adopted on January 1, 2020 (i.e., 2018 IFC/IBC and 2019 Editions of NFPA 400 and NFPA 13). The required re-analysis could prompt several changes, including, but not limited to:

- A change of occupancy classification from Group S-1 to Group H-3 and/or Group H-4,
- A change in the required construction type and the minimum fire rated construction requirements,
- A change in the minimum design basis of the sprinkler system, and
- The mandatory addition of fire protection systems not previously required (e.g., smoke detection).

## 6.0 Building Blocks of the Analysis

The foundation of determining the fire protection system design basis for the chemical warehouse is identifying the use and occupancy classification, which includes the following steps:

1. Confirm closed storage only vs. any processing or other use activities within the warehouse space.
2. Perform chemical classifications in accordance with the hazard category definitions in IFC Chapter 2 (or NFPA 400 Chapter 3), to determine all applicable IFC (and NFPA 400) hazard categories for each material.
  - a. It is essential to determine all applicable hazard categories for each product stored in the building and then analyze all the corresponding requirements to create a cohesive and comprehensive design basis that addresses all the hazards appropriately.
    - i. IFC §5001.1 requires that “where a material has multiple hazards, all hazards shall be addressed.” The same requirement is stated in IBC §307.8 and §415.7.2.
    - ii. NFPA 400 §4.4 states that “Hazardous materials that have multiple hazards shall conform to the code requirements for each applicable hazard category.”
  - b. There is an important nuance in applying the mandate to conform to the code requirements for all applicable hazard categories, as follows:
    - i. A few hazard classes are a specialized subset of a more general hazard class, in which case application of the more specific requirements that exist for the specialized sub-hazard class does not then also require application of the requirements associated with the more general classification.
    - ii. An example is that an organic peroxide may also meet the definition to be classified as an unstable (reactive) material. However, the proper regulation of this material is achieved by applying only the requirements of the organic peroxide chapter (NFPA 400 Chapter 14), which has been developed by the technical committee to address the unique combination of hazards posed by organic peroxides. In this case, additionally applying the more general requirements of NFPA 400 Chapter 19 for unstable (reactive) materials is not intended.
    - iii. This implementation nuance is consistent with NFPA 400 Annex section A.4.4, which states: “Where a conflict exists between applicable requirements, an analysis should be made and the proper applicable requirement should be implemented or conformed to subject to the approval of the AHJ.”
    - iv. **NOTE:** This discussion is specific to the requirements associated with the “physical hazards” such as combustibility and reactivity. Application of the health hazard requirements (corrosive, toxic, highly toxic) are still required to be done in addition to the physical hazards.
3. Create an inventory statement that aggregates the quantity of hazardous materials within each of the applicable chemical classifications (hazard categories) defined in the IFC/IBC; and
4. Compare the quantity of each chemical classification category with the maximum allowable quantity in IBC §307 to determine which, if any, Group H high hazard occupancy classifications are applicable. Note: The MAQ’s in IBC Tables 307.1.1 and 307.1.2 are identical to those in IFC Tables 5003.1.1(1) and 5003.1.1(2). The MAQ

With the chemical classifications (hazard categories) and occupancy classifications set, the next step is to analyze the applicable requirements in IBC Sections 414 and 415, and IFC Chapters 50-67, and the referenced NFPA standards to determine the integrated set of hazardous materials design criteria, including the automatic

sprinkler design criteria. Apply the fire protection systems requirements in IFC/IBC Chapter 9, along with the hazardous materials design criteria above to determine the full fire protection design basis.

The primary tool identified for use in performing chemical classifications is the safety datasheet (SDS), previously known as the material safety datasheet (MSDS). While the format of the SDS is standardized, the quantity and quality of data included in the SDS are highly variable. The information provided in the SDS are intended for multiple audiences, including: owners/users; emergency responders; and code enforcers for buildings, transportation and environmental requirements. Additionally, some common terms used in the SDS (e.g., toxic) have different technical meanings in different applicable regulations used by the different code enforcers.

Therefore, a fair amount of skill is necessary to interpret/use the information provided in the SDS to determine the proper chemical classifications for Building/Fire Code applications. This is especially true for the reactivity based physical hazards and the corrosive health hazard, due to the combination of the use of qualitative wording for the hazard classification definitions and the scarcity of actual data. As a result, there can sometimes be an over-reliance on “known” or “generally accepted” hazard category classifications for materials, which can be very helpful for pure substances but less helpful (or dangerous) for blends that are commercially known by a common name but in fact have variations in what is produced by different manufacturers (including in the proprietary or trade secret ingredients that are not disclosed). This is true of the common pool chemicals; a survey of SDS issued by different manufacturers for nominally the same product reveals some key differences in the hazard statements and the reported data that impact some of the chemical classifications. The conclusion is that the chemical classifications for blends/mixtures need to be specific to the actual product(s) being stored in the building, not a generic version.

Different but related to this challenge is the impact of the transportation classifications and labeling on the way hazardous materials are received, handled, stored and perceived inside the chemical warehouse. Hazardous materials are prohibited from transport without proper labeling and placarding per the transportation regulations. These systems tend to not have the level of sub-division as the Building/Fire Code schemes, which uses the sub-divisions to set occupancy classification and protection criteria. For example, the 5.1 placard for oxidizers is all encompassing but inside the chemical warehouse that same material could lead to any of the following occupancy classifications in a warehouse, which lead to different outcomes for the required fire protection design criteria:

- + Group S-1 if it is a Class 1 oxidizer,
- + Group H-3 if it is a Class 2 oxidizer,
- + Group H-3 or H-2 if it is a Class 3 oxidizer, and
- + Group H-1 if it is a Class 4 oxidizer

In recent decades some test-based methods and threshold criteria have been proposed for classifying reactivity hazards. However, they typically exist in non-mandatory Annex material or in other codes and standards instead of the body of the adopted Building and Fire Codes. Some examples include:

- + GHS and the UN Manual of Tests and Criteria
- + NFPA 400 Annex G, Section G.1.2 for oxidizers
- + NFPA 704 Annexes E and F for unstable reactive and water reactive materials

Their use as part of the design basis for a chemical warehouse is subject to adoption by the owner/operator/designer and approval by the AHJ. Furthermore, the current HAZCOM standard from OSHA, which governs the format and content of the SDS, does not mandate inclusion by the chemical manufacturers of the key calorimetry data that would allow for quantitative classification of the reactive chemicals.

## 7.0 Hazardous Materials Code Analysis

### 7.1 GENERAL

In a comprehensive technical report of a chemical warehouse developed to satisfy IBC §414.1.3, the following topic areas should be addressed:

- + Chemical hazard category classifications and commodity classifications (sprinklers)
- + Occupancy classification(s), including the analysis of the chemical inventory and the comparison with the applicable MAQ for all applicable chemical hazard category classifications of each product in the warehouse
- + Structural risk category (IBC Chapter 16) and building siting requirements (i.e., proximity to lot lines and other buildings), when toxic, highly toxic or explosive materials are stored above the MAQ
- + Height and area allowances based on occupancy classification(s) and construction type
- + Fire resistance rated construction and occupancy separation requirements
- + Hazardous materials storage arrangement limitations, including chemical incompatibility considerations
- + Fire protection system design criteria, including sprinkler system and the fire protection water supply
- + Spill control and secondary containment requirements
- + Detection and alarm systems requirements
- + Exhaust ventilation requirements
- + Electrical classification requirements
- + Explosion control requirements
- + Backup power requirements
- + Means of egress requirements

### 7.2 FIRE PROTECTION SYSTEM DESIGN BASIS

While all the topics of the IBC §414.1.3 hazardous materials code analysis are important, for the purposes and scope of this current analysis, this report focused on the items that most directly impact the fire protection system design and performance. Four case studies are presented below to examine the impact on the required fire protection system design criteria of either changing or mischaracterizing the chemical classification (hazard category), the occupancy classification, and the commodity classification. As noted earlier, the candidate classifications for the pool chemicals are assumed to be some combination of Oxidizer Class 1 or 2, Water Reactive Class 1 or 2, and Corrosive Solid. Some pool chemicals also meet the definition of unstable (reactive) materials, but that hazard classification was not included in the current exercise.

### 7.3 PASSIVE FIRE PROTECTION FEATURES

A related topic to fire protection system design is compartmentation and construction type, two of the building blocks of what is often called “passive fire protection” as a distinction from “active fire protection” such as automatic sprinkler systems. The intent of the building and fire codes is to use both passive and active fire protection features to achieve the objectives of life safety and property protection. The design of the automatic sprinkler system (and other active fire protection systems) is not only in response to the chemical classifications and occupancy classification, but it is also coordinated with the following:

- + The size of the compartment (i.e., the overall building or separated areas within the building),
- + The level of fire resistance provided for the structural elements of the building, and
- + The fire resistance rating of the boundaries of each occupancy.

The concept of an “unlimited area building” in IBC §507 is an example of the deployment of this coordination of passive and active fire protection features. IBC §507 unlimited area buildings are allowed to include storage of some hazardous materials, but it is limited as a risk management measure. A sprinkler protected, construction type IIB warehousing facility with an occupancy classification of Group S-1 is allowed to use the IBC §507.3 unlimited area provisions if none of the hazard categories stored within that Group S-1 space have exceeded the MAQ. Furthermore, IBC §507.8 clarifies that if storage of hazardous materials above the MAQ is needed, then that must be confined to designated Group H-2/H-3/H-4 rooms that are limited to both the IBC Table 503 construction type maximums and to no more than 10% of the overall building size, and are separated from the main Group S-1 warehouse by fire rated barriers. If, however, the hazardous material storage within the main warehouse (the larger space) exceeds the MAQ, then the use of IBC §507 is prohibited. In that case, the code intent is that the building construction type must be upgraded to protect the structural steel (columns, beams, roof, etc.) with fire resistance rated construction such as sprayed fireproofing or gypsum board, as follows:

- + An unlimited area warehouse with a Group H-4 occupancy classification (e.g., corrosive solids stored above the MAQ) must be construction type IA or IB, and
- + An unlimited area warehouse with a Group H-3 occupancy classification (e.g., Class 2 oxidizer or Class 2 water reactive stored above the MAQ) must be construction type IA.

## 8.0 Evaluation of Case Studies

This chapter will include a summary of the basis of design for the fire protection systems that would be derived from applying the code analysis topics and requirements that most directly impact the fire protection system design and effectiveness in four case studies of interest. The following were assumed to be common and true in all four cases:

- + The pool chemicals are stored in plastic buckets up to approximately 5-gallons in size, and in super sacks.
- + The pool chemicals are stored on wooden pallets, both in floor piles and in open metal racks.
- + Where pool chemicals are stored in super sacks on the floor, the storage height is on the order of 7-ft tall (i.e., stacked two-high).
- + The storage buckets and super sacks for pool chemicals are designed to “breathe” as the products naturally off-gas over time as they slowly degrade naturally. Pool chemicals are typically stored first-in, first-out to guard against loss of potency while in storage.

- + Where pool chemicals are stored in racks, the top of storage may be as much as 25-ft high.
- + The building height was estimated to be just under 40-ft to the roof/ceiling underside at the peak.
- + The building has an approved sprinkler system installed throughout, at minimum to the system design criteria necessary to protect the non-chemical storage within the warehouse (i.e., other goods and packaging materials).

**NOTE:** the analysis and discussions provided for Case Study #1 are foundational and applicable to all four case studies, unless something more specific in Case Study 2, 3 or 4 takes precedence. This is reflective of the code implementation intent where the general requirements applicable for storage below the MAQ (i.e., within the Group S-1 occupancy) are also applicable for the above the MAQ warehouses (i.e., Group H occupancies).

## 8.1 CASE #1: A ONE HAZARD CLASS CHEMICAL STORED BELOW THE MAQ

### 8.1.1 Case Study Details

A chemical warehouse with an intended inventory less than the maximum allowable quantity. The inventory exhibits only one hazardous property, such as water-reactivity or oxidizing or corrosive properties.

### 8.1.2 Occupancy Classification and Code Applicability

Per IBC §311.1 and §311.2, the required occupancy classification for the chemical warehouse is Group S-1 “moderate hazard” since the presence of the combustible packaging and pallets precludes use of the Group S-2 “low hazard” occupancy classification, and being below the MAQ means that no Group H “high hazard” occupancy classification is applicable. Group S-1 is the default occupancy classification for warehouses unless the MAQ is exceeded, triggering a Group H occupancy. Group S-2 occupancy classification applies to warehousing of largely non-combustible materials such as cement, steel, frozen foods, etc.

Therefore, for the chemical warehouse that actually stores all chemicals below the MAQ, only the hazardous materials code sections<sup>1</sup> for storage of quantities below the MAQ are applicable to the analysis, including:

- + IBC §414 (but not IBC §415), IFC §5001 and 5003 apply regardless of the chemical classification of Oxidizer 1 or 2, Water Reactive 1 or 2, or Corrosive.
- + IFC §6301 and 6303 also apply if the chemical classification is Oxidizer 1 or 2. For quantities of oxidizers below the MAQ, IFC 2012 does not explicitly adopt NFPA 400 for sprinkler system design criteria. However, following the requirement in OCGA 25-2-13(g) that the NFPA codes and standards take precedence means that the user in Georgia is required to use the NFPA 400 sprinkler design criteria (when the storage quantity is above 4,000 lbs. per NFPA 400 §15.3.2.2.2.1) since NFPA 400 has a more specific provision than IFC.
- + IFC §6701 and 6703 also apply if the chemical classification is Water Reactive 1 or 2. However, the only requirement is to point the user back to Chapter 50 and reiterate the need for permits where required by the administrative chapter of the code and the local enforcer.

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<sup>1</sup> See Appendices A, B and C to this report for selected excerpts from IBC, IFC and NFPA 400. Visit the free, view-only online portals by ICC and NFPA for the full code text.

- + IFC §5401 and 5403 also apply if the chemical classification is Corrosive Solid. However, the only requirement is to point the user back to Chapter 50 and reiterate the need for permits where required by the administrative chapter of the code and the local enforcer.

It should be noted that per IFC Table 5003.1.1(1) and 5003.1.1(2), a pool chemical that is classified only as a Class 1 oxidizer and/or only as a Class 1 water reactive can be stored in unlimited quantities and still be “below the MAQ” since the MAQ is not limited in a building with a sprinkler system approved for the prevailing occupancy. Conversely, for Class 2 oxidizers or Class 2 water reactive or corrosive solids, there are storage MAQ’s listed in the IFC tables. When the MAQ is not limited (i.e., for Class 1 oxidizer or Class water reactive), the code still includes storage arrangement limitations (e.g. pile size), as discussed further below.

### 8.1.3 Fire Rated Construction Requirements

With no chemical classification above the MAQ, the warehouse is considered a control area. No fire rated construction is required, except what may be needed to either separate the warehouse from another occupancy, or to sub-divide a storage area that is too large, or another reason that is unrelated to the hazardous materials status. Furthermore, per IBC Table 508.4, many common incidental spaces/room in a warehouse, such as office areas, a quality control lab, a small repair shop, a breakroom for less than 50 people, etc., are not required to be separated from the chemical warehouse by fire rated boundaries since a 0-hr barrier is acceptable between spaces classified as Group S-1, Group B and Group F-1.

IBC §507 includes provisions for the construction of an “unlimited area” building. A Group S-1 warehouse is one of the most common implementations of these provisions. In particular, IBC §507.3 allows for an unlimited area, sprinkler protected building, where the construction is Type I, II, III or IV, and the predominant occupancy is Group B, F, M or S. The building must have clear space, yard or public ways around it on all sides of at least 60 feet. Per IBC §507.8, the unlimited area building is allowed to have Group H-2, H-3 and H-4 occupancies within its footprint, with the following limitations:

- + The maximum aggregate Group H spaces cannot exceed 10% of the total building size nor the maximum allowable area for the construction type per IBC Table 503,
- + The Group H spaces must be separated from the non-Group H spaces by the required occupancy separation barriers of IBC Table 508.4, and
- + Group H-2 or H-3 storage rooms are required to be on the building perimeter.

### 8.1.4 Storage Arrangement Requirements

The storage in the warehouse met the definition of high-piled (combustible) storage and must comply with the applicable requirements of IFC Chapter 32, unless any hazard class specific requirements are more restrictive. For the water reactive classes 1 and 2, and corrosive solids below MAQ, the only storage arrangement limitations are segregation from incompatible materials per IFC §5003.9.8, and the rules associated with high piled storage in IFC chapter 32, including:

- + Maximum storage height up to 40-ft, as permitted by the sprinkler system design.
- + Maximum contiguous floor pile volume of 400,000 cubic feet and maximum pile dimension of 100 feet.

- + When the pile volume exceeds 400,000 cubic feet, then storage must be divided into multiple areas separated by a minimum 1-hr fire resistance rated barrier that extends from the floor to the underside of the roof or fire rated ceiling, with 1-hr fire doors protecting any openings.
- + Minimum aisle width between piles of 44 inches.
- + Flue spaces maintained in the longitudinal and/or transverse flue, in accordance with IFC Table 3208.3 or the sprinkler system design requirements.

The sprinkler system design requirements in NFPA 400 for oxidizers are tied to storage arrangement limits, with the following provisions that are more restrictive than the high piled storage rules for Class 1 oxidizers when more than 4,000 lbs. are being stored (NFPA 400 §15.3.2.2.1):

- + Maximum storage height of 20 ft
- + Maximum pile width of 24 ft
- + Aisle width between piles of between 4 and 8 ft wide
- + Minimum separation of 2 ft from the wall
- + Minimum separation of 8 ft. from incompatible materials and combustible commodities above NFPA 13 Class III
- + Maximum quantity per pile of 200 tons

Per 15.3.2.3.1, there are no additional storage arrangement rules for Class 2 oxidizers stored below the MAQ.

The implementation of storage arrangement impacts of the requirements for segregation of incompatible materials require care and skill. The following considerations are important:

- + Whereas the requirements within IFC §5003.9.8 provide a one size fits all solution (e.g., 20-ft separation), the degree of incompatibility of each pair of chemicals can vary widely based on chemistry. The approach in the Canada National Fire Code Section 3.2.7.6 reflects this approach; it includes provisions that prohibit some incompatible materials from being stored within the same room, while other incompatible pairs can be stored in the same room and only require a horizontal separation distance of 1 meter.
- + There is very little practical guidance within the applicable codes themselves on how to determine which materials are incompatible with each other. Some practical guidance is available in the UN Transport of Dangerous Goods Code, and in other industry references and handbooks<sup>2</sup>. The SDS provide some lists of incompatible materials in Section 7, *Handling and Storage*, but sometimes the language provided is either too broad or not granular enough. For example, a typical SDS for TCCA may say incompatible materials are “Strong oxidizing agents, strong bases, strong reducing agents, combustible material.” A practical question that arises is whether the TCCA is equally incompatible with Dichlor Dihydrate and/or Anhydrous Dichlor, and/or Bromine Tablets and/or Calcium Hypochlorite; this is not obvious from the SDS statements.
- + There is no minimum quantity below which segregation of incompatible materials is not applicable since IFC §5003.9.8 is within the general requirements section regulating hazardous materials. These requirements can only be pre-empted by requirements that originate within a hazard specific section of the code. For

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<sup>2</sup> An example of a respected industry reference for incompatible chemicals is *Bretherick's Handbook of Reactive Chemical Hazards*

example, requirements within the oxidizer chapter or the water reactive chapter take precedence over those in the general chapter:

- NFPA 400 Chapter 15 requires that Class 1 oxidizers are separated from flammable liquids by a minimum of 25 ft. but reduces the segregation distance from other incompatible materials to only 8-ft. Additionally, combustible commodities are explicitly included in NFPA 400 as an “incompatible material” to oxidizers.
- IFC §6704.1.2 and §6704.1.3 include provisions that treat water as an incompatible material to Class 2 and Class 3 water reactive materials. This requirement is included in the code section that is only enforced for storage above the MAQ but is mentioned here as a reference.

### 8.1.5 Fire Protection System Design Criteria

The IFC/IBC doesn't provide specific sprinkler system design criteria when the quantities are below the MAQ; this is true for all five hazard categories under consideration in this report. Whereas the IFC allows for the MAQ for corrosive solids to be increased by 100% from 5,000 lbs. to 10,000 lbs. (see footnote d in IFC Table 5003.1.1(2)) and the MAQ for Class 1 oxidizers to go from 4,000 lbs. to “not limited” (see footnote f in IFC Table 5003.1.1(1)), the condition/requirement to receive these increases is having an “approved” sprinkler system installed throughout the building. This is enforced as the sprinkler system being adequate to protect the prevailing occupancy and installed in accordance with NFPA 13. The hazardous material stored below its MAQ is treated as an exempt amount that does not impact the design of the sprinkler system. Similarly, the quantity of Class 1 water reactive materials is not limited, regardless of the sprinkler system design – including a building with no sprinkler system.

NFPA 400 is similar to IFC, with the exception that there is a specific sprinkler system design basis provided for the Class 1 oxidizers in NFPA 400 §15.3.2.2.3. Therefore, for a pool chemical classified as a Class 1 oxidizer the NFPA 400 criteria must govern the sprinkler system design, which includes that Class 1 oxidizers in plastic containers were designated to be protected as a NFPA 13 Class III commodity<sup>3</sup>. An NFPA 13 Class III commodity is within the normal range of what a typical (non-chemical) storage warehouse sprinkler system is designed to protect. In fact, the most common design basis for a modern warehouse is protection of a “cartoned unexpanded plastic commodity” which tends to describe many modern commodities.

In summary, for the five hazard categories within the scope of this pool chemicals warehouse analysis, the sprinkler system design criteria in a warehouse with below MAQ chemical quantities is governed by a typical NFPA 13 warehouse design as follows:

- + Per NFPA 13 Table 13.2.1, storage of ordinary combustibles up to 12 ft high is generally able to be protected by Ordinary Hazard Group 2 (OH2) and plastic commodities are generally protected by Extra Hazard Group 2 (EH2) designs.
- + High-piled storage (on the floor or on racks) of both ordinary combustibles and plastic commodities are generally protected using ESFR systems in modern facilities such as the subject building in Georgia. For example, under a 40-ft ceiling, per NFPA 13 Tables 14.4.1, 15.4.1, 16.3.3.1 and 17.3.3.1, acceptable ceiling

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<sup>3</sup> NFPA 13 Appendix section A.5.6 includes multiple tables with recommended and example commodity classifications for an extensive list of common consumer goods. Examples of Class III commodities in NFPA 13 Table A.5.6.3.3 include: packages of dried beans and other solid/powdered food products stored in cardboard cartons, rigid PVC pipe, asphalt-coated fiberglass shingles, and wooden furniture.

only (pendent) protection for both floor piles and rack storage of Class I to IV commodities and cartoned unexpanded plastic commodities include:

- K16.8 at a minimum of 52 psi
- K22.4 at a minimum of 40 psi
- K25.2 at a minimum of 25 psi.

#### **IMPORTANT NOTES:**

1. NFPA 13 chapters 14, 15, 16 and 17 include other sprinkler system types, such as CMSA and CMDA, that are approved to protect ordinary Class I to IV commodities and cartoned unexpanded plastic commodities; the three ESFR designs listed above are offered as examples of what is likely to be present in a warehouse constructed in 2019.
2. Starting in the 2016 edition of NFPA 400, the required commodity classified for a Class 1 oxidizer stored in a plastic container larger than 1 gallon is “unexpanded plastic commodity” and therefore an exposed plastic container with Class 1 oxidizer is classified as “uncartoned unexpanded plastic,” which is a higher hazard than the cartoned unexpanded plastic commodity. Therefore, if a change in warehouse storage was made after January 1, 2020 it would necessitate a sprinkler design re-evaluation, which would require this higher level of sprinkler protection.

So, while the sprinkler system design criteria is not truly impacted in the scenario where all pool chemicals are being stored below their applicable MAQ, what is different is what level of storage is allowable in those cases depending on the hazard category assigned to the pool chemical. Specifically:

- + If the pool chemical is classified as **only** either a Class 1 oxidizer or a Class 1 water reactive material, then this sprinkler system allows for the quantity of pool chemicals stored in the warehouse to be “not limited.”
- + If the pool chemical is classified as only a corrosive solid, then this sprinkler system allows for only up to 10,000 lbs. of the pool chemical to be stored in the warehouse. In order to store more, the building must be divided into multiple control areas (up to maximum of four control areas allowed), separated from each other by minimum 1-hr fire barrier walls, and with up to 10,000 lbs. stored in each control area (i.e., maximum aggregate of 40,000 lbs. of the pool chemical allowed in the entire building if it is to remain as being below MAQ). The way to store more than 40,000 lbs. of a corrosive solid in a building is to convert the occupancy classification to Group H-4, separate the warehouse from the adjacent spaces by minimum 1-hr. fire barrier walls, and add the accompanying Group H-4 protection features, such as exhaust ventilation throughout the warehouse (see Case Study #2 for details).
- + If the pool chemical is classified as only a Class 2 oxidizer, then this sprinkler system allows only up to 500 lbs. of the pool chemical to be stored in the warehouse. To store more, the building must be divided into multiple controls areas (up to four allowed), separated from each other by 1-hr fire barrier walls and with up to 500 lbs. of the pool chemical stored in each control area (aggregate of 2,000 lbs. in the building). To store more than an aggregate of 2,000 lbs. in the building, the occupancy classification must be changed to Group H-3, the storage area separated from all adjacent spaces by minimum 2-hr fire rated barriers and the other applicable required Group H-3 protection features for OX2 added (see Case Study #2), including exhaust ventilation and automatic smoke detection.
- + If the pool chemical is classified as only a Class 2 water reactive material, then this sprinkler system allows for only up to 100 lbs. of the pool chemical to be stored in the warehouse. In order to store more, the building must be divided into multiple control areas (up to four allowed), separated from each other by

minimum 1-hr fire barrier walls and with up to 100 lbs. stored in each control area (aggregate of 400 lbs. in the building). To store more than an aggregate of 400 lbs. in the building, the occupancy classification must be changed to Group H-3, the storage area separated from all adjacent spaces by minimum 1-hr fire barrier walls and the other applicable required Group H-3 protection features for WR2 added (see Case Study #2), including exhaust ventilation on backup power.

## 8.2 CASE #2: A ONE HAZARD CLASS CHEMICAL STORED ABOVE THE MAQ

### 8.2.1 Case Study Details

A chemical warehouse with an intended inventory greater than the maximum allowable quantity. The inventory exhibits only one hazardous property, such as water-reactivity or oxidizing or corrosive properties.

### 8.2.2 Occupancy Classification and Code Applicability

According to IBC Tables 307.1(1) and 307.1(2), the applicable occupancy classification upon exceeding the MAQ, and the corresponding additional applicable code sections are as follows:

- + Class 1 oxidizer and Class 1 water reactive materials: not applicable since the MAQ is “not limited.”
- + Class 2 oxidizer: Group H-3. Add IBC §415, IFC §5004 and IFC §6304 (plus NFPA 400 Chapter 15 as applicable for specific topics).
- + Class 2 water reactive materials: Group H-3. Add IBC §415, IFC §5004 and IFC §6704 (plus NFPA 400 Chapter 20 when it provides more specific requirements).
- + Corrosive solids: Group H-4. Add IBC §415, IFC §5004 and IFC §5404 (plus NFPA 400 Chapter 12 when it provides more specific requirements).

Per IBC §414, §415 and IFC §5004, the following requirements become applicable whether the above MAQ category is Class 2 oxidizer, Class 2 water reactive or corrosive:

- + The floors must be of non-combustible construction.
- + Mechanical exhaust ventilation (unless proven that natural ventilation is sufficient) must be provided at a rate of at least 1 CFM/SF across the entire floor of the room (design must address dead zones) to remove the heavier than air vapors and exhaust them directly to the outside.
- + A manual emergency alarm system with local alarm to alert occupants of an emergency involving the hazardous materials must be provided.

Additionally, the following requirements become applicable if the exceeded MAQ is for Class 2 oxidizer or Class 2 water reactive, both of which make the chemical warehouse a Group H -3 occupancy:

- + Per IBC §415.5, if the storage room for the above MAQ storage is an attached room, then at least 25% of the perimeter of this room must be on an exterior wall.
- + The floors must be liquid-tight.
- + Secondary containment is required with capacity for a spill of the largest container plus at least 20 minutes of discharge based on the design flow of the sprinkler system.

While not explicitly stated in IBC, IFC and NFPA 400, if the applicable exceeded MAQ is “Corrosive” then consideration should be given to whether there is a prevailing corrosive environment, thereby triggering other applicable prescriptive or performance-based code requirements tied to corrosive environments. The question of a prevailing corrosive environment is relevant to these pool chemicals because the containers are designed to “breathe” and there is a known history in the industry that metal surfaces and equipment (including electrical components, storage racks and sprinkler system components) in a pool chemicals warehouse can tend to corrode unless there is sufficient (even aggressive) ventilation removing the vapors that evolve as the containers breathe. Relevant code sections for consideration in a potentially corrosive environment include:

- + NFPA 70 §300.6, *Protection Against Corrosion and Deterioration*: “Raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, fittings, supports, and support hardware shall be of materials suitable for the environment in which they are to be installed.” The section goes on to give specific requirements depending on whether the equipment and raceways are metallic or non-metallic.
- + NFPA 13 §8.16.4.2.1, *Protection of Piping Against Corrosion*: “Where corrosive conditions are known to exist due to moisture or fumes from corrosive chemicals or both, special types of fittings, pipes, and hangers that resist corrosion shall be used, or a protective coating shall be applied to all unprotected exposed surfaces of the sprinkler system.”

### 8.2.3 Fire Rated Construction Requirements

Per IBC §507.3, the special Section 507 unlimited area construction provisions are not allowed to be used if the predominant occupancy is Group H-3 or H-4, instead of the Group S-1 that applies when the MAQ is not exceeded. Therefore, the means to have an unlimited area building would be by improving the construction type from Type IIB to either Type IB or Type IA, in accordance with the minimum required construction type in IBC Table 503, which requires protection of all the structural steel in the building.

Per IBC §507.8, the Group S-1 unlimited area building is allowed to have Group H-2, H-3 and H-4 occupancies within its footprint, with the following limitations:

- + The maximum aggregate Group H spaces cannot exceed 10% of the total building size nor the maximum allowable area for the construction type per IBC Table 503.
- + The Group H spaces must be separated from the non-Group H spaces by the required occupancy separation barriers of IBC Table 508.4.
- + If the Group H spaces are classified as Group H-3 (i.e. Class 2 oxidizer or Class 2 water reactive), then at least 25% of the room perimeter must be on the building perimeter.
- + If the Group H spaces are classified as Group H-4 (i.e., Corrosive, but not Class 2 oxidizer and not Class 2 water reactive), then the room is allowed to be away from an exterior wall but the maximum size of the room is limited to 25% of the size normally allowed by IBC Sections 503 and 506.

Per IBC Tables 602 and 508.4, both Group H-3 and H-4 require the same fire resistance ratings for occupancy separation from adjacent areas. For example:

- + Unless the building is already compliant with the 60-foot separation distance for unlimited area buildings per IBC §507, the fire separation distance from the exterior wall of the Group H-3 chemical warehouse to other buildings (or a buildable lot line) must be at least 30 feet, unless it is fire rated in accordance with the requirements of IBC Table 602.

- + Minimum 2-hr fire resistance rated boundaries are needed to separate a Group H-3 or H-4 warehouse/room from a Group A assembly area such as a large cafeteria or a training room.
- + Minimum 1-hr fire resistance rated boundaries are needed to separate a Group H-3 or H-4 warehouse/room from an adjacent Group S-1 moderate hazard warehouse or a Group B office area.
  - However, per footnote c of IFC Table 6304.1.7(2), a minimum 2-hr fire rated boundary is required for all Class 2 and Class 3 oxidizer storage rooms/warehouses from all adjacent spaces. Therefore, the 2-hr requirement governs the Class 2 oxidizer storage room.

#### 8.2.4 Storage Arrangement Requirements

Among the five candidate chemical classifications<sup>4</sup>, IFC and NFPA 400 include the following increased restrictions on storage arrangements:

- + For the Class 2 oxidizer classification:
  - For a detached building, the storage arrangement limits are identical in IFC and NFPA 400, but whereas a detached building is never required for Class 2 oxidizer storage in IFC, in NFPA 400 Table 5.3.7, storage of more than 2,000 tons requires a detached building.
  - For the attached room (i.e., the chemical warehouse) that is separated by a fire barrier wall, IFC Table 6304.1.7(2) includes the following storage limits that are more restrictive than NFPA 400 Table 15.3.2.3.2.3(b):
    - Maximum pile width = 25 feet
    - Maximum pile height = 12 feet
    - Minimum distance to walls = 2 feet
    - Maximum quantity per pile = 50 tons
    - Maximum quantity per building = 500 tons
  - Per IFC §6304.1.9, the oxidizers must not be stored on or against combustible surfaces, and must be protected from contamination. The IFC Commentary adds that combustible surfaces may become ignited in the event of a spill of an oxidizer or uncontrolled release of vapors from the oxidizer.
- + For the Class 2 water reactive classification:
  - Per IBC Table 415.5.2, storage of the commodity must be in a detached building if the total storage inside the warehouse is greater than 25 tons. NFPA 400 Table 5.3.7 has the same limit to trigger a required detached building.
  - IFC §6704.1.5 requires that each pile is limited to 500 cubic feet, separated by aisles that are a minimum of 4 feet or the height of the pile, whichever is greater.
  - The room must be resistant to water penetration and piping conveying liquids (other than fire protection water) shall not pass over or through the room, unless isolated by approved liquid-tight construction (IBC §415.7.4 and IFC §6704.1.3).

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<sup>4</sup> This analysis assumes Class 1 or 2 oxidizer, Class 1 or 2 water reactive, and corrosive solid

NOTE: For both Class 2 water reactive and Class 2 oxidizers, if the requirement to provide a detached warehouse is triggered, it is possible that a structurally independent fire wall separation may be acceptable to the AHJ in lieu of a detached building since a fire wall creates a separate building. It is unknown whether that approach was in use in the subject building.

### 8.2.5 Fire Protection System Design Criteria

Both IFC §5004.5 and NFPA 400 §6.2.1.1 provide a generic requirement of OH2 sprinkler design for hazardous materials stored above MAQ (3,000 SF design area in IFC), unless another more restrictive requirement is provided. Class 2 oxidizers (in NFPA 400 §15.3.2.3.4) is the only material classification in the scope of this analysis with a more restrictive requirement. IFC §6304.1.4 directly references NFPA 400 (previously NFPA 430) as applicable for determining sprinkler design for storage above the MAQ of Class 2 oxidizers.

In addition to the requirement to use high temperature sprinklers at the ceiling, NFPA 400 Table 15.3.2.3.2.10(B) provides the following requirements for protection of Class 2 oxidizers above the MAQ:

- + Floor piles up to 8 ft high require 0.20 gpm/SF over a 3,750 SF design area
- + Floor piles up to 12 feet high require 0.35 gpm/SF over a 3,750 SF design area
- + Rack storage requires one line of in-rack sprinklers above each level of storage (except the top level) plus
  - 0.2 gpm/SF over 3,750 SF at the ceiling for storage up to 12 feet high, and
  - 0.3 gpm/SF over 2,000 SF at the ceiling for storage up to 16 feet high

Note: The requirement for the ceiling sprinklers to be high temperature for the protection of Class 2 oxidizers has the effect to make ESFR sprinklers inappropriate for the protection of Class 2 oxidizers in a large warehouse, since ESFR are only available as ordinary and intermediate temperature sprinklers. The intent of the requirement is to prevent activation of sprinklers remote from the fire. In a small room up to the size of the sprinkler design area the sprinkler activation temperature will not matter, but in a typical warehouse building (i.e., much larger than sprinkler design area) this activation temperature difference is vital to protect the available water pressure of the sprinkler system and the effectiveness of the sprinkler system.

In a warehouse storing above the MAQ of Class 2 oxidizers, the following relevant additional systems are required to be provided:

- + A supervised automatic smoke detection system with local alarm.

There are no additional protection requirements for a warehouse storing above the MAQ of exclusively Class 2 water reactive material, beyond the general protection requirements for the Group H-3 occupancy (such as the exhaust ventilation), as listed above.

## 8.3 CASE #3: A MULTI-HAZARD CLASS CHEMICAL STORED BELOW THE MAQ

### 8.3.1 Case Study Details

A chemical warehouse with an intended inventory less than the maximum allowable quantity. The inventory exhibits multiple hazardous properties, such as water-reactivity and oxidizing properties.

### 8.3.2 Analysis

Based on the analysis provided above for Case Study #1, the two key results of having a material be classified as both an oxidizer and a water reactive, as well as corrosive, but with the quantity below the MAQ, are:

- + Actual MAQ limits for Class 2 oxidizers, Class 2 water reactive materials and corrosive solids provide an actual cap on the quantity of material that can be present in the control area (i.e., the building, unless multiple control areas are created by minimum 1-hr fire rated barrier walls).
  - Class 1 oxidizers and Class 1 water reactive materials do not have a true MAQ in a sprinkler protected building and therefore a building classified as being below the MAQ can have unlimited quantities if the classification of the stored materials is **only** stated as Class 1 oxidizer and/or Class 1 water reactive.
  - Conversely, if the material is classified as Class 1 oxidizer and corrosive, then the corrosives MAQ of 19,500 lbs. (IFC Table 5003.11.1) is applicable if the maximum container size does not exceed 100 lbs. If the products are in super sacks (much larger than 100 lbs.), then the base MAQ of 10,000 lbs. from IFC Table 5003.1.1(2) is applicable.
  - Similarly, the Table 5003.11.1 MAQ for Class 2 oxidizer (4,500 lbs.) and Class 2 water reactive (2,300 lbs.) may be used if the containers are limited to a maximum of 100 lbs. If super sacks are used, then the MAQ revert to the much lower limits in IFC Table 5003.1.1(1).
- + The designer has more clarity on the code intent for the sprinkler system design basis when the material is classified as an oxidizer. This is because NFPA 400 provides clarity on the intended sprinkler design basis for Class 1 oxidizer.

## 8.4 CASE #4: A MULTI-HAZARD CLASS CHEMICAL STORED ABOVE THE MAQ

### 8.4.1 Case Study Details

A chemical warehouse with an intended inventory greater than the maximum allowable quantity. The inventory exhibits multiple hazardous properties, such as water-reactivity and oxidizing properties.

### 8.4.2 Analysis

Based on the analysis provided above for Case Studies #2 and #3, the key results of having a material be classified as both an oxidizer and a water reactive (and/or corrosive), but with the quantity above the MAQ, are:

- + The driving classification is the Class 2 oxidizer status because:
  - The increase in minimum fire rated separation from 1-hr. to 2-hr.,
  - The sprinkler system design is more demanding than the other categories, plus the ceiling sprinklers are required to be high temperature (i.e., not ESFR).
  - There is a requirement to add a supervised automatic smoke detection system with local alarm.
- + The addition of the Class 2 water reactive classification adds the following key requirements
  - There is a limit of 25 tons that can be stored inside a warehouse that is part of a larger building, above which the storage warehouse must be a standalone (detached) building.
  - The storage warehouse must be resistant to water penetration and not allow liquid carrying pipes other than sprinkler piping through the room.

- + The addition of the Corrosive solid classification adds the need to properly consider the corrosive environment that may result from the containers breathing and therefore releasing corrosive vapors. As discussed in Section 8.2.2:
  - NFPA 70 includes a requirement that in a corrosive environment the electrical equipment, materials and wiring methods must be appropriate for the environment.
  - NFPA 13 includes a requirement that the sprinkler system pipes, fittings and hangers must be properly selected to resist corrosion or be protected against corrosion.

## 9.0 Summary and Conclusions

The purpose of this report was to summarize and discuss the fire protection requirements that were applicable to a pool chemicals warehouse designed and constructed in Georgia in 2019. The report identifies, interprets and weaves together the relevant sections and requirements from the applicable Georgia fire safety regulations and the relevant chapters of the then adopted building and fire codes and NFPA standards that together governed the design and construction of chemical warehousing facilities for pool chemicals. The focus of the analysis was on design and effectiveness of the fire protection system, including but not limited to the automatic sprinkler system.

The key findings from this analysis include:

1. The crucial building blocks for the proper design basis development are:
  - a. Correct and comprehensive chemical classification, including identifying all the secondary hazard categories that are applicable. The case studies included in this analysis assumed that the pool chemicals have a chemical classification that is some combination of the following:
    - i. Class 1 or 2 oxidizer
    - ii. Class 1 or 2 water reactive
    - iii. Corrosive solid
  - b. Determination of the proper occupancy classification
    - i. The default occupancy classification for a storage warehouse is Group S-1, which allows for use of the IBC §507 special allowance for an unlimited area building that is only Type IIB construction (i.e., unprotected structural steel).
    - ii. If the correct chemical classifications for the pool chemicals include Corrosive Solid and/or Class 2 oxidizer and/or Class 2 water reactive, then at warehousing quantities the occupancy classification will be Group H-4 and/or Group H-3 since the MAQ are exceeded.
    - iii. If the main warehouse is classified as Group H instead of Group S-1, then the special IBC §507 Type IIB unlimited area building allowance is restricted and the structural steel must be protected to the level of Construction Type IB (for a Corrosive solid) or Construction Type IA (for a Class 2 oxidizer or Class 2 water reactive) to allow for an unlimited area building in which the entire warehouse is Group H-4 or Group H-3.
    - iv. Additionally, if the warehouse is classified as Group H-4 due to a Corrosive solid classification, then proper consideration must be given to whether the environment is corrosive due to the breathing of the pool chemicals containers. In that case, the following additional requirements are applicable:

- 1.) NFPA 70 §300.6, *Protection Against Corrosion and Deterioration*: “Raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, fittings, supports, and support hardware shall be of materials suitable for the environment in which they are to be installed.” The section goes on to give specific requirements depending on whether the equipment and raceways are metallic or non-metallic.
  - 2.) NFPA 13 §8.16.4.2.1, *Protection of Piping Against Corrosion*: “Where corrosive conditions are known to exist due to moisture or fumes from corrosive chemicals or both, special types of fittings, pipes, and hangers that resist corrosion shall be used, or a protective coating shall be applied to all unprotected exposed surfaces of the sprinkler system.”
- c. Proper commodity classification towards sprinkler system design basis development.
    - i. The top differentiator is that if the pool chemical is a Class 2 oxidizer, then the sprinkler system design includes a requirement to use high temperature sprinklers at the ceiling, which effectively eliminates use of ESFR sprinklers.
    - ii. For the other four chemical classifications, the typical warehouse sprinkler system type is acceptable, including the ESFR systems that are common in modern warehouses.
2. If the chemical classification or inventory development is wrong, the entire fire protection system design basis will be wrong.
  3. Changing the mix of chemicals in the warehouse or changing the storage arrangements can invalidate an existing design and jeopardize system effectiveness.
    - a. Per IFC and NFPA 400, re-evaluation will be required against the current code at the time of the change, not the original code of construction.
    - b. It must be noted that NFPA 400 has changed (i.e., increased) the required commodity classification for Class 1 oxidizers in plastic containers starting in the 2016 edition so that the compliance status of the typical warehouse sprinkler system that is based on protecting cartoned unexpanded plastic (CUP) commodities may not be automatically approved for protection of Class 1 oxidizers in plastic containers without further evaluation.

The table below provides a summary and comparison of some of the key differences between the resultant required fire protection design basis, depending on the complete chemical classification of the pool chemical when stored at typical warehousing quantities. Warehousing quantities are assumed to be many thousands of pounds of product so that for Corrosive solids, Class 2 oxidizers and/or Class 2 water reactive materials, the MAQ will be exceeded.

*2019 Georgia Fire Protection System Design Criteria Impact of Hazard Category with Storage of Warehousing Quantities<sup>5</sup>*

| <i>Chemical Classification Scenario</i> | <i>Occupancy Classification and Building Size Limits</i> | <i>Sprinkler System Criteria</i>                                               | <i>Other Fire Protection System Requirements</i>                                                               | <i>Fire Rated Barriers Requirements</i>            | <i>Storage Arrangements</i>                                                                           |
|-----------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Class 1 Oxidizer Only                   | IBC §507 Unlimited Area Group S-1                        | Typical NFPA 13 warehouse design such as ESFR                                  | Smoke/heat vents only if not using ESFR                                                                        | None                                               | Maximum storage height of 20 ft. per NFPA 400 and IFC                                                 |
| Class 1 WR Only                         | IBC §507 Unlimited Area Group S-1                        | Typical NFPA 13 warehouse design such as ESFR                                  | Smoke/heat vents only if not using ESFR                                                                        | None                                               |                                                                                                       |
| Corrosive Only                          | H-4 (IBC §507 Unlimited Area Restricted)                 | NFPA 13 OH2 with 3,000 SF design area or typical warehouse ESFR                | + Add exhaust ventilation with backup power, and emergency alarm.<br>+ Smoke/heat vents only if not using ESFR | 1-hr fire barrier separation from adjacent spaces  |                                                                                                       |
| Class 2 Oxidizer Only                   | H-3 (IBC §507 Unlimited Area Restricted)                 | High temperature standard spray sprinklers per NFPA 400 Table 15.3.2.3.2.10(B) | + Add smoke detectors, exhaust ventilation, secondary containment and emergency alarm<br>+ Smoke/heat vents    | 2-hr fire barrier separation from adjacent spaces. | + Detached storage if over 2,000 tons<br>+ Max storage height of 16-ft (or less per sprinkler design) |
| Class 2 WR Only                         | H-3 (IBC §507 Unlimited Area Restricted)                 | NFPA 13 OH2 with 3,000 SF design area or typical warehouse ESFR                | + Add exhaust ventilation with backup power and emergency alarm.<br>+ Smoke/heat vents only if not using ESFR  | 1-hr fire barrier separation from adjacent spaces  | Detached storage if over 25 tons                                                                      |

<sup>5</sup> Warehousing quantities are anticipated to be several thousand pounds and therefore above the MAQ for the Corrosive, Class 2 Oxidizer and Class 2 Water Reactive hazard classifications

| <i>Chemical Classification Scenario</i> | <i>Occupancy Classification and Building Size Limits</i> | <i>Sprinkler System Criteria</i>                                               | <i>Other Fire Protection System Requirements</i>                                                                              | <i>Fire Rated Barriers Requirements</i>            | <i>Storage Arrangements</i>                                                                           |
|-----------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Class 1 Ox + Class 1 WR                 | IBC §507 Unlimited Area Group S-1                        | Typical NFPA 13 warehouse design such as ESFR                                  | Smoke/heat vents only if not using ESFR                                                                                       | None                                               | Maximum storage height of 20 ft.                                                                      |
| Class 1 Ox + Corrosive                  | H-4 (IBC §507 Unlimited Area Restricted)                 | NFPA 13 OH2 with 3,000 SF design area or typical warehouse ESFR                | + Add exhaust ventilation with backup power and emergency alarm.<br>+ Smoke/heat vents only if not using ESFR                 | 1-hr fire barrier separation from adjacent spaces  | Maximum storage height of 20 ft.                                                                      |
| Class 1 Ox + Class 1 WR + Corrosive     | H-4 (IBC §507 Unlimited Area Restricted)                 | NFPA 13 OH2 with 3,000 SF design area or typical warehouse ESFR                | + Add exhaust ventilation with backup power and emergency alarm.<br>+ Smoke/heat vents only if not using ESFR                 | 1-hr fire barrier separation from adjacent spaces  | Maximum storage height of 20 ft.                                                                      |
| Class 2 Ox + Class 1 WR                 | H-3 (IBC §507 Unlimited Area Restricted)                 | High temperature standard spray sprinklers per NFPA 400 Table 15.3.2.3.2.10(B) | + Add smoke detectors, exhaust ventilation, secondary containment and emergency alarm<br>+ Smoke/heat vents                   | 2-hr fire barrier separation from adjacent spaces. | + Detached storage if over 2,000 tons<br>+ Max storage height of 16-ft (or less per sprinkler design) |
| Class 2 Ox + Class 1 WR + Corrosive     | H-3 and H-4 (IBC §507 Unlimited Area Restricted)         | High temperature standard spray sprinklers per NFPA 400 Table 15.3.2.3.2.10(B) | + Add smoke detectors, exhaust ventilation with backup power, secondary containment and emergency alarm<br>+ Smoke/heat vents | 2-hr fire barrier separation from adjacent spaces. | + Detached storage if over 2,000 tons<br>+ Max storage height of 16-ft (or less per sprinkler design) |

| Chemical Classification Scenario    | Occupancy Classification and Building Size Limits | Sprinkler System Criteria                                                      | Other Fire Protection System Requirements                                                                                                                                               | Fire Rated Barriers Requirements                   | Storage Arrangements                                                                                                                              |
|-------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Class 2 Ox + Class 2 WR + Corrosive | H-3 and H-4 (IBC §507 Unlimited Area Restricted)  | High temperature standard spray sprinklers per NFPA 400 Table 15.3.2.3.2.10(B) | <div><div></div><div>Add smoke detectors, exhaust ventilation with backup power, secondary containment and emergency alarm</div><div></div><div></div><div>Smoke/heat vents</div></div> | 2-hr fire barrier separation from adjacent spaces. | <div><div></div><div>Detached storage if over 25 tons</div><div></div><div>Max storage height of 16-ft (or less per sprinkler design)</div></div> |
| Class 1 Ox + Class 2 WR + Corrosive | H-3 and H-4 (IBC §507 Unlimited Area Restricted)  | NFPA 13 OH2 with 3,000 SF design area or typical warehouse ESFR                | <div><div></div><div>Add exhaust ventilation with backup power and emergency alarm.</div><div></div><div></div><div>Smoke/heat vents only if not using ESFR</div></div>                 | 1-hr fire barrier separation from adjacent spaces  | <div><div></div><div>Detached storage if over 25 tons</div><div></div><div>Maximum storage height of 20 ft.</div></div>                           |

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## Appendix A Selected IBC Excerpts

### SECTION 307 HIGH-HAZARD GROUP H

**[F] 307.1 High-hazard Group H.** High-hazard Group H occupancy includes, among others, the use of a building or structure, or a portion thereof, that involves the manufacturing, processing, generation or storage of materials that constitute a physical or health hazard in quantities in excess of those allowed in *control areas* complying with Section 414, based on the maximum allowable quantity limits for *control areas* set forth in Tables 307.1(1) and 307.1(2). Hazardous occupancies are classified in Groups H-1, H-2, H-3, H-4 and H-5 and shall be in accordance with this section, the requirements of Section 415 and the *International Fire Code*. Hazardous materials stored, or used on top of roofs or canopies shall be classified as outdoor storage or use and shall comply with the *International Fire Code*.

**Exceptions:** The following shall not be classified as Group H, but shall be classified as the occupancy that they most nearly resemble.

1. Buildings and structures occupied for the application of flammable finishes, provided that such buildings or areas conform to the requirements of Section 416 and the *International Fire Code*.
2. Wholesale and retail sales and storage of flammable and combustible liquids in mercantile occupancies conforming to the *International Fire Code*.
3. Closed piping system containing flammable or combustible liquids or gases utilized for the operation of machinery or equipment.
4. Cleaning establishments that utilize combustible liquid solvents having a flash point of 140°F (60°C) or higher in closed systems employing equipment *listed* by an *approved* testing agency, provided that this occupancy is separated from all other areas of the building by 1-hour *fire barriers* constructed in accordance with Section 707 or 1-hour *horizontal assemblies* constructed in accordance with Section 711, or both.
5. Cleaning establishments that utilize a liquid solvent having a flash point at or above 200°F (93°C).
6. Liquor stores and distributors without bulk storage.
7. Refrigeration systems.
8. The storage or utilization of materials for agricultural purposes on the premises.
9. Stationary batteries utilized for facility emergency power, uninterruptible power supply or telecommunication facilities, provided that the batteries are provided with safety venting caps and *ventilation* is provided in accordance with the *International Mechanical Code*.
10. Corrosives shall not include personal or household products in their original packaging used in retail display or commonly used building materials.
11. Buildings and structures occupied for aerosol storage shall be classified as Group S-1, provided that such buildings conform to the requirements of the *International Fire Code*.
12. Display and storage of nonflammable solid and nonflammable or noncombustible liquid hazardous materials in quantities not exceeding the maximum allowable quantity per *control area* in Group M or S occupancies complying with Section 414.2.5.
13. The storage of black powder, smokeless propellant and small arms primers in Groups M and R-3 and

special industrial explosive devices in Groups B, F, M and S, provided such storage conforms to the quantity limits and requirements prescribed in the *International Fire Code*.

**[F] 307.1.1 Hazardous materials.** Hazardous materials in any quantity shall conform to the requirements of this code, including Section 414, and the *International Fire Code*.

**[F] 307.4 High-hazard Group H-2.** Buildings and structures containing materials that pose a deflagration hazard or a hazard from accelerated burning shall be classified as Group H-2. Such materials shall include, but not be limited to, the following:

Class I, II or IIIA flammable or combustible liquids which are used or stored in normally open containers or systems, or in closed containers or systems pressurized at more than 15 psi (103.4 kPa) gage  
Combustible dusts where manufactured, generated or used in such a manner that the concentration and conditions create a fire or explosion hazard based on information prepared in accordance with Section 414.1.3  
Cryogenic fluids, flammable  
Flammable gases  
Organic peroxides, Class I  
Oxidizers, Class 3, that are used or stored in normally open containers or systems, or in closed containers or systems pressurized at more than 15 psi (103 kPa) gage  
Pyrophoric liquids, solids and gases, nondetonable  
Unstable (reactive) materials, Class 3, nondetonable  
Water-reactive materials, Class 3

**[F] 307.5 High-hazard Group H-3.** Buildings and structures containing materials that readily support combustion or that pose a physical hazard shall be classified as Group H-3. Such materials shall include, but not be limited to, the following:

Class I, II or IIIA flammable or combustible liquids that are used or stored in normally closed containers or systems pressurized at 15 pounds per square inch gauge (103.4 kPa) or less  
Combustible fibers, other than densely packed baled cotton  
Consumer fireworks, 1.4G (Class C, Common)  
Cryogenic fluids, oxidizing  
Flammable solids  
Organic peroxides, Class II and III  
Oxidizers, Class 2  
Oxidizers, Class 3, that are used or stored in normally closed containers or systems pressurized at 15 pounds per square inch gauge (103 kPa) or less  
Oxidizing gases  
Unstable (reactive) materials, Class 2  
Water-reactive materials, Class 2

**[F] 307.6 High-hazard Group H-4.** Buildings and structures which contain materials that are health hazards shall be classified as Group H-4. Such materials shall include, but not be limited to, the following:

Corrosives  
Highly toxic materials  
Toxic materials

**[F] 307.7 High-hazard Group H-5.** Semiconductor fabrication facilities and comparable research and development areas in which hazardous production materials (HPM) are used and the aggregate quantity of materials is in excess of those listed in Tables 307.1(1) and 307.1(2) shall be classified as Group H-5. Such facilities and areas shall be designed and constructed in accordance with Section 415.10.

**[F] 307.8 Multiple hazards.** Buildings and structures containing a material or materials representing hazards that are classified in one or more of Groups H-1, H-2, H-3 and H-4 shall conform to the code requirements for each of the occupancies so classified.

## SECTION 414 HAZARDOUS MATERIALS

**[F] 414.1 General.** The provisions of Sections 414.1 through 414.7 shall apply to buildings and structures occupied for the manufacturing, processing, dispensing, use or storage of hazardous materials.

**[F] 414.1.1 Other provisions.** Buildings and structures with an occupancy in Group H shall comply with this section and the applicable provisions of Section 415 and the *International Fire Code*.

**[F] 414.1.2 Materials.** The safe design of hazardous material occupancies is material dependent. Individual material requirements are also found in Sections 307 and 415, and in the *International Mechanical Code* and the *International Fire Code*.

**[F] 414.1.2.1 Aerosols.** Level 2 and 3 aerosol products shall be stored and displayed in accordance with the *International Fire Code*. See Section 311.2 and the *International Fire Code* for occupancy group requirements.

**[F] 414.1.3 Information required.** A report shall be submitted to the *building official* identifying the maximum expected quantities of hazardous materials to be stored, used in a *closed system* and used in an *open system*, and subdivided to separately address hazardous material classification categories based on Tables 307.1(1) and 307.1(2). The methods of protection from such hazards, including but not limited to *control areas*, fire protection systems and Group H occupancies shall be indicated in the report and on the *construction documents*. The opinion and report shall be prepared by a qualified person, firm or corporation *approved* by the *building official* and provided without charge to the enforcing agency.

For buildings and structures with an occupancy in Group H, separate floor plans shall be submitted identifying the locations of anticipated contents and processes so as to reflect the nature of each occupied portion of every building and structure.

**[F] 414.2 Control areas.** *Control areas* shall comply with Sections 414.2.1 through 414.2.5 and the *International Fire Code*.

**[F] 414.2.1 Construction requirements.** *Control areas* shall be separated from each other by *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.

**[F] 414.2.2 Percentage of maximum allowable quantities.** The percentage of maximum allowable quantities of hazardous materials per *control area* permitted at each floor level within a building shall be in accordance with Table 414.2.2.

**[F] 414.2.3 Number.** The maximum number of *control areas* within a building shall be in accordance with Table 414.2.2.

**[F] 414.2.4 Fire-resistance-rating requirements.** The required *fire-resistance rating* for *fire barriers* shall be in accordance with Table 414.2.2. The floor assembly of the *control area* and the construction supporting the floor of

the *control area* shall have a *fire-resistance rating* of not less than 2 hours.

**Exception:** The floor assembly of the *control area* and the construction supporting the floor of the *control area* are allowed to be 1-hour fire-resistance rated in buildings of Types IIA, IIIA and VA construction, provided that both of the following conditions exist:

1. The building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1; and
2. The building is three or fewer stories above *grade plane*.

**[F] 414.2.5 Hazardous material in Group M display and storage areas and in Group S storage areas.** The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials permitted within a single *control area* of a Group M display and storage area, a Group S storage area or an outdoor *control area* is permitted to exceed the maximum allowable quantities per *control area* specified in Tables 307.1(1) and 307.1(2) without classifying the building or use as a Group H occupancy, provided that the materials are displayed and stored in accordance with the *International Fire Code* and quantities do not exceed the maximum allowable specified in Table 414.2.5(1).

In Group M occupancy wholesale and retail sales uses, indoor storage of flammable and combustible liquids shall not exceed the maximum allowable quantities per *control area* as indicated in Table 414.2.5(2), provided that the materials are displayed and stored in accordance with the *International Fire Code*.

The maximum quantity of aerosol products in Group M occupancy retail display areas, storage areas adjacent to retail display areas and retail storage areas shall be in accordance with the *International Fire Code*.

**[F] 414.3 Ventilation.** Rooms, areas or spaces of Group H in which explosive, corrosive, combustible, flammable or highly toxic dusts, mists, fumes, vapors or gases are or may be emitted due to the processing, use, handling or storage of materials shall be mechanically ventilated as required by the *International Fire Code* and the *International Mechanical Code*.

Ducts conveying explosives or flammable vapors, fumes or dusts shall extend directly to the exterior of the building without entering other spaces. Exhaust ducts shall not extend into or through ducts and plenums.

**Exception:** Ducts conveying vapor or fumes having flammable constituents less than 25 percent of their lower flammable limit (LFL) are permitted to pass through other spaces.

Emissions generated at workstations shall be confined to the area in which they are generated as specified in the *International Fire Code* and the *International Mechanical Code*.

The location of supply and exhaust openings shall be in accordance with the *International Mechanical Code*. Exhaust air contaminated by *highly toxic* material shall be treated in accordance with the *International Fire Code*.

A manual shutoff control for *ventilation* equipment required by this section shall be provided outside the room adjacent to the principal access door to the room. The switch shall be of the break-glass type and shall be labeled: VENTILATION SYSTEM EMERGENCY SHUTOFF.

[F] TABLE 414.2.2  
DESIGN AND NUMBER OF CONTROL AREAS

| FLOOR LEVEL       |               | PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA <sup>a</sup> | NUMBER OF CONTROL AREAS PER FLOOR | FIRE-RESISTANCE RATING FOR FIRE BARRIERS IN HOURS <sup>b</sup> |
|-------------------|---------------|----------------------------------------------------------------------------|-----------------------------------|----------------------------------------------------------------|
| Above grade plane | Higher than 9 | 5                                                                          | 1                                 | 2                                                              |
|                   | 7-9           | 5                                                                          | 2                                 | 2                                                              |
|                   | 6             | 12.5                                                                       | 2                                 | 2                                                              |
|                   | 5             | 12.5                                                                       | 2                                 | 2                                                              |
|                   | 4             | 12.5                                                                       | 2                                 | 2                                                              |
|                   | 3             | 50                                                                         | 2                                 | 1                                                              |
|                   | 2             | 75                                                                         | 3                                 | 1                                                              |
|                   | 1             | 100                                                                        | 4                                 | 1                                                              |
| Below grade plane | 1             | 75                                                                         | 3                                 | 1                                                              |
|                   | 2             | 50                                                                         | 2                                 | 1                                                              |
|                   | Lower than 2  | Not Allowed                                                                | Not Allowed                       | Not Allowed                                                    |

a. Percentages shall be of the maximum allowable quantity per control area shown in Tables 307.1(1) and 307.1(2), with all increases allowed in the notes to those tables.

b. Separation shall include fire barriers and horizontal assemblies as necessary to provide separation from other portions of the building.

[F] 414.4 **Hazardous material systems.** Systems involving hazardous materials shall be suitable for the intended application. Controls shall be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate or path. Automatic controls, where provided, shall be designed to be fail safe.

[F] 414.5 **Inside storage, dispensing and use.** The inside storage, dispensing and use of hazardous materials shall be in accordance with Sections 414.5.1 through 414.5.4 of this code and the *International Fire Code*.

[F] 414.5.1 **Explosion control.** Explosion control shall be provided in accordance with the *International Fire Code* as required by Table 414.5.1 where quantities of hazardous materials specified in that table exceed the maximum allowable quantities in Table 307.1(1) or where a structure, room or space is occupied for purposes involving explosion hazards as required by Section 415 or the *International Fire Code*.

[F] 414.5.2 **Monitor control equipment.** Monitor control equipment shall be provided where required by the *International Fire Code*.

[F] 414.5.3 **Emergency or standby power.** Where mechanical ventilation, treatment systems, temperature control, alarm, detection or other electrically operated systems are required by the *International Fire Code* or this code, such systems shall be provided with an emergency or standby power system in accordance with Chapter 27.

**Exceptions:**

1. Emergency or standby power are not required for the following storage areas:
  - 1.1. Mechanical ventilation for storage of Class IB and Class IC flammable and combustible liquids in closed containers not exceeding 6.5 gallons (25 L) capacity.
  - 1.2. Storage areas for Class 1 and 2 oxidizers.
  - 1.3. Storage areas for Class II, III, IV and V organic peroxides.
  - 1.4. Storage, use and handling areas for asphyxiant, irritant and radioactive gases.
  - 1.5. For storage, use and handling areas for highly toxic or toxic materials, see Sections 6004.2.2.8 and 6004.3.4.2 of the *International Fire Code*.

2. Standby power for mechanical ventilation, treatment systems and temperature control systems shall not be required where an approved fail-safe engineered system is installed.

[F] 414.5.4 **Spill control, drainage and containment.** Rooms, buildings or areas occupied for the storage of solid and liquid hazardous materials shall be provided with a means to control spillage and to contain or drain off spillage and fire protection water discharged in the storage area where required in the *International Fire Code*. The methods of spill control shall be in accordance with the *International Fire Code*.

[F] 414.7 **Emergency alarms.** Emergency alarms for the detection and notification of an emergency condition in Group H occupancies shall be provided as set forth herein.

[F] 414.7.1 **Storage.** An approved manual emergency alarm system shall be provided in buildings, rooms or areas used for storage of hazardous materials. Emergency alarm-initiating devices shall be installed outside of each interior exit or exit access door of storage buildings, rooms or areas. Activation of an emergency alarm-initiating device shall sound a local alarm to alert occupants of an emergency situation involving hazardous materials.

[F] 414.7.2 **Dispensing, use and handling.** Where hazardous materials having a hazard ranking of 3 or 4 in accordance with NFPA 704 are transported through corridors, interior exit stairways or ramps, or exit passageways there shall be an emergency telephone system, a local manual alarm station or an approved alarm-initiating device at not more than 150-foot (45 720 mm) intervals and at each exit and exit access doorway throughout the transport route. The signal shall be relayed to an approved central, proprietary or remote station service or constantly attended on-site location and shall initiate a local audible alarm.

[F] 414.7.3 **Supervision.** Emergency alarm systems shall be supervised by an approved central, proprietary or remote station service or shall initiate an audible and visual signal at a constantly attended on-site location.

**[F] TABLE 414.5.1  
EXPLOSION CONTROL REQUIREMENTS<sup>a</sup>**

| MATERIAL                                        | CLASS           | EXPLOSION CONTROL METHODS |                                                                                              |
|-------------------------------------------------|-----------------|---------------------------|----------------------------------------------------------------------------------------------|
|                                                 |                 | Barricade construction    | Explosion (deflagration) venting or explosion (deflagration) prevention systems <sup>b</sup> |
| HAZARD CATEGORY                                 |                 |                           |                                                                                              |
| Combustible dusts <sup>c</sup>                  | —               | Not Required              | Required                                                                                     |
| Cryogenic flammables                            | —               | Not Required              | Required                                                                                     |
| Explosives                                      | Division 1.1    | Required                  | Not Required                                                                                 |
|                                                 | Division 1.2    | Required                  | Not Required                                                                                 |
|                                                 | Division 1.3    | Not Required              | Required                                                                                     |
|                                                 | Division 1.4    | Not Required              | Required                                                                                     |
|                                                 | Division 1.5    | Required                  | Not Required                                                                                 |
|                                                 | Division 1.6    | Required                  | Not Required                                                                                 |
| Flammable gas                                   | Gaseous         | Not Required              | Required                                                                                     |
|                                                 | Liquefied       | Not Required              | Required                                                                                     |
| Flammable liquid                                | IA <sup>e</sup> | Not Required              | Required                                                                                     |
|                                                 | IB <sup>e</sup> | Not Required              | Required                                                                                     |
| Organic peroxides                               | U               | Required                  | Not Permitted                                                                                |
|                                                 | I               | Required                  | Not Permitted                                                                                |
| Oxidizer liquids and solids                     | 4               | Required                  | Not Permitted                                                                                |
| Pyrophoric gas                                  | —               | Not Required              | Required                                                                                     |
| Unstable (reactive)                             | 4               | Required                  | Not Permitted                                                                                |
|                                                 | 3 Detonable     | Required                  | Not Permitted                                                                                |
|                                                 | 3 Nondetonable  | Not Required              | Required                                                                                     |
| Water-reactive liquids and solids               | 3               | Not Required              | Required                                                                                     |
|                                                 | 2 <sup>g</sup>  | Not Required              | Required                                                                                     |
| SPECIAL USES                                    |                 |                           |                                                                                              |
| Acetylene generator rooms                       | —               | Not Required              | Required                                                                                     |
| Grain processing                                | —               | Not Required              | Required                                                                                     |
| Liquefied petroleum gas-distribution facilities | —               | Not Required              | Required                                                                                     |
| Where explosion hazards exist <sup>f</sup>      | Detonation      | Required                  | Not Permitted                                                                                |
|                                                 | Deflagration    | Not Required              | Required                                                                                     |

a. See Section 414.1.3.

b. See the *International Fire Code*.

c. As generated during manufacturing or processing.

d. Storage or use.

e. In open use or dispensing.

f. Rooms containing dispensing and use of hazardous materials when an explosive environment can occur because of the characteristics or nature of the hazardous materials or as a result of the dispensing or use process.

g. A method of explosion control shall be provided when Class 2 water-reactive materials can form potentially explosive mixtures.

#### SECTION 415 GROUPS H-1, H-2, H-3, H-4 AND H-5

Section 415 has been completely reorganized from the 2009 code; therefore, the \* and \*\* margin indicators have not been included for clarity.

**[F] 415.1 Scope.** The provisions of Sections 415.1 through 415.10 shall apply to the storage and use of hazardous materials in excess of the maximum allowable quantities per control area listed in Section 307.1. Buildings and structures with an occupancy in Group H shall also comply with the applicable provisions of Section 414 and the *International Fire Code*.

**[F] 415.3 Automatic fire detection systems.** Group H occupancies shall be provided with an automatic fire detection system in accordance with Section 907.2.

**[F] 415.4 Automatic sprinkler system.** Group H occupancies shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.2.5.

**[F] 415.5 Fire separation distance.** Group H occupancies shall be located on property in accordance with the other provisions of this chapter.

In Groups H-2 and H-3, not less than 25 percent of the perimeter wall of the occupancy shall be an exterior wall.

#### Exceptions:

1. *Liquid use, dispensing and mixing rooms* having a floor area of not more than 500 square feet (46.5 m<sup>2</sup>) need not be located on the outer perimeter of the building where they are in accordance with the *International Fire Code* and NFPA 30.
2. *Liquid storage rooms* having a floor area of not more than 1,000 square feet (93 m<sup>2</sup>) need not be located on the outer perimeter where they are in accordance with the *International Fire Code* and NFPA 30.
3. Spray paint booths that comply with the *International Fire Code* need not be located on the outer perimeter.

**[F] 415.5.1 Group H occupancy minimum fire separation distance.** Regardless of any other provisions, buildings containing Group H occupancies shall be set back to the minimum *fire separation distance* as set forth in Sections 415.5.1.1 through 415.5.1.4. Distances shall be measured from the walls enclosing the occupancy to *lot lines*, including those on a public way. Distances to assumed *lot lines* established for the purpose of determining exterior wall and opening protection are not to be used to establish the minimum *fire separation distance* for buildings on sites where explosives are manufactured or used when separation is provided in accordance with the quantity distance tables specified for explosive materials in the *International Fire Code*.

**[F] 415.5.1.1 Group H-1.** Group H-1 occupancies shall be set back not less than 75 feet (22 860 mm) and not less than required by the *International Fire Code*.

**Exception:** Fireworks manufacturing buildings separated in accordance with NFPA 1124.

**[F] 415.5.1.2 Group H-2.** Group H-2 occupancies shall be set back not less than 30 feet (9144 mm) where the area of the occupancy is greater than 1,000 square feet (93 m<sup>2</sup>) and it is not required to be located in a *detached building*.

**[F] 415.5.1.3 Groups H-2 and H-3.** Group H-2 and H-3 occupancies shall be set back not less than 50 feet (15 240 mm) where a *detached building* is required (see Table 415.3.2).

**[F] 415.5.1.4 Explosive materials.** Group H-2 and H-3 occupancies containing materials with explosive characteristics shall be separated as required by the *International Fire Code*. Where separations are not specified, the distances required shall be determined by a technical report issued in accordance with Section 414.1.3.

**[F] 415.5.2 Detached buildings for Group H-1, H-2 or H-3 occupancy.** The storage or use of hazardous materials in excess of those amounts listed in Table 415.5.2 shall be in accordance with the applicable provisions of Sections 415.6 and 415.7.

**[F] 415.5.2.1 Wall and opening protection.** Where a *detached building* is required by Table 415.5.2, there are no requirements for wall and opening protection based on *fire separation distance*.

**[F] 415.7 Special provisions for Group H-2 and H-3 occupancies.** Group H-2 and H-3 occupancies containing quantities of hazardous materials in excess of those set forth in Table 415.5.2 shall be in *detached buildings* used for manufacturing, processing, dispensing, use or storage of hazardous materials. Materials listed for Group H-1 occupancies in Section 307.3 are permitted to be located within Group H-2 or H-3 *detached buildings* provided the amount of materials per *control area* do not exceed the maximum allowed quantity specified in Table 307.1(1).

**[F] 415.7.1 Detached buildings.** *Detached buildings* shall not exceed one *story* in height and shall be without *basements*, crawl spaces or other under-floor spaces.

**[F] 415.7.2 Multiple hazards.** Group H-2 or H-3 occupancies containing materials which are in themselves both physical and health hazards in quantities exceeding the maximum allowable quantities per *control area* in Table 307.1(2) shall comply with requirements for Group H-2, H-3 or H-4 occupancies as applicable.

**[F] 415.7.3 Separation of incompatible materials.** Hazardous materials other than those listed in Table 415.3.2 shall be allowed in manufacturing, processing, dispensing, use or storage areas when separated from incompatible materials in accordance with the provisions of the *International Fire Code*.

**[F] 415.7.4 Water reactives.** Group H-2 and H-3 occupancies containing water-reactive materials shall be resistant to water penetration. Piping for conveying liquids shall not be over or through areas containing water reactives, unless isolated by *approved liquid-tight construction*.

**Exception:** Fire protection piping shall be permitted over or through areas containing water reactives without isolating it with liquid-tight construction.

**[F] 415.7.5 Floors in storage rooms.** Floors in storage areas for organic peroxides, oxidizers, pyrophoric materials, unstable (reactive) materials and water-reactive solids and liquids shall be of liquid-tight, noncombustible construction.

**[F] 415.7.6 Waterproof room.** Rooms or areas used for the storage of water-reactive solids and liquids shall be constructed in a manner that resists the penetration of water through the use of waterproof materials. Piping carrying water for other than *approved automatic sprinkler systems* shall not be within such rooms or areas.

**[F] 415.9 Groups H-3 and H-4.** Groups H-3 and H-4 shall be constructed in accordance with the applicable provisions of this code and the *International Fire Code*.

**[F] 415.9.1 Flammable and combustible liquids.** The storage, handling, processing and transporting of flammable and combustible liquids in Group H-3 occupancies shall be in accordance with Section 415.8.2.

**[F] 415.9.2 Gas rooms.** Where gas rooms are provided, such rooms shall be separated from other areas by not less than 1-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.

**[F] 415.9.3 Floors in storage rooms.** Floors in storage areas for corrosive liquids and highly toxic or toxic materials shall be of liquid-tight, noncombustible construction.

**[F] 415.9.4 Separation-highly toxic solids and liquids.** Highly toxic solids and liquids not stored in *approved hazardous materials storage cabinets* shall be isolated from other hazardous materials storage by not less than 1-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.

**[F] TABLE 415.5.2  
DETACHED BUILDING REQUIRED**

| A DETACHED BUILDING IS REQUIRED WHEN THE QUANTITY OF MATERIAL EXCEEDS THAT LISTED HEREIN |                           |                                           |                                    |
|------------------------------------------------------------------------------------------|---------------------------|-------------------------------------------|------------------------------------|
| Material                                                                                 | Class                     | Solids and Liquids (tons) <sup>a, b</sup> | Gases (cubic feet) <sup>a, b</sup> |
| Explosives                                                                               | Division 1.1              | Maximum Allowable Quantity                | Not Applicable                     |
|                                                                                          | Division 1.2              | Maximum Allowable Quantity                |                                    |
|                                                                                          | Division 1.3              | Maximum Allowable Quantity                |                                    |
|                                                                                          | Division 1.4              | Maximum Allowable Quantity                |                                    |
|                                                                                          | Division 1.4 <sup>c</sup> | 1                                         |                                    |
|                                                                                          | Division 1.5              | Maximum Allowable Quantity                |                                    |
|                                                                                          | Division 1.6              | Maximum Allowable Quantity                |                                    |
| Oxidizers                                                                                | Class 4                   | Maximum Allowable Quantity                | Maximum Allowable Quantity         |
| Unstable (reactives) detonable                                                           | Class 3 or 4              | Maximum Allowable Quantity                | Maximum Allowable Quantity         |
| Oxidizer, liquids and solids                                                             | Class 3                   | 1,200                                     | Not Applicable                     |
|                                                                                          | Class 2                   | 2,000                                     | Not Applicable                     |
| Organic peroxides                                                                        | Detonable                 | Maximum Allowable Quantity                | Not Applicable                     |
|                                                                                          | Class I                   | Maximum Allowable Quantity                | Not Applicable                     |
|                                                                                          | Class II                  | 25                                        | Not Applicable                     |
|                                                                                          | Class III                 | 50                                        | Not Applicable                     |
| Unstable (reactives) nondetonable                                                        | Class 3                   | 1                                         | 2,000                              |
|                                                                                          | Class 2                   | 25                                        | 10,000                             |
| Water reactives                                                                          | Class 3                   | 1                                         | Not Applicable                     |
|                                                                                          | Class 2                   | 25                                        | Not Applicable                     |
| Pyrophoric gases                                                                         | Not Applicable            | Not Applicable                            | 2,000                              |

For SI: 1 ton = 906 kg, 1 cubic foot = 0.02832 m<sup>3</sup>, 1 pound = 0.454 kg.

a. For materials that are detonable, the distance to other buildings or lot lines shall be in accordance with Chapter 33 of the *International Fire Code* based on trinitrotoluene (TNT) equivalence of the material. For materials classified as explosives, see Chapter 56 of the *International Fire Code*.

b. "Maximum Allowable Quantity" means the maximum allowable quantity per control area set forth in Table 307.1(1).

c. Limited to Division 1.4 materials and articles, including articles packaged for shipment, that are not regulated as an explosive under Bureau of Alcohol, Tobacco, Firearms and Explosives (BATF) regulations or unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles, provided the net explosive weight of individual articles does not exceed 1 pound.

### SECTION 503 GENERAL BUILDING HEIGHT AND AREA LIMITATIONS

**503.1 General.** The *building height and area* shall not exceed the limits specified in Table 503 based on the type of construction as determined by Section 602 and the occupancies as determined by Section 302 except as modified hereafter. Each portion of a building separated by one or more *fire walls* complying with Section 706 shall be considered to be a separate building.

**503.1.1 Special industrial occupancies.** Buildings and structures designed to house special industrial processes that require large areas and unusual *building heights* to accommodate cranes or special machinery and equipment, including, among others, rolling mills; structural metal fabrication shops and foundries; or the production and distribution of electric, gas or steam power, shall be exempt from the *building height and area* limitations of Table 503.

**503.1.2 Buildings on same lot.** Two or more buildings on the same *lot* shall be regulated as separate buildings or shall be considered as portions of one building if the *building height* of each building and the aggregate *building area* of the buildings are within the limitations of Table 503 as modified by Sections 504 and 506. The provisions of this code applicable to the aggregate building shall be applicable to each building.

**503.1.3 Type I construction.** Buildings of Type I construction permitted to be of unlimited *tabular building heights and areas* are not subject to the special requirements that allow unlimited area buildings in Section 507 or unlimited *building height* in Sections 503.1.1 and 504.3 or increased *building heights and areas* for other types of construction.

**TABLE 503**  
**ALLOWABLE BUILDING HEIGHTS AND AREAS<sup>a,b</sup>**  
 Building height limitations shown in feet above grade plane. Story limitations shown as stories above grade plane.  
 Building area limitations shown in square feet, as determined by the definition of "Area, building," per story

| GROUP |               | TYPE OF CONSTRUCTION   |        |         |        |          |        |         |        |        |
|-------|---------------|------------------------|--------|---------|--------|----------|--------|---------|--------|--------|
|       |               | TYPE I                 |        | TYPE II |        | TYPE III |        | TYPE IV | TYPE V |        |
|       |               | A                      | B      | A       | B      | A        | B      | HT      | A      | B      |
|       |               | UL                     | 160    | 65      | 55     | 65       | 55     | 65      | 50     | 40     |
|       | HEIGHT (feet) | STORIES(S)<br>AREA (A) |        |         |        |          |        |         |        |        |
| A-1   | S             | UL                     | 5      | 3       | 2      | 3        | 2      | 3       | 2      | 1      |
|       | A             | UL                     | UL     | 15,500  | 8,500  | 14,000   | 8,500  | 15,000  | 11,500 | 5,500  |
| A-2   | S             | UL                     | 11     | 3       | 2      | 3        | 2      | 3       | 2      | 1      |
|       | A             | UL                     | UL     | 15,500  | 9,500  | 14,000   | 9,500  | 15,000  | 11,500 | 6,000  |
| A-3   | S             | UL                     | 11     | 3       | 2      | 3        | 2      | 3       | 2      | 1      |
|       | A             | UL                     | UL     | 15,500  | 9,500  | 14,000   | 9,500  | 15,000  | 11,500 | 6,000  |
| A-4   | S             | UL                     | 11     | 3       | 2      | 3        | 2      | 3       | 2      | 1      |
|       | A             | UL                     | UL     | 15,500  | 9,500  | 14,000   | 9,500  | 15,000  | 11,500 | 6,000  |
| A-5   | S             | UL                     | UL     | UL      | UL     | UL       | UL     | UL      | UL     | UL     |
|       | A             | UL                     | UL     | UL      | UL     | UL       | UL     | UL      | UL     | UL     |
| B     | S             | UL                     | 11     | 5       | 3      | 5        | 3      | 5       | 3      | 2      |
|       | A             | UL                     | UL     | 37,500  | 23,000 | 28,500   | 19,000 | 36,000  | 18,000 | 9,000  |
| E     | S             | UL                     | 5      | 3       | 2      | 3        | 2      | 3       | 1      | 1      |
|       | A             | UL                     | UL     | 26,500  | 14,500 | 23,500   | 14,500 | 25,500  | 18,500 | 9,500  |
| F-1   | S             | UL                     | 11     | 4       | 2      | 3        | 2      | 4       | 2      | 1      |
|       | A             | UL                     | UL     | 25,000  | 15,500 | 19,000   | 12,000 | 33,500  | 14,000 | 8,500  |
| F-2   | S             | UL                     | 11     | 5       | 3      | 4        | 3      | 5       | 3      | 2      |
|       | A             | UL                     | UL     | 37,500  | 23,000 | 28,500   | 18,000 | 50,500  | 21,000 | 13,000 |
| H-1   | S             | 1                      | 1      | 1       | 1      | 1        | 1      | 1       | 1      | NP     |
|       | A             | 21,000                 | 16,500 | 11,000  | 7,000  | 9,500    | 7,000  | 10,500  | 7,500  | NP     |
| H-2   | S             | UL                     | 3      | 2       | 1      | 2        | 1      | 2       | 1      | 1      |
|       | A             | 21,000                 | 16,500 | 11,000  | 7,000  | 9,500    | 7,000  | 10,500  | 7,500  | 3,000  |
| H-3   | S             | UL                     | 6      | 4       | 2      | 4        | 2      | 4       | 2      | 1      |
|       | A             | UL                     | 60,000 | 26,500  | 14,000 | 17,500   | 13,000 | 25,500  | 10,000 | 5,000  |
| H-4   | S             | UL                     | 7      | 5       | 3      | 5        | 3      | 5       | 3      | 2      |
|       | A             | UL                     | UL     | 37,500  | 17,500 | 28,500   | 17,500 | 36,000  | 18,000 | 6,500  |
| H-5   | S             | 4                      | 4      | 3       | 3      | 3        | 3      | 3       | 3      | 2      |
|       | A             | UL                     | UL     | 37,500  | 23,000 | 28,500   | 19,000 | 36,000  | 18,000 | 9,000  |
| I-1   | S             | UL                     | 9      | 4       | 3      | 4        | 3      | 4       | 3      | 2      |
|       | A             | UL                     | 55,000 | 19,000  | 10,000 | 16,500   | 10,000 | 18,000  | 10,500 | 4,500  |
| I-2   | S             | UL                     | 4      | 2       | 1      | 1        | NP     | 1       | 1      | NP     |
|       | A             | UL                     | UL     | 15,000  | 11,000 | 12,000   | NP     | 12,000  | 9,500  | NP     |
| I-3   | S             | UL                     | 4      | 2       | 1      | 2        | 1      | 2       | 2      | 1      |
|       | A             | UL                     | UL     | 15,000  | 10,000 | 10,500   | 7,500  | 12,000  | 7,500  | 5,000  |
| I-4   | S             | UL                     | 5      | 3       | 2      | 3        | 2      | 3       | 1      | 1      |
|       | A             | UL                     | 60,500 | 26,500  | 13,000 | 23,500   | 13,000 | 25,500  | 18,500 | 9,000  |

(continued)

**TABLE 503—continued**  
**ALLOWABLE BUILDING HEIGHTS AND AREAS<sup>a, b</sup>**

| GROUP                  |               | TYPE OF CONSTRUCTION |        |         |        |          |        |         |        |        |
|------------------------|---------------|----------------------|--------|---------|--------|----------|--------|---------|--------|--------|
|                        |               | TYPE I               |        | TYPE II |        | TYPE III |        | TYPE IV | TYPE V |        |
|                        |               | A                    | B      | A       | B      | A        | B      | HT      | A      | B      |
|                        | HEIGHT (feet) | UL                   | 160    | 85      | 55     | 65       | 55     | 65      | 50     | 40     |
| STORIES(S)<br>AREA (A) |               |                      |        |         |        |          |        |         |        |        |
| M                      | S             | UL                   | 11     | 4       | 2      | 4        | 2      | 4       | 3      | 1      |
|                        | A             | UL                   | UL     | 21,500  | 12,500 | 18,500   | 12,500 | 20,500  | 14,000 | 9,000  |
| R-1                    | S             | UL                   | 11     | 4       | 4      | 4        | 4      | 4       | 3      | 2      |
|                        | A             | UL                   | UL     | 24,000  | 16,000 | 24,000   | 16,000 | 20,500  | 12,000 | 7,000  |
| R-2                    | S             | UL                   | 11     | 4       | 4      | 4        | 4      | 4       | 3      | 2      |
|                        | A             | UL                   | UL     | 24,000  | 16,000 | 24,000   | 16,000 | 20,500  | 12,000 | 7,000  |
| R-3                    | S             | UL                   | 11     | 4       | 4      | 4        | 4      | 4       | 3      | 3      |
|                        | A             | UL                   | UL     | UL      | UL     | UL       | UL     | UL      | UL     | UL     |
| R-4                    | S             | UL                   | 11     | 4       | 4      | 4        | 4      | 4       | 3      | 2      |
|                        | A             | UL                   | UL     | 24,000  | 16,000 | 24,000   | 16,000 | 20,500  | 12,000 | 7,000  |
| S-1                    | S             | UL                   | 11     | 4       | 2      | 3        | 2      | 4       | 3      | 1      |
|                        | A             | UL                   | 48,000 | 26,000  | 17,500 | 26,000   | 17,500 | 25,500  | 14,000 | 9,000  |
| S-2                    | S             | UL                   | 11     | 5       | 3      | 4        | 3      | 5       | 4      | 2      |
|                        | A             | UL                   | 79,000 | 39,000  | 26,000 | 39,000   | 26,000 | 38,500  | 21,000 | 13,500 |
| U                      | S             | UL                   | 5      | 4       | 2      | 3        | 2      | 4       | 2      | 1      |
|                        | A             | UL                   | 35,500 | 19,000  | 8,500  | 14,000   | 8,500  | 18,000  | 9,000  | 5,500  |

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m<sup>2</sup>.

A = building area per story, S = stories above grade plane, UL = Unlimited, NP = Not permitted.

a. See the following sections for general exceptions to Table 503:

1. Section 504.2, Allowable building height and story increase due to automatic sprinkler system installation.
2. Section 506.2, Allowable building area increase due to street frontage.
3. Section 506.3, Allowable building area increase due to automatic sprinkler system installation.
4. Section 507, Unlimited area buildings.

b. See Chapter 4 for specific exceptions to the allowable height and areas in Chapter 5.

## SECTION 507 UNLIMITED AREA BUILDINGS

**507.1 General.** The area of buildings of the occupancies and configurations specified in Sections 507.1 through 507.12 shall not be limited.

**Exception:** Other occupancies shall be permitted in unlimited area buildings in accordance with the provisions of Section 508.2.

Where Sections 507.2 through 507.12 require buildings to be surrounded and adjoined by *public ways* and *yards*, those open spaces shall be determined as follows:

1. *Yards* shall be measured from the building perimeter in all directions to the closest interior *lot lines* or to the exterior face of an opposing building located on the same *lot*, as applicable.
2. Where the building fronts on a *public way*, the entire width of the *public way* shall be used.

**507.2 Nonsprinklered, one story.** The area of a Group F-2 or S-2 building no more than one *story* in height shall not be limited where the building is surrounded and adjoined by *public ways* or *yards* not less than 60 feet (18 288 mm) in width.

**507.3 Sprinklered, one story.** The area of a Group B, F, M or S building no more than one *story* above *grade plane* of any construction type, or the area of a Group A-4 building no more than one *story* above *grade plane* of other than Type V construction, shall not be limited where the building is provided with an *automatic sprinkler system* throughout in accordance with Section 903.3.1.1 and is surrounded and adjoined by *public ways* or *yards* not less than 60 feet (18 288 mm) in width.

### Exceptions:

1. Buildings and structures of Types I and II construction for rack storage facilities that do not have access by the public shall not be limited in height, provided that such buildings conform to the requirements of Sections 507.3 and 903.3.1.1 and Chapter 32 of the *International Fire Code*.
2. The *automatic sprinkler system* shall not be required in areas occupied for indoor participant sports, such as tennis, skating, swimming and equestrian activities in occupancies in Group A-4, provided that:
  - 2.1. *Exit* doors directly to the outside are provided for occupants of the participant sports areas; and
  - 2.2. The building is equipped with a *fire alarm system* with *manual fire alarm boxes* installed in accordance with Section 907.

**507.3.1 Mixed occupancy buildings with Groups A-1 and A-2.** Group A-1 and A-2 occupancies of other than Type V construction shall be permitted within mixed occupancy buildings of unlimited area complying with Section 507.3, provided:

1. Group A-1 and A-2 occupancies are separated from other occupancies as required for separated occupancies in Section 508.4.4 with no reduction allowed in the *fire-resistance rating* of the separation based upon the installation of an *automatic sprinkler system*.
2. Each area of the portions of the building used for Group A-1 or A-2 occupancies shall not exceed the maximum allowable area permitted for such occupancies in Section 503.1; and

3. *Exit* doors from Group A-1 and A-2 occupancies shall discharge directly to the exterior of the building.

**507.8 Group H occupancies.** Group H-2, H-3 and H-4 occupancies shall be permitted in unlimited area buildings containing Group F and S occupancies in accordance with Sections 507.3 and 507.4 and the provisions of Sections 507.8.1 through 507.8.4.

**507.8.1 Allowable area.** The aggregate floor area of Group H occupancies located in an unlimited area building shall not exceed 10 percent of the area of the building nor the area limitations for the Group H occupancies as specified in Table 503 as modified by Section 506.2 based upon the perimeter of each Group H floor area that fronts on a *public way* or open space.

**507.8.1.1 Located within the building.** The aggregate floor area of Group H occupancies not located at the perimeter of the building shall not exceed 25 percent of the area limitations for the Group H occupancies as specified in Table 503.

**507.8.1.1.1 Liquid use, dispensing and mixing rooms.** Liquid use, dispensing and mixing rooms having a floor area of not more than 500 square feet (46.5 m<sup>2</sup>) need not be located on the outer perimeter of the building where they are in accordance with the *International Fire Code* and NFPA 30.

**507.8.1.1.2 Liquid storage rooms.** Liquid storage rooms having a floor area of not more than 1,000 square feet (93 m<sup>2</sup>) need not be located on the outer perimeter where they are in accordance with the *International Fire Code* and NFPA 30.

**507.8.1.1.3 Spray paint booths.** Spray paint booths that comply with the *International Fire Code* need not be located on the outer perimeter.

**507.8.2 Located on building perimeter.** Except as provided for in Section 507.8.1.1, Group H occupancies shall be located on the perimeter of the building. In Group H-2 and H-3 occupancies, not less than 25 percent of the perimeter of such occupancies shall be an *exterior wall*.

**507.8.3 Occupancy separations.** Group H occupancies shall be separated from the remainder of the unlimited area building and from each other in accordance with Table 508.4.

**507.8.4 Height limitations.** For two-story unlimited area buildings, Group H occupancies shall not be located more than one *story* above *grade plane* unless permitted based on the allowable height in *stories* and feet as set forth in Table 503 for the type of construction of the unlimited area building.

## Appendix B Selected IFC Excerpts

### SECTION 102 APPLICABILITY

**[A] 102.1 Construction and design provisions.** The construction and design provisions of this code shall apply to:

1. Structures, facilities and conditions arising after the adoption of this code.
2. Existing structures, facilities and conditions not legally in existence at the time of adoption of this code.
3. Existing structures, facilities and conditions when required in Chapter 11.
4. Existing structures, facilities and conditions which, in the opinion of the *fire code official*, constitute a distinct hazard to life or property.

**Exception:** This Code does not apply to one- and two-family dwellings or one- and two- family row houses (townhouses) separated by a 2-hour fire wall containing not more than three dwelling units per structure.

**[A] 102.2 Administrative, operational and maintenance provisions.** The administrative, operational and maintenance provisions of this code shall apply to:

1. Conditions and operations arising after the adoption of this code.
2. Existing conditions and operations.

**Exception:** This Code does not apply to one- and two-family dwellings or one- and two- family row houses (townhouses) separated by a 2-hour fire wall containing not more than three dwelling units per structure.

**102.3 Change of use or occupancy.** No change shall be made in use or occupancy of any building or structure that would place the structure in a different division of the same group or occupancy or in a different group of occupancies, unless such structure is made to comply with the requirements of this Code, as may be applicable, as well as those of the International Building Code (IBC), as adopted by the Department of Community Affairs. Pursuant to O.C.G.A. 25-2-14, due to a change of use or occupancy of a building or structure the building or structure shall be treated as a proposed (new) building. (Refer to 103.3 of this Code regarding the requirements applicable to proposed (new) buildings and structures.)

**[A] 102.10 Conflicting provisions.** Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable. Where, in a specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

### SECTION 3203 COMMODITY CLASSIFICATION

**3203.1 Classification of commodities.** Commodities shall be classified as Class I, II, III, IV or high hazard in accordance with this section. Materials listed within each commodity classification are assumed to be unmodified for improved combustibility characteristics. Use of flame-retarding modifiers or the physical form of the material could change the classification. See Section 3203.7 for classification of Group A, B and C plastics.

### SECTION 3206 GENERAL FIRE PROTECTION AND LIFE SAFETY FEATURES

**3206.1 General.** Fire protection and life safety features for *high-piled storage areas* shall be in accordance with Sections 3206.2 through 3206.10.

**3206.2 Extent and type of protection.** Where required by Table 3206.2, fire detection systems, smoke and heat removal, draft curtains and automatic sprinkler design densities shall extend the lesser of 15 feet (4572 mm) beyond the *high-piled storage area* or to a permanent partition. Where portions of *high-piled storage areas* have different fire protection requirements because of commodity, method of storage or storage height, the fire protection features required by Table 3206.2 within this area shall be based on the most restrictive design requirements.

### SECTION 5001 GENERAL

**5001.1 Scope.** Prevention, control and mitigation of dangerous conditions related to storage, dispensing, use and handling of hazardous materials shall be in accordance with this chapter.

This chapter shall apply to all hazardous materials, including those materials regulated elsewhere in this code, except that when specific requirements are provided in other chapters, those specific requirements shall apply in accordance with the applicable chapter. Where a material has multiple hazards, all hazards shall be addressed.

#### Exceptions:

1. In retail or wholesale sales occupancies, the quantities of medicines, foodstuffs, consumer or industrial products and cosmetics containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable shall not be limited, provided such materials are packaged in individual containers not exceeding 1.3 gallons (5 L).
2. Quantities of alcoholic beverages in retail or wholesale sales occupancies shall not be limited providing the liquids are packaged in individual containers not exceeding 1.3 gallons (5 L).
3. Application and release of pesticide and agricultural products and materials intended for use in weed abatement, erosion control, soil amendment or similar applications when applied in accordance with the manufacturers' instructions and label directions.
4. The off-site transportation of hazardous materials when in accordance with Department of Transportation (DOTn) regulations.
5. Building materials not otherwise regulated by this code.
6. Refrigeration systems (see Section 606).
7. Stationary storage battery systems regulated by Section 608.
8. The display, storage, sale or use of fireworks and explosives in accordance with Chapter 56.
9. *Corrosives* utilized in personal and household products in the manufacturers' original consumer packaging in Group M occupancies.
10. The storage of distilled spirits and wines in wooden barrels and casks.

**TABLE 3206.2**  
**GENERAL FIRE PROTECTION AND LIFE SAFETY REQUIREMENTS**

| COMMODITY CLASS | SIZE OF HIGH-PILED STORAGE AREA* (square feet) (see Sections 3206.2 and 3206.4) | ALL STORAGE AREAS (See Sections 3206, 3207 and 3208) <sup>a</sup> |                                            |                                      |                                             |                                     | SOLID-PILED STORAGE, SHELF STORAGE AND PALLETIZED STORAGE (see Section 3207.3) |                                            |                                  |
|-----------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------|--------------------------------------|---------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------|----------------------------------|
|                 |                                                                                 | Automatic fire-extinguishing system (see Section 3206.4)          | Fire detection system (see Section 3206.5) | Building access (see Section 3206.6) | Smoke and heat removal (see Section 3206.7) | Draft curtains (see Section 3206.7) | Maximum pile dimension* (feet)                                                 | Maximum permissible storage height* (feet) | Maximum pile volume (cubic feet) |
| I-IV            | 0-500                                                                           | Not Required <sup>a</sup>                                         | Not Required                               | Not Required <sup>a</sup>            | Not Required                                | Not Required                        | Not Required                                                                   | Not Required                               | Not Required                     |
|                 | 501-2,500                                                                       | Not Required <sup>a</sup>                                         | Yes <sup>i</sup>                           | Not Required <sup>a</sup>            | Not Required                                | Not Required                        | 100                                                                            | 40                                         | 100,000                          |
|                 | 2,501-12,000<br>Public accessible                                               | Yes                                                               | Not Required                               | Not Required <sup>a</sup>            | Not Required                                | Not Required                        | 100                                                                            | 40                                         | 400,000                          |
|                 | 2,501-12,000<br>Nonpublic accessible (Option 1)                                 | Yes                                                               | Not Required                               | Not Required <sup>a</sup>            | Not Required                                | Not Required                        | 100                                                                            | 40                                         | 400,000                          |
|                 | 2,501-12,000<br>Nonpublic accessible (Option 2)                                 | Not Required <sup>a</sup>                                         | Yes                                        | Yes                                  | Yes <sup>j</sup>                            | Yes <sup>j</sup>                    | 100                                                                            | 30 <sup>f</sup>                            | 200,000                          |
|                 | 12,001-20,000                                                                   | Yes                                                               | Not Required                               | Yes                                  | Yes <sup>j</sup>                            | Not Required                        | 100                                                                            | 40                                         | 400,000                          |
|                 | 20,001-500,000                                                                  | Yes                                                               | Not Required                               | Yes                                  | Yes <sup>j</sup>                            | Not Required                        | 100                                                                            | 40                                         | 400,000                          |
|                 | Greater than 500,000 <sup>a</sup>                                               | Yes                                                               | Not Required                               | Yes                                  | Yes <sup>j</sup>                            | Not Required                        | 100                                                                            | 40                                         | 400,000                          |
| High hazard     | 0-500                                                                           | Not Required <sup>a</sup>                                         | Not Required                               | Not Required <sup>a</sup>            | Not Required                                | Not Required                        | 50                                                                             | Not Required                               | Not Required                     |
|                 | 501-2,500<br>Public accessible                                                  | Yes                                                               | Not Required                               | Not Required <sup>a</sup>            | Not Required                                | Not Required                        | 50                                                                             | 30                                         | 75,000                           |
|                 | 501-2,500<br>Nonpublic accessible (Option 1)                                    | Yes                                                               | Not Required                               | Not Required <sup>a</sup>            | Not Required                                | Not Required                        | 50                                                                             | 30                                         | 75,000                           |
|                 | 501-2,500<br>Nonpublic accessible (Option 2)                                    | Not Required <sup>a</sup>                                         | Yes                                        | Yes                                  | Yes <sup>j</sup>                            | Yes <sup>j</sup>                    | 50                                                                             | 20                                         | 50,000                           |
|                 | 2,501-300,000                                                                   | Yes                                                               | Not Required                               | Yes                                  | Yes <sup>j</sup>                            | Not Required                        | 50                                                                             | 30                                         | 75,000                           |
|                 | 300,001-500,000 <sup>a, b</sup>                                                 | Yes                                                               | Not Required                               | Yes                                  | Yes <sup>j</sup>                            | Not Required                        | 50                                                                             | 30                                         | 75,000                           |

For SI: 1 foot = 304.8 mm, 1 cubic foot = 0.02832 m<sup>3</sup>, 1 square foot = 0.0929 m<sup>2</sup>.

- When automatic sprinklers are required for reasons other than those in Chapter 32, the portion of the sprinkler system protecting the high-piled storage area shall be designed and installed in accordance with Sections 3207 and 3208.
- For aisles, see Section 3206.9.
- Piles shall be separated by aisles complying with Section 3206.9.
- For storage in excess of the height indicated, special fire protection shall be provided in accordance with Note g when required by the fire code official. See also Chapters 51 and 57 for special limitations for aerosols and flammable and combustible liquids, respectively.
- Section 503 shall apply for fire apparatus access.
- For storage exceeding 30 feet in height, Option 1 shall be used.
- Special fire protection provisions including, but not limited to, fire protection of exposed steel columns; increased sprinkler density; additional in-rack sprinklers, without associated reductions in ceiling sprinkler density; or additional fire department hose connections shall be provided when required by the fire code official.
- High-piled storage areas shall not exceed 500,000 square feet. A 2-hour fire wall constructed in accordance with Section 706 of the *International Building Code* shall be used to divide high-piled storage exceeding 500,000 square feet in area.
- Not required when an automatic fire-extinguishing system is designed and installed to protect the high-piled storage area in accordance with Sections 3207 and 3208.
- Not required when storage areas are protected by early suppression fast response (ESFR) sprinkler systems installed in accordance with NFPA 13.

11. The use of wall-mounted dispensers containing alcohol-based hand rubs classified as Class I or II liquids when in accordance with Section 5705.5.
12. Storage, transportation, use, dispensing, mixing and handling of Flammable and Combustible Liquids as outlined in Chapter 120-3-11 Rules and Regulations of the Safety Fire Commissioner entitled, "Rules and Regulations for Flammable and Combustible Liquids
13. Storage, handling, and transportation of liquefied petroleum gas (LP-Gas) and the installation of LP-gas equipment pertinent to systems for such use as outlined Chapter 120-3-16 Rules and Regulations of the Safety Fire Commissioner entitled, "Rules and Regulations for Liquefied Petroleum Gases."

**5001.1.1 Waiver.** The provisions of this chapter are waived when the *fire code official* determines that such enforcement is preempted by other codes, statutes or ordinances. The details of any action granting such a waiver shall be recorded and entered in the files of the code enforcement agency.

**5001.2 Material classification.** Hazardous materials are those chemicals or substances defined as such in this code. Definitions of hazardous materials shall apply to all hazardous materials, including those materials regulated elsewhere in this code.

**5001.2.1 Mixtures.** Mixtures shall be classified in accordance with hazards of the mixture as a whole. Mixtures of hazardous materials shall be classified in accordance with nationally recognized reference standards; by an *approved* qualified organization, individual, or Material Safety Data Sheet (MSDS); or by other *approved* methods.

**5001.2.2 Hazard categories.** Hazardous materials shall be classified according to hazard categories. The categories include materials regulated by this chapter and materials regulated elsewhere in this code.

**5001.2.2.1 Physical hazards.** The material categories listed in this section are classified as *physical hazards*. A material with a primary classification as a *physical hazard* can also pose a *health hazard*.

1. *Explosives* and blasting agents.
2. *Combustible liquids*.
3. Flammable solids, liquids and gases.
4. Organic peroxide solids or liquids.
5. Oxidizer, solids or liquids.
6. Oxidizing gases.
7. Pyrophoric solids, liquids or gases.
8. Unstable (reactive) solids, liquids or gases.
9. Water-reactive materials solids or liquids.
10. *Cryogenic fluids*.

**5001.2.2.2 Health hazards.** The material categories listed in this section are classified as *health hazards*. A material with a primary classification as a *health hazard* can also pose a *physical hazard*.

1. Highly toxic and toxic materials.
2. *Corrosive* materials.

## SECTION 5003 GENERAL REQUIREMENTS

**5003.1 Scope.** The storage, use and handling of all hazardous materials shall be in accordance with this section.

**5003.1.1 Maximum allowable quantity per control area.** The *maximum allowable quantity per control area* shall be as specified in Tables 5003.1.1(1) through 5003.1.1(4).

For retail and wholesale storage and display in Group M occupancies and Group S storage, see Section 5003.11.

**5003.1.2 Conversion.** Where quantities are indicated in pounds and when the weight per gallon of the liquid is not provided to the *fire code official*, a conversion factor of 10 pounds per gallon (1.2 kg/L) shall be used.

**5003.1.3 Quantities not exceeding the maximum allowable quantity per control area.** The storage, use and handling of hazardous materials in quantities not exceeding the *maximum allowable quantity per control area* indicated in Tables 5003.1.1(1) through 5003.1.1(4) shall be in accordance with Sections 5001 and 5003.

**5003.1.4 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of hazardous materials in quantities exceeding the *maximum allowable quantity per control area* indicated in Tables 5003.1.1(1) through 5003.1.1(4) shall be in accordance with this chapter.

**5003.8 Construction requirements.** Buildings, *control areas*, enclosures and cabinets for hazardous materials shall be in accordance with Sections 5003.8.1 through 5003.8.6.3.

**5003.8.1 Buildings.** Buildings, or portions thereof, in which hazardous materials are stored, handled or used shall be constructed in accordance with the *International Building Code*.

**5003.8.2 Required detached buildings.** Group H occupancies containing quantities of hazardous materials in excess of those set forth in Table 5003.8.2 shall be in detached buildings.

**5003.8.3 Control areas.** *Control areas* shall comply with Sections 5003.8.3.1 through 5003.8.3.5.

**5003.8.3.1 Construction requirements.** *Control areas* shall be separated from each other by *fire barriers* constructed in accordance with Section 707 of the *International Building Code* or *horizontal assemblies* constructed in accordance with Section 711 of the *International Building Code*, or both.

**5003.8.3.2 Percentage of maximum allowable quantities.** The percentage of maximum allowable quantities of hazardous materials per *control area* allowed at each floor level within a building shall be in accordance with Table 5003.8.3.2.

**5003.8.3.3 Number.** The maximum number of *control areas* per floor within a building shall be in accordance with Table 5003.8.3.2.

**5003.8.3.4 Fire-resistance-rating requirements.** The required *fire-resistance rating* for *fire barriers* shall be in accordance with Table 5003.8.3.2. The floor assembly of the *control area* and the construction supporting the floor of the *control area* shall have a *fire-resistance rating* of not less than 2-hours.

**Exception:** The floor assembly of the *control area* and the construction supporting the floor of the *control area* is allowed to be 1-hour *fire-resistance* rated in buildings of Type IIA, IIIA and VA construction, provided that both of the following conditions exist:

1. The building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1; and
2. The building is three stories or less above grade plane.

**TABLE 5003.1.1(1)**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD<sup>a, b, c, d, e, f</sup>**

| MATERIAL                                   | CLASS                    | GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED | STORAGE <sup>a</sup>      |                                                                      |                                         | USE-CLOSED SYSTEMS <sup>b</sup> |                                                             |                                         | USE-OPEN SYSTEMS <sup>c</sup> |                                                          |
|--------------------------------------------|--------------------------|-------------------------------------------------------|---------------------------|----------------------------------------------------------------------|-----------------------------------------|---------------------------------|-------------------------------------------------------------|-----------------------------------------|-------------------------------|----------------------------------------------------------|
|                                            |                          |                                                       | Solid pounds (cubic feet) | Liquid gallons (pounds)                                              | Gas cubic feet at NTP                   | Solid pounds (cubic feet)       | Liquid gallons (pounds)                                     | Gas cubic feet at NTP                   | Solid pounds (cubic feet)     | Liquid gallons (pounds)                                  |
| Combustible dust                           | Not Applicable           | H-2                                                   | See Note q                | Not Applicable                                                       | Not Applicable                          | See Note q                      | Not Applicable                                              | Not Applicable                          | See Note q                    | Not Applicable                                           |
| Combustible fiber                          | Loose Baled <sup>g</sup> | H-3                                                   | (100)<br>(1,000)          | Not Applicable                                                       | Not Applicable                          | (100)<br>(1,000)                | Not Applicable                                              | Not Applicable                          | (20)<br>(200)                 | Not Applicable                                           |
| Combustible liquid <sup>e, f</sup>         | II<br>IIIA<br>IIIB       | H-2 or H-3<br>H-2 or H-3<br>Not Applicable            | Not Applicable            | 120 <sup>d, g</sup><br>330 <sup>d, e</sup><br>13,200 <sup>d, f</sup> | Not Applicable                          | Not Applicable                  | 120 <sup>d</sup><br>330 <sup>d</sup><br>13,200 <sup>f</sup> | Not Applicable                          | Not Applicable                | 30 <sup>d</sup><br>80 <sup>d</sup><br>3,300 <sup>f</sup> |
| Cryogenic Flammable                        | Not Applicable           | H-2                                                   | Not Applicable            | 45 <sup>d</sup>                                                      | Not Applicable                          | Not Applicable                  | 45 <sup>e</sup>                                             | Not Applicable                          | Not Applicable                | 10 <sup>d</sup>                                          |
| Consumer fireworks                         | 1.4G                     | H-3                                                   | 125 <sup>d, e, f</sup>    | Not Applicable                                                       | Not Applicable                          | Not Applicable                  | Not Applicable                                              | Not Applicable                          | Not Applicable                | Not Applicable                                           |
| Cryogenic Oxidizing                        | Not Applicable           | H-3                                                   | Not Applicable            | 45 <sup>d</sup>                                                      | Not Applicable                          | Not Applicable                  | 45 <sup>d</sup>                                             | Not Applicable                          | Not Applicable                | 10 <sup>d</sup>                                          |
| Explosives                                 | Division 1.1             | H-1                                                   | 1 <sup>e, g</sup>         | (1) <sup>e, g</sup>                                                  | Not Applicable                          | 0.25 <sup>g</sup>               | (0.25) <sup>g</sup>                                         | Not Applicable                          | 0.25 <sup>g</sup>             | (0.25) <sup>g</sup>                                      |
|                                            | Division 1.2             | H-1                                                   | 1 <sup>e, g</sup>         | (1) <sup>e, g</sup>                                                  |                                         | 0.25 <sup>g</sup>               | (0.25) <sup>g</sup>                                         |                                         | 0.25 <sup>g</sup>             | (0.25) <sup>g</sup>                                      |
|                                            | Division 1.3             | H-1 or H-2                                            | 5 <sup>e, g</sup>         | (5) <sup>e, g</sup>                                                  |                                         | 1 <sup>g</sup>                  | (1) <sup>g</sup>                                            |                                         | 1 <sup>g</sup>                | (1) <sup>g</sup>                                         |
|                                            | Division 1.4             | H-3                                                   | 50 <sup>e, g</sup>        | (50) <sup>e, g</sup>                                                 |                                         | 50 <sup>g</sup>                 | (50) <sup>g</sup>                                           |                                         | Not Applicable                | Not Applicable                                           |
|                                            | Division 1.4G            | H-3                                                   | 125 <sup>d, e, f</sup>    | Not Applicable                                                       |                                         | Not Applicable                  | Not Applicable                                              |                                         | Not Applicable                | Not Applicable                                           |
|                                            | Division 1.5             | H-1                                                   | 1 <sup>e, g</sup>         | (1) <sup>e, g</sup>                                                  |                                         | 0.25 <sup>g</sup>               | (0.25) <sup>g</sup>                                         |                                         | 0.25 <sup>g</sup>             | (0.25) <sup>g</sup>                                      |
|                                            | Division 1.6             | H-1                                                   | 1 <sup>e, g</sup>         | Not Applicable                                                       |                                         | Not Applicable                  | Not Applicable                                              |                                         | Not Applicable                | Not Applicable                                           |
| Flammable gas                              | Gaseous<br>Liquefied     | H-2                                                   | Not Applicable            | Not Applicable<br>(150) <sup>d, e</sup>                              | 1,000 <sup>d, e</sup><br>Not Applicable | Not Applicable                  | Not Applicable<br>(150) <sup>d, e</sup>                     | 1,000 <sup>d, e</sup><br>Not Applicable | Not Applicable                | Not Applicable                                           |
| Flammable liquid <sup>f</sup>              | IA                       | H-2                                                   | Not Applicable            | 30 <sup>d, e</sup>                                                   | Not Applicable                          | Not Applicable                  | 30 <sup>d</sup>                                             | Not Applicable                          | Not Applicable                | 10 <sup>d</sup>                                          |
|                                            | IB and IC                | or<br>H-3                                             | Not Applicable            | 120 <sup>d, e</sup>                                                  | Not Applicable                          | Not Applicable                  | 120 <sup>d</sup>                                            | Not Applicable                          | Not Applicable                | 30 <sup>d</sup>                                          |
| Flammable liquid, combination (IA, IB, IC) | Not Applicable           | H-2<br>or<br>H-3                                      | Not Applicable            | 120 <sup>d, e, h</sup>                                               | Not Applicable                          | Not Applicable                  | 120 <sup>d, h</sup>                                         | Not Applicable                          | Not Applicable                | 30 <sup>d, h</sup>                                       |
| Flammable solid                            | Not Applicable           | H-3                                                   | 125 <sup>d, e</sup>       | Not Applicable                                                       | Not Applicable                          | 125 <sup>d</sup>                | Not Applicable                                              | Not Applicable                          | 25 <sup>d</sup>               | Not Applicable                                           |

(continued)

**TABLE 5003.1.1(1)—continued**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD<sup>a, b, c, d</sup>**

| MATERIAL            | CLASS          | GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED | STORAGE <sup>a</sup>      |                                      |                                      | USE-CLOSED SYSTEMS <sup>a</sup> |                                      |                                      | USE-OPEN SYSTEMS <sup>a</sup> |                         |
|---------------------|----------------|-------------------------------------------------------|---------------------------|--------------------------------------|--------------------------------------|---------------------------------|--------------------------------------|--------------------------------------|-------------------------------|-------------------------|
|                     |                |                                                       | Solid pounds (cubic feet) | Liquid gallons (pounds)              | Gas cubic feet at NTP                | Solid pounds (cubic feet)       | Liquid gallons (pounds)              | Gas cubic feet at NTP                | Solid pounds (cubic feet)     | Liquid gallons (pounds) |
| Inert Gas           | Gaseous        | Not Applicable                                        | Not Applicable            | Not Applicable                       | Not Limited                          | Not Applicable                  | Not Applicable                       | Not Limited                          | Not Applicable                | Not Applicable          |
|                     | Liquefied      | Not Applicable                                        | Not Applicable            | Not Applicable                       | Not Limited                          | Not Applicable                  | Not Applicable                       | Not Limited                          | Not Applicable                | Not Applicable          |
| Cryogenic Inert     | Not Applicable | Not Applicable                                        | Not Applicable            | Not Applicable                       | Not Limited                          | Not Applicable                  | Not Applicable                       | Not Limited                          | Not Applicable                | Not Applicable          |
| Organic peroxide    | UD             | H-1                                                   | 1 <sup>a, b</sup>         | (1) <sup>a, b</sup>                  |                                      | 0.25 <sup>a</sup>               | (0.25) <sup>a</sup>                  |                                      | 0.25 <sup>a</sup>             | (0.25) <sup>a</sup>     |
|                     | I              | H-2                                                   | 5 <sup>a, b</sup>         | (5) <sup>a, b</sup>                  |                                      | 1 <sup>a</sup>                  | (1) <sup>a</sup>                     |                                      | 1 <sup>a</sup>                | (1) <sup>a</sup>        |
|                     | II             | H-3                                                   | 50 <sup>a, b</sup>        | (50) <sup>a, b</sup>                 | Not Applicable                       | 50 <sup>a</sup>                 | (50) <sup>a</sup>                    | Not Applicable                       | 10 <sup>a</sup>               | (10) <sup>a</sup>       |
|                     | III            | H-3                                                   | 125 <sup>a, b</sup>       | (125) <sup>a, b</sup>                | Not Applicable                       | 125 <sup>a</sup>                | (125) <sup>a</sup>                   | Not Applicable                       | 25 <sup>a</sup>               | (25) <sup>a</sup>       |
|                     | IV             | Not Applicable                                        | Not Limited               | Not Limited                          |                                      | Not Limited                     | Not Limited                          |                                      | Not Limited                   | Not Limited             |
|                     | V              | Not Applicable                                        | Not Limited               | Not Limited                          |                                      | Not Limited                     | Not Limited                          |                                      | Not Limited                   | Not Limited             |
| Oxidizer            | 4              | H-1                                                   | 1 <sup>a</sup>            | (1) <sup>a, b</sup>                  |                                      | 0.25 <sup>a</sup>               | (0.25) <sup>a</sup>                  |                                      | 0.25 <sup>a</sup>             | (0.25) <sup>a</sup>     |
|                     | 3 <sup>b</sup> | H-2 or H-3                                            | 10 <sup>a, b</sup>        | (10) <sup>a, b</sup>                 | Not Applicable                       | 2 <sup>a</sup>                  | (2) <sup>a</sup>                     | Not Applicable                       | 2 <sup>a</sup>                | (2) <sup>a</sup>        |
|                     | 2              | H-3                                                   | 250 <sup>a, b</sup>       | (250) <sup>a, b</sup>                | Not Applicable                       | 250 <sup>a</sup>                | (250) <sup>a</sup>                   | Not Applicable                       | 50 <sup>a</sup>               | (50) <sup>a</sup>       |
|                     | 1              | Not Applicable                                        | 4,000 <sup>a, b</sup>     | (4,000) <sup>a, b</sup>              |                                      | 4,000 <sup>a</sup>              | (4,000) <sup>a</sup>                 |                                      | 1,000 <sup>a</sup>            | (1,000) <sup>a</sup>    |
| Oxidizing gas       | Gaseous        |                                                       |                           |                                      |                                      |                                 |                                      |                                      |                               |                         |
|                     | Liquefied      | H-3                                                   | Not Applicable            | Not Applicable (150) <sup>a, b</sup> | 1,500 <sup>a, b</sup> Not Applicable | Not Applicable                  | Not Applicable (150) <sup>a, b</sup> | 1,500 <sup>a, b</sup> Not Applicable | Not Applicable                | Not Applicable          |
| Pyrophoric          | Not Applicable | H-2                                                   | 4 <sup>a, b</sup>         | (4) <sup>a, b</sup>                  | 50 <sup>a, b</sup>                   | 1 <sup>a</sup>                  | (1) <sup>a</sup>                     | 10 <sup>a, b</sup>                   | 0                             | 0                       |
| Unstable (reactive) | 4              | H-1                                                   | 1 <sup>a, b</sup>         | (1) <sup>a, b</sup>                  | 10 <sup>a, b</sup>                   | 0.25 <sup>a</sup>               | (0.25) <sup>a</sup>                  | 2 <sup>a, b</sup>                    | 0.25 <sup>a</sup>             | (0.25) <sup>a</sup>     |
|                     | 3              | H-1 or H-2                                            | 5 <sup>a, b</sup>         | (5) <sup>a, b</sup>                  | 50 <sup>a, b</sup>                   | 1 <sup>a</sup>                  | (1) <sup>a</sup>                     | 10 <sup>a, b</sup>                   | 1 <sup>a</sup>                | (1) <sup>a</sup>        |
|                     | 2              | H-3                                                   | 50 <sup>a, b</sup>        | (50) <sup>a, b</sup>                 | 250 <sup>a, b</sup>                  | 50 <sup>a</sup>                 | (50) <sup>a</sup>                    | 250 <sup>a, b</sup>                  | 10 <sup>a</sup>               | (10) <sup>a</sup>       |
|                     | 1              | Not Applicable                                        | Not Limited               | Not Limited                          | Not Limited                          | Not Limited                     | Not Limited                          | Not Limited                          | Not Limited                   | Not Limited             |
| Water reactive      | 3              | H-2                                                   | 5 <sup>a, b</sup>         | (5) <sup>a, b</sup>                  | Not Applicable                       | 5 <sup>a</sup>                  | (5) <sup>a</sup>                     | Not Applicable                       | 1 <sup>a</sup>                | (1) <sup>a</sup>        |
|                     | 2              | H-3                                                   | 50 <sup>a, b</sup>        | (50) <sup>a, b</sup>                 | Not Applicable                       | 50 <sup>a</sup>                 | (50) <sup>a</sup>                    | Not Applicable                       | 10 <sup>a</sup>               | (10) <sup>a</sup>       |
|                     | 1              | Not Applicable                                        | Not Limited               | Not Limited                          |                                      | Not Limited                     | Not Limited                          |                                      | Not Limited                   | Not Limited             |

For SI: 1 cubic foot = 0.02832 m<sup>3</sup>, 1 pound = 0.454 kg, 1 gallon = 3.785 L.

a. For use of control areas, see Section 5003.8.3.

b. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.

c. The quantities of alcoholic beverages in retail and wholesale sales occupancies shall not be limited providing the liquids are packaged in individual containers not exceeding 1.3 gallons. In retail and wholesale sales occupancies, the quantities of medicines, foodstuffs, consumer or industrial products, and cosmetics containing not more than 50 percent by volume of water-miscible liquids with the remainder of the solutions not being flammable shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.

d. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1. Where Note e also applies, the increase for both notes shall be applied accumulatively.

(continued)

**TABLE 5003.1.1(1)—continued**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD<sup>a, b, c, d, e, f</sup>**

- e. Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets, day boxes, gas cabinets, exhausted enclosures, or listed safety cans. Listed safety cans shall be in accordance with Section 5003.9.10. Where Note d also applies, the increase for both notes shall be applied accumulatively.
- f. Quantities shall not be limited in a building equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1.
- g. Allowed only in buildings equipped throughout with an approved automatic sprinkler system.
- h. Containing not more than the maximum allowable quantity per control area of Class IA, Class IB or Class IC flammable liquids.
- i. The maximum allowable quantity shall not apply to fuel oil storage complying with Section 603.3.2.
- j. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column.
- k. A maximum quantity of 200 pounds of solid or 20 gallons of liquid Class 3 oxidizers is allowed when such materials are necessary for maintenance purposes, operation or sanitation of equipment when the storage containers and the manner of storage are approved.
- l. Net weight of pyrotechnic composition of the fireworks. Where the net weight of the pyrotechnic composition of the fireworks is not known, 25 percent of the gross weight of the fireworks including packaging shall be used.
- m. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2.
- n. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 5003.11, see Table 5003.11.1.
- o. Densely-packed baled cotton that complies with the packing requirements of ISO 8115 shall not be included in this material class.
- p. The following shall not be included in determining the maximum allowable quantities:
  - 1. Liquid or gaseous fuel in fuel tanks on vehicles.
  - 2. Liquid or gaseous fuel in fuel tanks on motorized equipment operated in accordance with this code.
  - 3. Gaseous fuels in piping systems and fixed appliances regulated by the *International Fuel Gas Code*.
  - 4. Liquid fuels in piping systems and fixed appliances, regulated by the *International Mechanical Code*.
- q. Where manufactured, generated or used in such a manner that the concentration and conditions create a fire or explosion hazard based on information prepared in accordance with Section 104.7.2.

**TABLE 5003.1.1(2)**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIAL POSING A HEALTH HAZARD<sup>a, b, c, h, i</sup>**

| MATERIAL      | STORAGE <sup>a</sup>         |                                         |                                                          | USE-CLOSED SYSTEMS <sup>a</sup> |                                      |                                                          | USE-OPEN SYSTEMS <sup>a</sup> |                                      |
|---------------|------------------------------|-----------------------------------------|----------------------------------------------------------|---------------------------------|--------------------------------------|----------------------------------------------------------|-------------------------------|--------------------------------------|
|               | Solid pounds <sup>a, f</sup> | Liquid gallons (pounds) <sup>a, f</sup> | Gas cubic feet at NTP (pounds) <sup>a</sup>              | Solid pounds <sup>a</sup>       | Liquid gallons (pounds) <sup>a</sup> | Gas cubic feet at NTP (pounds) <sup>a</sup>              | Solid pounds <sup>a</sup>     | Liquid gallons (pounds) <sup>a</sup> |
| Corrosives    | 5,000                        | 500                                     | Gaseous 810 <sup>f</sup><br>Liquefied (150)              | 5,000                           | 500                                  | Gaseous 810 <sup>f</sup><br>Liquefied (150)              | 1,000                         | 100                                  |
| Highly Toxics | 10                           | (10)                                    | Gaseous 20 <sup>g</sup><br>Liquefied (4) <sup>g</sup>    | 10                              | (10)                                 | Gaseous 20 <sup>g</sup><br>Liquefied (4) <sup>g</sup>    | 3                             | (3)                                  |
| Toxics        | 500                          | (500)                                   | Gaseous 810 <sup>f</sup><br>Liquefied (150) <sup>f</sup> | 500                             | (500)                                | Gaseous 810 <sup>f</sup><br>Liquefied (150) <sup>f</sup> | 125                           | (125)                                |

For SI: 1 cubic foot = 0.02832 m<sup>3</sup>, 1 pound = 0.454 kg, 1 gallon = 3.785 L.

- a. For use of control areas, see Section 5003.8.3.
- b. In retail and wholesale sales occupancies, the quantities of medicines, foodstuffs, consumer or industrial products, and cosmetics, containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.
- c. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 5003.11, see Table 5003.11.1.
- d. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.
- e. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1. Where Note f also applies, the increase for both notes shall be applied cumulatively.
- f. Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets, gas cabinets or exhausted enclosures. Where Note e also applies, the increase for both notes shall be applied cumulatively.
- g. Allowed only when stored in approved exhausted gas cabinets or exhausted enclosures.
- h. Quantities in parentheses indicate quantity units in parentheses at the head of each column.
- i. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2.

**TABLE 5003.1.1(3)**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD IN AN OUTDOOR CONTROL AREA<sup>a, b, c, d</sup>**

| MATERIAL             | CLASS                       | STORAGE <sup>b</sup>      |                                      |                         | USE-CLOSED SYSTEMS <sup>b</sup> |                                      |                         | USE-OPEN SYSTEMS <sup>b</sup> |                                      |
|----------------------|-----------------------------|---------------------------|--------------------------------------|-------------------------|---------------------------------|--------------------------------------|-------------------------|-------------------------------|--------------------------------------|
|                      |                             | Solid pounds (cubic feet) | Liquid gallons (pounds) <sup>a</sup> | Gas cubic feet at NTP   | Solid pounds (cubic feet)       | Liquid gallons (pounds) <sup>a</sup> | Gas cubic feet at NTP   | Solid pounds (cubic feet)     | Liquid gallons (pounds) <sup>a</sup> |
| Flammable gas        | Gaseous<br>Liquefied        | Not Applicable            | Not Applicable (300)                 | 3,000<br>Not Applicable | Not Applicable                  | Not Applicable (150)                 | 1,500<br>Not Applicable | Not Applicable                | Not Applicable                       |
| Flammable solid      | Not Applicable              | 500                       | Not Applicable                       | Not Applicable          | 250                             | Not Applicable                       | Not Applicable          | 50                            | Not Applicable                       |
| Inert Gas            | Gaseous                     | Not Applicable            | Not Applicable                       | Not Limited             | Not Applicable                  | Not Applicable                       | Not Limited             | Not Applicable                | Not Applicable                       |
| Cryogenic inert      | Liquefied<br>Not Applicable | Not Applicable            | Not Applicable                       | Not Limited             | Not Applicable                  | Not Applicable                       | Not Limited             | Not Applicable                | Not Applicable                       |
| Organic peroxide     | Unclassified<br>Detonable   | 1                         | (1)                                  | Not Applicable          | 0.25                            | (0.25)                               | Not Applicable          | 0.25                          | (0.25)                               |
| Organic peroxide     | I                           | 20                        | (20)                                 | Not Applicable          | 10                              | (10)                                 | Not Applicable          | 2                             | (2)                                  |
|                      | II                          | 200                       | (200)                                |                         | 100                             | (100)                                |                         | 20                            | (20)                                 |
|                      | III                         | 500                       | (500)                                |                         | 250                             | (250)                                |                         | 50                            | (50)                                 |
|                      | IV                          | 1,000                     | (1,000)                              |                         | 500                             | (500)                                |                         | 100                           | (100)                                |
|                      | V                           | Not Limited               | Not Limited                          |                         | Not Limited                     | Not Limited                          |                         | Not Limited                   | Not Limited                          |
| Oxidizer             | 4                           | 2                         | (2)                                  | Not Applicable          | 1                               | (1)                                  | Not Applicable          | 0.25                          | (0.25)                               |
|                      | 3                           | 40                        | (40)                                 |                         | 20                              | (20)                                 |                         | 4                             | (4)                                  |
|                      | 2                           | 1,000                     | (1,000)                              |                         | 500                             | (500)                                |                         | 100                           | (100)                                |
|                      | 1                           | Not Limited               | Not Limited                          |                         | Not Limited                     | Not Limited                          |                         | Not Limited                   | Not Limited                          |
| Oxidizing gas        | Gaseous<br>Liquefied        | Not Applicable            | Not Applicable (600)                 | 6,000<br>Not Applicable | Not Applicable                  | Not Applicable (300)                 | 1,500<br>Not Applicable | Not Applicable                | Not Applicable                       |
| Pyrophoric materials | Not Applicable              | 8                         | (8)                                  | 100                     | 4                               | (4)                                  | 10                      | 0                             | 0                                    |
| Unstable (reactive)  | 4                           | 2                         | (2)                                  | 20                      | 1                               | (1)                                  | 2                       | 0.25                          | (0.25)                               |
|                      | 3                           | 20                        | (20)                                 | 200                     | 10                              | (10)                                 | 10                      | 1                             | 1                                    |
|                      | 2                           | 2000                      | (200)                                | 1,000                   | 100                             | (100)                                | 250                     | 10                            | 10                                   |
|                      | 1                           | Not Limited               | Not Limited                          | 1,500                   | Not Limited                     | Not Limited                          | Not Limited             | Not Limited                   | Not Limited                          |
| Water reactive       | 3                           | 20                        | (20)                                 | Not Applicable          | 10                              | (10)                                 | Not Applicable          | 1                             | (1)                                  |
|                      | 2                           | 200                       | (200)                                |                         | 100                             | (100)                                |                         | 10                            | (10)                                 |
|                      | 1                           | Not Limited               | Not Limited                          |                         | Not Limited                     | Not Limited                          |                         | Not Limited                   | Not Limited                          |

For SI: 1 pound = 0.454 kg, 1 gallon = 3.785 L, 1 cubic foot = 0.02832 m<sup>3</sup>.

a. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2.

b. The aggregate quantities in storage and use shall not exceed the quantity listed for storage.

c. The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials allowed in outdoor storage per single property under the same ownership or control used for retail or wholesale sales is allowed to exceed the maximum allowable quantity per control area when such storage is in accordance with Section 5003.11.

d. Quantities in parentheses indicate quantity units in parentheses at the head of each column.

**TABLE 5003.1.1(4)**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A HEALTH HAZARD IN AN OUTDOOR CONTROL AREA<sup>a, b, c, f</sup>**

| MATERIAL      | STORAGE      |                         |                                                       | USE-CLOSED SYSTEMS |                         |                                                       | USE-OPEN SYSTEMS |                         |
|---------------|--------------|-------------------------|-------------------------------------------------------|--------------------|-------------------------|-------------------------------------------------------|------------------|-------------------------|
|               | Solid pounds | Liquid gallons (pounds) | Gas cubic feet at NTP (gallons)                       | Solid pounds       | Liquid gallons (pounds) | Gas cubic feet at NTP (gallons)                       | Solid pounds     | Liquid gallons (pounds) |
| Corrosives    | 20,000       | 2,000                   | Gaseous 1,620<br>Liquefied (300)                      | 10,000             | 1,000                   | Gaseous 810<br>Liquefied (150)                        | 1,000            | 100                     |
| Highly toxics | 20           | (20)                    | Gaseous 40 <sup>d</sup><br>Liquefied (8) <sup>d</sup> | 10                 | (10)                    | Gaseous 20 <sup>d</sup><br>Liquefied (4) <sup>d</sup> | 3                | (3)                     |
| Toxics        | 1,000        | (1,000) <sup>e</sup>    | Gaseous 1,620<br>Liquefied (300)                      | 500                | 50 <sup>e</sup>         | Gaseous 810<br>Liquefied (150)                        | 125              | (125) <sup>e</sup>      |

For SI: 1 cubic foot = 0.02832 m<sup>3</sup>, 1 pound = 0.454 kg, 1 gallon = 3.785 L, 1 pound per square inch absolute = 6.895 kPa, °C = [(°F)-32/1.8].

a. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2.

b. The aggregate quantities in storage and use shall not exceed the quantity listed for storage.

c. The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials allowed in outdoor storage per single property under the same ownership or control used for retail or wholesale sales is allowed to exceed the maximum allowable quantity per control area when such storage is in accordance with Section 5003.11.

d. Allowed only when used in approved exhausted gas cabinets, exhausted enclosures or under fume hoods.

e. The maximum allowable quantity per control area for toxic liquids with vapor pressures in excess of 1 psia at 77°F shall be the maximum allowable quantity per control area listed for highly toxic liquids.

f. Quantities in parentheses indicate quantity units in parentheses at the head of each column.

**5003.9.8 Separation of incompatible materials.** *Incompatible materials* in storage and storage of materials that are incompatible with materials in use shall be separated when the stored materials are in containers having a capacity of more than 5 pounds (2 kg) or 0.5 gallon (2 L). Separation shall be accomplished by:

1. Segregating *incompatible materials* in storage by a distance of not less than 20 feet (6096 mm).
2. Isolating *incompatible materials* in storage by a noncombustible partition extending not less than 18 inches (457 mm) above and to the sides of the stored material.
3. Storing liquid and solid materials in hazardous material storage cabinets.
4. Storing *compressed gases* in gas cabinets or exhausted enclosures in accordance with Sections 5003.8.5 and 5003.8.6. Materials that are incompatible shall not be stored within the same cabinet or exhausted enclosure.

#### SECTION 5004 STORAGE

**5004.1 Scope.** Storage of hazardous materials in amounts exceeding the *maximum allowable quantity per control area* as set forth in Section 5003.1 shall be in accordance with Sections 5001, 5003 and 5004. Storage of hazardous materials in amounts not exceeding the *maximum allowable quantity per control area* as set forth in Section 5003.1 shall be in accordance with Sections 5001 and 5003. Retail and wholesale storage and display of nonflammable solid and nonflammable and noncombustible liquid hazardous materials in Group M occupancies and Group S storage shall be in accordance with Section 5003.11.

**5004.2 Spill control and secondary containment for liquid and solid hazardous materials.** Rooms, buildings or areas used for the storage of liquid or solid hazardous materials shall be provided with spill control and secondary containment in accordance with Sections 5004.2.1 through 5004.2.3.

**Exception:** Outdoor storage of containers on approved containment pallets in accordance with Section 5004.2.3.

**5004.2.1 Spill control for hazardous material liquids.** Rooms, buildings or areas used for the storage of hazardous material liquids in individual vessels having a capacity of more than 55 gallons (208 L), or in which the aggregate capacity of multiple vessels exceeds 1,000 gallons (3785 L), shall be provided with spill control to prevent the flow of liquids to adjoining areas. Floors in indoor locations and similar surfaces in outdoor locations shall be constructed to contain a spill from the largest single vessel by one of the following methods:

1. Liquid-tight sloped or recessed floors in indoor locations or similar areas in outdoor locations.
2. Liquid-tight floors in indoor locations or similar areas in outdoor locations provided with liquid-tight raised or recessed sills or dikes.
3. Sumps and collection systems.
4. Other *approved* engineered systems.

Except for surfacing, the floors, sills, dikes, sumps and collection systems shall be constructed of noncombustible material, and the liquid-tight seal shall be compatible with the material stored. When liquid-tight sills or dikes are provided, they are not required at perimeter openings having an open-grate trench across the opening that connects to an approved collection system.

**5004.2.2 Secondary containment for hazardous material liquids and solids.** Where required by Table 5004.2.2 buildings, rooms or areas used for the storage of hazardous materials liquids or solids shall be provided with secondary containment in accordance with this section when the capacity of an individual vessel or the aggregate capacity of multiple vessels exceeds the following:

1. Liquids: Capacity of an individual vessel exceeds 55 gallons (208 L) or the aggregate capacity of multiple vessels exceeds 1,000 gallons (3785 L); and
2. Solids: Capacity of an individual vessel exceeds 550 pounds (250 kg) or the aggregate capacity of multiple vessels exceeds 10,000 pounds (4540 kg).

**5004.2.2.1 Containment and drainage methods.** The building, room or area shall contain or drain the hazardous materials and fire protection water through the use of one of the following methods:

1. Liquid-tight sloped or recessed floors in indoor locations or similar areas in outdoor locations.
2. Liquid-tight floors in indoor locations or similar areas in outdoor locations provided with liquid-tight raised or recessed sills or dikes.
3. Sumps and collection systems.
4. Drainage systems leading to an *approved* location.
5. Other *approved* engineered systems.

**5004.2.2.2 Incompatible materials.** *Incompatible materials* used in *open systems* shall be separated from each other in the secondary containment system.

**5004.2.2.3 Indoor design.** Secondary containment for indoor storage areas shall be designed to contain a spill from the largest vessel plus the design flow volume of fire protection water calculated to discharge from the fire-extinguishing system over the minimum required system design area or area of the room or area in which the storage is located, whichever is smaller. The containment capacity shall be designed to contain the flow for a period of 20 minutes.

**5004.2.2.4 Outdoor design.** Secondary containment for outdoor storage areas shall be designed to contain a spill from the largest individual vessel. If the area is open to rainfall, secondary containment shall be designed to include the volume of a 24-hour rainfall as determined by a 25-year storm and provisions shall be made to drain accumulations of groundwater and rainwater.

**5004.2.2.5 Monitoring.** An *approved* monitoring method shall be provided to detect hazardous materials in the secondary containment system. The monitoring method is allowed to be visual inspection of the primary or secondary containment, or other *approved* means. Where secondary containment is subject to the intrusion of water, a monitoring method for detecting water shall be provided. Where monitoring devices are provided, they shall be connected to *approved* visual or audible alarms.

**5004.2.2.6 Drainage system design.** Drainage systems shall be in accordance with the *International Plumbing Code* and all of the following:

**TABLE 5003.8.2  
DETACHED BUILDING REQUIRED**

| A DETACHED BUILDING IS REQUIRED WHEN THE QUANTITY OF MATERIAL EXCEEDS THAT LISTED HEREIN |                           |                                           |                                    |
|------------------------------------------------------------------------------------------|---------------------------|-------------------------------------------|------------------------------------|
| Material                                                                                 | Class                     | Solids and liquids (tons) <sup>a, b</sup> | Gases (cubic feet) <sup>a, b</sup> |
| Explosives                                                                               | Division 1.1              | Maximum Allowable Quantity                | Not Applicable                     |
|                                                                                          | Division 1.2              | Maximum Allowable Quantity                |                                    |
|                                                                                          | Division 1.3              | Maximum Allowable Quantity                |                                    |
|                                                                                          | Division 1.4              | Maximum Allowable Quantity                |                                    |
|                                                                                          | Division 1.4 <sup>c</sup> | 1                                         |                                    |
|                                                                                          | Division 1.5              | Maximum Allowable Quantity                |                                    |
|                                                                                          | Division 1.6              | Maximum Allowable Quantity                |                                    |
| Oxidizers                                                                                | Class 4                   | Maximum Allowable Quantity                | Maximum Allowable Quantity         |
| Unstable (reactives) detonable                                                           | Class 3 or 4              | Maximum Allowable Quantity                | Maximum Allowable Quantity         |
| Oxidizer, liquids and solids                                                             | Class 3                   | 1,200                                     | Not Applicable                     |
|                                                                                          | Class 2                   | 2,000                                     |                                    |
| Organic peroxides                                                                        | Detonable                 | Maximum Allowable Quantity                | Not Applicable                     |
|                                                                                          | Class I                   | Maximum Allowable Quantity                |                                    |
|                                                                                          | Class II                  | 25                                        |                                    |
| Unstable (reactives) nondetonable                                                        | Class III                 | 50                                        | 2,000                              |
|                                                                                          | Class 3                   | 1                                         |                                    |
|                                                                                          | Class 2                   | 25                                        |                                    |
| Water reactives                                                                          | Class 3                   | 1                                         | Not Applicable                     |
|                                                                                          | Class 2                   | 25                                        |                                    |
| Pyrophoric gases                                                                         | Not Applicable            | Not Applicable                            | 2,000                              |

For SI: 1 pound = 0.454 kg, 1 cubic foot = 0.02832 m<sup>3</sup>, 1 ton = 2000 lbs. = 907.2 kg.

- For materials which are detonable, the distance to other buildings or lot lines shall be as specified in the *International Building Code*. For materials classified as explosives, the required separation distances shall be as specified in Chapter 56.
- "Maximum Allowable Quantity" means the maximum allowable quantity per control area set forth in Table 5003.1.1(1).
- Limited to Division 1.4 materials and articles, including articles packaged for shipment, that are not regulated as an explosive under Bureau of Alcohol, Tobacco, Firearms and Explosives regulations, or unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles, providing the net explosive weight of individual articles does not exceed 1 pound.

- The slope of floors to drains in indoor locations, or similar areas in outdoor locations shall not be less than 1 percent.
- Drains from indoor storage areas shall be sized to carry the volume of the fire protection water as determined by the design density discharged from the automatic fire-extinguishing system over the minimum required system design area or area of the room or area in which the storage is located, whichever is smaller.
- Drains from outdoor storage areas shall be sized to carry the volume of the fire flow and the volume of a 24-hour rainfall as determined by a 25-year storm.
- Materials of construction for drainage systems shall be compatible with the materials stored.
- Incompatible materials used in open systems shall be separated from each other in the drainage system.
- Drains shall terminate in an approved location away from buildings, valves, means of egress, fire access roadways, adjoining property and storm drains.

**5004.2.3 Containment pallets.** When used as an alternative to spill control and secondary containment for outdoor storage in accordance with the exception in Section 5004.2, containment pallets shall comply with all of the following:

- A liquid-tight sump accessible for visual inspection shall be provided.
- The sump shall be designed to contain not less than 66 gallons (250 L).

- Exposed surfaces shall be compatible with material stored.
- Containment pallets shall be protected to prevent collection of rainwater within the sump.

**5004.3 Ventilation.** Indoor storage areas and storage buildings shall be provided with mechanical exhaust ventilation or natural ventilation where natural ventilation can be shown to be acceptable for the materials as stored.

**Exception:** Storage areas for flammable solids complying with Chapter 59.

**5004.3.1 System requirements.** Exhaust ventilation systems shall comply with all of the following:

- Installation shall be in accordance with the *International Mechanical Code*.
- Mechanical ventilation shall be at a rate of not less than 1 cubic foot per minute per square foot [0.00508 m<sup>3</sup>/(s • m<sup>2</sup>)] of floor area over the storage area.
- Systems shall operate continuously unless alternative designs are approved.
- A manual shutoff control shall be provided outside of the room in a position adjacent to the access door to the room or in an approved location. The switch shall be a break-glass or other approved type and shall be labeled: VENTILATION SYSTEM EMERGENCY SHUTOFF.
- Exhaust ventilation shall be designed to consider the density of the potential fumes or vapors released. For fumes or vapors that are heavier than air, exhaust shall be taken from a point within 12 inches (305 mm) of the floor. For fumes or vapors that are lighter than air, exhaust shall be taken from a point within 12 inches (305 mm) of the highest point of the room.

**TABLE 5004.2.2  
REQUIRED SECONDARY CONTAINMENT—HAZARDOUS MATERIAL SOLIDS AND LIQUIDS STORAGE**

| MATERIAL                     |                        | INDOOR STORAGE |                | OUTDOOR STORAGE |                |
|------------------------------|------------------------|----------------|----------------|-----------------|----------------|
|                              |                        | Solids         | Liquids        | Solids          | Liquids        |
| 1. Physical-hazard materials |                        |                |                |                 |                |
| Combustible liquids          | Class II               | Not Applicable | See Chapter 57 | Not Applicable  | See Chapter 57 |
|                              | Class IIIA             |                | See Chapter 57 |                 | See Chapter 57 |
|                              | Class IIIB             |                | See Chapter 57 |                 | See Chapter 57 |
|                              | Cryogenic fluids       |                | See Chapter 55 |                 | See Chapter 55 |
| Explosives                   |                        | See Chapter 56 |                | See Chapter 56  |                |
| Flammable liquids            | Class IA               | Not Applicable | See Chapter 57 | Not Applicable  | See Chapter 57 |
|                              | Class IB               |                | See Chapter 57 |                 | See Chapter 57 |
|                              | Class IC               |                | See Chapter 57 |                 | See Chapter 57 |
| Flammable solids             |                        | Not Required   | Not Applicable | Not Required    | Not Applicable |
| Organic peroxides            | Unclassified Detonable | Required       | Required       | Not Required    | Not Required   |
|                              | Class I                |                |                |                 |                |
|                              | Class II               |                |                |                 |                |
|                              | Class III              |                |                |                 |                |
|                              | Class IV               |                |                |                 |                |
|                              | Class V                | Not Required   | Not Required   | Not Required    | Not Required   |
| Oxidizers                    | Class 4                | Required       | Required       | Not Required    | Not Required   |
|                              | Class 3                |                |                |                 |                |
|                              | Class 2                |                |                |                 |                |
|                              |                        | Class 1        | Not Required   | Not Required    | Not Required   |
| Pyrophorics                  |                        | Not Required   | Required       | Not Required    | Required       |
| Unstable (reactives)         | Class 4                | Required       | Required       | Required        | Required       |
|                              | Class 3                |                |                |                 |                |
|                              | Class 2                |                |                |                 |                |
|                              |                        | Class 1        | Not Required   | Not Required    | Not Required   |
| Water reactives              | Class 3                | Required       | Required       | Required        | Required       |
|                              | Class 2                |                |                |                 |                |
|                              |                        | Class 1        | Not Required   | Not Required    | Not Required   |
| 2. Health-hazard materials   |                        |                |                |                 |                |
| Corrosives                   |                        | Not Required   | Required       | Not Required    | Required       |
| Highly toxics                |                        | Required       | Required       | Required        | Required       |
| Toxics                       |                        |                |                |                 |                |

6. The location of both the exhaust and inlet air openings shall be designed to provide air movement across all portions of the floor or room to prevent the accumulation of vapors.
7. Exhaust air shall not be recirculated to occupied areas if the materials stored are capable of emitting hazardous vapors and contaminants have not been removed. Air contaminated with explosive or flammable vapors, fumes or dusts; flammable, highly toxic or toxic gases; or radioactive materials shall not be recirculated.

**5004.4 Separation of incompatible hazardous materials.** *Incompatible materials* shall be separated in accordance with Section 5003.9.8.

**5004.5 Automatic sprinkler systems.** Indoor storage areas and storage buildings shall be equipped throughout with an *approved automatic sprinkler system* in accordance with Section 903.3.1.1. The design of the sprinkler system shall not be less than that required for Ordinary Hazard Group 2 with a minimum design area of 3,000 square feet (279 m<sup>2</sup>). Where the materials or storage arrangement are required by other regulations to be provided with a higher level of sprinkler

system protection, the higher level of sprinkler system protection shall be provided.

**5004.6 Explosion control.** Indoor storage rooms, areas and buildings shall be provided with explosion control in accordance with Section 911.

**5004.7 Standby or emergency power.** Where mechanical ventilation, treatment systems, temperature control, alarm, detection or other electrically operated systems are required, such systems shall be provided with an emergency or standby power system in accordance with NFPA 70 and Section 604.

**Exceptions:**

1. Mechanical ventilation for storage of Class IB and Class IC flammable and *combustible liquids* in closed containers not exceeding 6½ gallons (25 L) capacity.
2. Storage areas for Class I and 2 oxidizers.
3. Storage areas for Class II, III, IV and V organic peroxides.
4. Storage areas for asphyxiant, irritant and radioactive gases.
5. For storage areas for highly toxic or toxic materials, see Sections 6004.2.2.8 and 6004.3.4.2.
6. Standby power for mechanical ventilation, treatment systems and temperature control systems shall not be required where an *approved* fail-safe engineered system is installed.

**5004.8 Limit controls.** Limit controls shall be provided in accordance with Sections 5004.8.1 and 5004.8.2.

**5004.8.1 Temperature control.** Materials that must be kept at temperatures other than normal ambient temperatures to prevent a hazardous reaction shall be provided with an approved means to maintain the temperature within a safe range. Redundant temperature control equipment that will operate on failure of the primary temperature control system shall be provided. Where *approved*, alternative means that prevent a hazardous reaction are allowed.

**5004.8.2 Pressure control.** Stationary tanks and equipment containing hazardous material liquids that can generate pressures exceeding design limits because of exposure fires or internal reaction shall have some form of construction or other *approved* means that will relieve excessive internal pressure. The means of pressure relief shall vent to an *approved* location or to an exhaust scrubber or treatment system where required by Chapter 60.

**5004.9 Emergency alarm.** An *approved* manual emergency alarm system shall be provided in buildings, rooms or areas used for storage of hazardous materials. Emergency alarm-initiating devices shall be installed outside of each interior *exit* or *exit access* door of storage buildings, rooms or areas. Activation of an emergency alarm-initiating device shall sound a local alarm to alert occupants of an emergency situation involving hazardous materials.

**5004.10 Supervision and monitoring.** Emergency alarm, detection and automatic fire-extinguishing systems required

by Section 5004 shall be electrically supervised and monitored by an *approved* supervising station or, when approved, shall initiate an audible and visual signal at a constantly attended on-site location.

**5004.11 Clearance from combustibles.** The area surrounding an outdoor storage area or tank shall be kept clear of combustible materials and vegetation for a minimum distance of 25 feet (7620 mm).

**5004.12 Noncombustible floor.** Except for surfacing, floors of storage areas shall be of noncombustible construction.

**5004.13 Weather protection.** Where overhead noncombustible construction is provided for sheltering outdoor hazardous material storage areas, such storage shall not be considered indoor storage when the area is constructed in accordance with the requirements for weather protection as required by the *International Building Code*.

**Exception:** Storage of *explosive* materials shall be considered as indoor storage.

## SECTION 5401 GENERAL

**5401.1 Scope.** The storage and use of *corrosive* materials shall be in accordance with this chapter. *Compressed gases* shall also comply with Chapter 53.

**Exceptions:**

1. Display and storage in Group M and storage in Group S occupancies complying with Section 5003.11.
2. Stationary storage battery systems in accordance with Section 608.
3. This chapter shall not apply to R-717 (ammonia) where used as a refrigerant in a refrigeration system (see Section 606).

**5401.2 Permits.** Permits shall be required as set forth in Section 105.6.

## SECTION 5403 GENERAL REQUIREMENTS

**5403.1 Quantities not exceeding the maximum allowable quantity per control area.** The storage and use of *corrosive* materials in amounts not exceeding the *maximum allowable quantity per control area* indicated in Section 5003.1 shall be in accordance with Sections 5001, 5003 and 5401.

**5403.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of *corrosive* materials in amounts exceeding the *maximum allowable quantity per control area* indicated in Section 5003.1 shall be in accordance with this chapter and Chapter 50.

## SECTION 5404 STORAGE

**5404.1 Indoor storage.** Indoor storage of *corrosive* materials in amounts exceeding the *maximum allowable quantity per control area* indicated in Table 5003.1.1(2), shall be in accordance with Sections 5001, 5003, 5004 and this chapter.

**5404.1.1 Liquid-tight floor.** In addition to the provisions of Section 5004.12, floors in storage areas for *corrosive* liquids shall be of liquid-tight construction.

**5404.2 Outdoor storage.** Outdoor storage of *corrosive* materials in amounts exceeding the *maximum allowable quantity*

per control area indicated in Table 5003.1.1(4) shall be in accordance with Sections 5001, 5003, 5004 and this chapter.

**5404.2.1 Above-ground outside storage tanks.** Above-ground outside storage tanks exceeding an aggregate quantity of 1,000 gallons (3785 L) of *corrosive* liquids shall be provided with secondary containment in accordance with Section 5004.2.2.

**5404.2.2 Distance from storage to exposures.** Outdoor storage of *corrosive* materials shall not be within 20 feet (6096 mm) of buildings not associated with the manufacturing or distribution of such materials, *lot lines*, public streets, public alleys, *public ways* or *means of egress*. A 2-hour *fire barrier* without openings or penetrations, and extending not less than 30 inches (762 mm) above and to the sides of the storage area, is allowed in lieu of such distance. The wall shall either be an independent structure, or the *exterior wall* of the building adjacent to the storage area.

## SECTION 6301 GENERAL

**6301.1 Scope.** The storage and use of oxidizing materials shall be in accordance with this chapter and Chapter 50. Oxidizing gases shall also comply with Chapter 53. Oxidizing *cryogenic fluids* shall also comply with Chapter 55.

### Exceptions:

1. Display and storage in Group M and storage in Group S occupancies complying with Section 5003.11.
2. Bulk oxygen systems at industrial and institutional consumer sites shall be in accordance with NFPA 55.
3. Liquid oxygen stored or used in home health care in Group I-1, I-4 and R occupancies in accordance with Section 6306.

**6301.2 Permits.** Permits shall be required as set forth in Section 105.6.

## SECTION 6303 GENERAL REQUIREMENTS

**6303.1 Quantities not exceeding the maximum allowable quantity per control area.** The storage and use of oxidizing materials in amounts not exceeding the *maximum allowable quantity per control area* indicated in Section 5003.1 shall be in accordance with Sections 5001, 5003, 6301 and 6303. Oxidizing gases shall also comply with Chapter 53.

**6303.1.1 Special limitations for indoor storage and use by occupancy.** The indoor storage and use of oxidizing materials shall be in accordance with Sections 6303.1.1.1 through 6303.1.1.3.

**6303.1.1.1 Class 4 liquid and solid oxidizers.** The storage and use of Class 4 liquid and solid oxidizers shall comply with Sections 6303.1.1.1.1 through 6303.1.1.1.4.

**6303.1.1.1.1 Group A, E, I or U occupancies.** In Group A, E, I or U occupancies, any amount of Class 4 liquid and solid oxidizers shall be stored in accordance with the following:

1. Class 4 liquid and solid oxidizers shall be stored in hazardous materials storage cabinets complying with Section 5003.8.7.
2. The hazardous materials storage cabinets shall not contain other storage.

**6303.1.1.1.2 Group R occupancies.** Class 4 liquid and solid oxidizers shall not be stored or used within Group R occupancies.

**6303.1.1.1.3 Offices and retail sales areas.** Class 4 liquid and solid oxidizers shall not be stored or used in offices or retail sales areas of Group B, F, M or S occupancies.

**6303.1.1.1.4 Classrooms.** In classrooms of Group B, F or M occupancies, any amount of Class 4 liquid and solid oxidizers shall be stored in accordance with the following:

1. Class 4 liquid and solid oxidizers shall be stored in hazardous materials storage cabinets complying with Section 5003.8.7.
2. Hazardous materials storage cabinets shall not contain other storage.

**6303.1.1.2 Class 3 liquid and solid oxidizers.** A maximum of 200 pounds (91 kg) of solid or 20 gallons (76 L) of liquid Class 3 oxidizer is allowed in Group I occupancies when such materials are necessary for maintenance purposes or operation of equipment. The oxidizers shall be stored in *approved* containers and in an *approved* manner.

**6303.1.1.3 Oxidizing gases.** Except for cylinders of nonliquefied *compressed gases* not exceeding a capacity of 250 cubic feet (7 m<sup>3</sup>) or liquefied *compressed gases* not exceeding a capacity of 46 pounds (21 kg) each used for maintenance purposes, patient care or operation of equipment, oxidizing gases shall not be stored or used in Group A, E, I or R occupancies or in offices in Group B occupancies.

The aggregate quantities of gases used for maintenance purposes and operation of equipment shall not exceed the *maximum allowable quantity per control area* listed in Table 5003.1.1(1).

Medical gas systems and medical gas supply cylinders shall also be in accordance with Section 5306.

**6303.1.2 Emergency shutoff.** *Compressed gas* systems conveying oxidizing gases shall be provided with *approved* manual or automatic emergency shutoff valves that can be activated at each point of use and at each source.

**6303.1.2.1 Shutoff at source.** A manual or automatic fail-safe emergency shutoff valve shall be installed on supply piping at the cylinder or bulk source. Manual or automatic cylinder valves are allowed to be used as the required emergency shutoff valve when the source of supply is limited to unmanifolded cylinder sources.

**6303.1.2.2 Shutoff at point of use.** A manual or automatic emergency shutoff valve shall be installed on the supply piping at the point of use or at a point where the equipment using the gas is connected to the supply system.

**6303.1.3 Ignition source control.** Ignition sources in areas containing oxidizing gases shall be controlled in accordance with Section 5003.7.

**6304.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of oxidizing materials in amounts exceeding the *maximum allowable quantity per control area* indicated in Section 5003.1 shall be in accordance with Chapter 50 and this chapter.

## SECTION 6304 STORAGE

**6304.1 Indoor storage.** Indoor storage of oxidizing materials in amounts exceeding the *maximum allowable quantity per control area* indicated in Table 5003.1.1(1) shall be in accordance with Sections 5001, 5003 and 5004 and this chapter.

**6304.1.1 Detached storage.** Storage of liquid and solid oxidizers shall be in detached buildings when required by Section 5003.8.2.

**6304.1.2 Distance from detached storage buildings to exposures.** In addition to the requirements of the *International Building Code*, detached storage buildings shall be located in accordance with Table 6304.1.2.

**6304.1.3 Explosion control.** Indoor storage rooms, areas and buildings containing Class 4 liquid or solid oxidizers shall be provided with explosion control in accordance with Section 911.

**6304.1.4 Automatic sprinkler system.** The *automatic sprinkler system* shall be designed in accordance with NFPA 430.

**6304.1.5 Liquid-tight floor.** In addition to Section 5004.12, floors of storage areas for liquid and solid oxidizers shall be of liquid-tight construction.

**TABLE 6304.1.2  
OXIDIZER LIQUIDS AND SOLIDS—DISTANCE FROM DETACHED  
BUILDINGS AND OUTDOOR STORAGE AREAS TO EXPOSURES**

| OXIDIZER CLASS | WEIGHT (pounds) | MINIMUM DISTANCE TO BUILDINGS, LOT LINES, PUBLIC STREETS, PUBLIC ALLEYS, PUBLIC WAYS OR MEANS OF EGRESS (feet) |
|----------------|-----------------|----------------------------------------------------------------------------------------------------------------|
| 1              | Note a          | Not Required                                                                                                   |
| 2              | Note a          | 35                                                                                                             |
| 3              | Note a          | 50                                                                                                             |
| 4              | Over 10 to 100  | 75                                                                                                             |
|                | 101 to 500      | 100                                                                                                            |
|                | 501 to 1,000    | 125                                                                                                            |
|                | 1,001 to 3,000  | 200                                                                                                            |
|                | 3,001 to 5,000  | 300                                                                                                            |
|                | 5,001 to 10,000 | 400                                                                                                            |
|                | Over 10,000     | As required by the fire code official                                                                          |

For SI: 1 foot = 304.8 mm, 1 pound = 0.454 kg.

a. Any quantity over the amount required for detached storage in accordance with Section 5003.8.2, or over the outdoor maximum allowable quantity for outdoor control areas.

**6304.1.6 Smoke detection.** An *approved* supervised smoke detection system in accordance with Section 907 shall be installed in liquid and solid oxidizer storage areas. Activation of the smoke detection system shall sound a local alarm.

**Exception:** Detached storage buildings protected by an *approved* automatic fire-extinguishing system.

**6304.1.7 Storage conditions.** The maximum quantity of oxidizers per building in detached storage buildings shall not exceed those quantities set forth in Tables 6304.1.7(1) through 6304.1.7(4).

The storage configuration for liquid and solid oxidizers shall be as set forth in Tables 6304.1.7(1) through 6304.1.7(4).

Class 2 oxidizers shall not be stored in *basements* except when such storage is in stationary tanks.

Class 3 and 4 oxidizers in amounts exceeding the *maximum allowable quantity per control area* set forth in Section 5003.1 shall be stored on the ground floor only.

**TABLE 6304.1.7(1)  
STORAGE OF CLASS 1 OXIDIZER LIQUIDS AND  
SOLIDS IN COMBUSTIBLE CONTAINERS\***

| STORAGE CONFIGURATION         | LIMITS (feet) |
|-------------------------------|---------------|
| Piles                         |               |
| Maximum length                | No Limit      |
| Maximum width                 | 50            |
| Maximum height                | 20            |
| Minimum distance to next pile | 3             |
| Minimum distance to walls     | 2             |
| Maximum quantity per pile     | No Limit      |
| Maximum quantity per building | No Limit      |

For SI: 1 foot = 304.8 mm.

a. Storage in noncombustible containers or in bulk in detached storage buildings is not limited as to quantity or arrangement.

**TABLE 6304.1.7(2)  
STORAGE OF CLASS 2 OXIDIZER LIQUIDS AND SOLIDS\*\***

| STORAGE CONFIGURATION         | LIMITS             |                       |                   |
|-------------------------------|--------------------|-----------------------|-------------------|
|                               | Segregated storage | Cutoff storage rooms* | Detached building |
| Piles                         |                    |                       |                   |
| Maximum width                 | 16 feet            | 25 feet               | 25 feet           |
| Maximum height                | 10 feet            | 12 feet               | 12 feet           |
| Minimum distance to next pile | Note d             | Note d                | Note d            |
| Minimum distance to walls     | 2 feet             | 2 feet                | 2 feet            |
| Maximum quantity per pile     | 20 tons            | 50 tons               | 200 tons          |
| Maximum quantity per building | 200 tons           | 500 tons              | No Limit          |

For SI: 1 foot = 304.8 mm, 1 ton = 0.907185 metric ton.

a. Storage in noncombustible containers is not limited as to quantity or arrangement, except that piles shall be at least 2 feet from walls in sprinklered buildings and 4 feet from walls in nonsprinklered buildings; the distance between piles shall not be less than the pile height.

b. Quantity limits shall be reduced by 50 percent in buildings or portions of buildings used for retail sales.

c. Cutoff storage rooms shall be separated from the remainder of the building by 2-hour fire barriers.

d. Aisle width shall not be less than the pile height.

**TABLE 6304.1.7(3)**  
**STORAGE OF CLASS 3 OXIDIZER LIQUIDS AND SOLIDS<sup>a, b</sup>**

| STORAGE CONFIGURATION         | LIMITS             |                                   |                   |
|-------------------------------|--------------------|-----------------------------------|-------------------|
|                               | Segregated storage | Cutoff storage rooms <sup>c</sup> | Detached building |
| Piles                         |                    |                                   |                   |
| Maximum width                 | 12 feet            | 16 feet                           | 20 feet           |
| Maximum height                | 8 feet             | 10 feet                           | 10 feet           |
| Minimum distance to next pile | Note d             | Note d                            | Note d            |
| Minimum distance to walls     | 4 feet             | 4 feet                            | 4 feet            |
| Maximum quantity per pile     | 20 tons            | 30 tons                           | 150 tons          |
| Maximum quantity per building | 100 tons           | 500 tons                          | No Limit          |

For SI: 1 foot = 304.8 mm, 1 ton = 0.907185 metric ton.

- Storage in noncombustible containers is not limited as to quantity or arrangement, except that piles shall be at least 2 feet from walls in sprinklered buildings and 4 feet from walls in nonsprinklered buildings; the distance between piles shall not be less than the pile height.
- Quantity limits shall be reduced by 50 percent in buildings or portions of buildings used for retail sales.
- Cutoff storage rooms shall be separated from the remainder of the building by 2-hour fire barriers.
- Aisle width shall not be less than the pile height.

**TABLE 6304.1.7(4)**  
**STORAGE OF CLASS 4 OXIDIZER LIQUIDS AND SOLIDS**

| STORAGE CONFIGURATION         | LIMITS (feet) |
|-------------------------------|---------------|
| Piles                         |               |
| Maximum length                | 10            |
| Maximum width                 | 4             |
| Maximum height                | 8             |
| Minimum distance to next pile | 8             |
| Maximum quantity per building | No Limit      |

For SI: 1 foot = 304.8 mm.

**6304.1.8 Separation of Class 4 oxidizers from other materials.** In addition to the requirements in Section 5003.9.8, Class 4 oxidizer liquids and solids shall be separated from other hazardous materials by not less than a 1-hour fire barrier or stored in hazardous materials storage cabinets.

Detached storage buildings for Class 4 oxidizer liquids and solids shall be located a minimum of 50 feet (15 240 mm) from other hazardous materials storage.

**6304.1.9 Contamination.** Liquid and solid oxidizers shall not be stored on or against combustible surfaces. Liquid and solid oxidizers shall be stored in a manner to prevent contamination.

**6304.2 Outdoor storage.** Outdoor storage of oxidizing materials in amounts exceeding the *maximum allowable quantities per control area* set forth in Table 5003.1.1(3) shall be in accordance with Sections 5001, 5003, 5004 and this chapter. Oxidizing gases shall also comply with Chapter 53.

**6304.2.1 Distance from storage to exposures for liquid and solid oxidizers.** Outdoor storage areas for liquid and solid oxidizers shall be located in accordance with Table 6304.1.2.

**6304.2.2 Distance from storage to exposures for oxidizing gases.** Outdoor storage areas for oxidizing gases shall be located in accordance with Table 6304.2.2.

**6304.2.2.1 Oxidizing cryogenic fluids.** Outdoor storage areas for oxidizing *cryogenic fluids* shall be located in accordance with Chapter 55.

**6304.2.3 Storage configuration for liquid and solid oxidizers.** Storage configuration for liquid and solid oxidizers shall be in accordance with Tables 6304.1.7(1) through 6304.1.7(4).

**6304.2.4 Storage configuration for oxidizing gases.** Storage configuration for oxidizing gases shall be in accordance with Table 6304.2.2.

**TABLE 6304.2.2**  
**OXIDIZER GASES—DISTANCE FROM STORAGE TO EXPOSURES<sup>a</sup>**

| QUANTITY OF GAS STORED<br>(cubic feet at NTP) | DISTANCE TO A BUILDING NOT ASSOCIATED WITH THE<br>MANUFACTURE OR DISTRIBUTION OF OXIDIZING GASES OR<br>PUBLIC WAY OR LOT LINE THAT CAN BE BUILT UPON (feet) | DISTANCE BETWEEN STORAGE AREAS (feet) |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 0 – 50,000                                    | 5                                                                                                                                                           | 5                                     |
| 50,001 – 100,000                              | 10                                                                                                                                                          | 10                                    |
| 100,001 or greater                            | 15                                                                                                                                                          | 10                                    |

For SI: 1 foot = 304.8 mm, 1 cubic foot = 0.02832 m<sup>3</sup>.

- The minimum required distances shall not apply when fire barriers without openings or penetrations having a minimum fire-resistance rating of 2 hours interrupt the line of sight between the storage and the exposure. The configuration of the fire barrier shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

## SECTION 6701 GENERAL

**6701.1 Scope.** The storage and use of water-reactive solids and liquids shall be in accordance with this chapter.

### Exceptions:

1. Display and storage in Group M and storage in Group S occupancies complying with Section 5003.11.
2. Detonable water-reactive solids and liquids shall be stored in accordance with Chapter 56.

**6701.2 Permits.** Permits shall be required as set forth in Section 105.6.

## SECTION 6703 GENERAL REQUIREMENTS

**6703.1 Quantities not exceeding the maximum allowable quantity per control area.** The storage and use of water-reactive solids and liquids in amounts not exceeding the *maximum allowable quantity per control area* indicated in Section 5003.1 shall be in accordance with Sections 5001, 5003, 6701 and 6703.

**6703.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of water-reactive solids and liquids in amounts exceeding the *maximum allowable quantity per control area* indicated in Section 5003.1 shall be in accordance with Chapter 50 and this chapter.

## SECTION 6704 STORAGE

**6704.1 Indoor storage.** Indoor storage of water-reactive solids and liquids in amounts exceeding the *maximum allowable quantity per control area* indicated in Table 5003.1.1(1), shall be in accordance with Sections 5001, 5003, 5004 and this chapter.

**6704.1.1 Detached storage.** Storage of water-reactive solids and liquids shall be in detached buildings when required by Section 5003.8.2.

**6704.1.2 Liquid-tight floor.** In addition to the provisions of Section 5004.12, floors in storage areas for water-reactive solids and liquids shall be of liquid-tight construction.

**6704.1.3 Waterproof room.** Rooms or areas used for the storage of water-reactive solids and liquids shall be constructed in a manner which resists the penetration of water through the use of waterproof materials. Piping carrying water for other than *approved automatic sprinkler systems* shall not be within such rooms or areas.

**6704.1.4 Water-tight containers.** When Class 3 water-reactive solids and liquids are stored in areas equipped with an *automatic sprinkler system*, the materials shall be stored in closed water-tight containers.

**6704.1.5 Storage configuration.** Water-reactive solids and liquids stored in quantities greater than 500 cubic feet (14 m<sup>3</sup>) shall be separated into piles, each not larger than 500 cubic feet (14 m<sup>3</sup>). Aisle widths between piles shall not be less than the height of the pile or 4 feet (1219 mm), whichever is greater.

**Exception:** Water-reactive solids and liquids stored in tanks.

Class 2 water-reactive solids and liquids shall not be stored in *basements* unless such materials are stored in closed water-tight containers or tanks.

Class 3 water-reactive solids and liquids shall not be stored in *basements*.

Class 2 or 3 water-reactive solids and liquids shall not be stored with flammable liquids.

**6704.1.6 Explosion control.** Indoor storage rooms, areas and buildings containing Class 2 or 3 water-reactive solids and liquids shall be provided with explosion control in accordance with Section 911.

**6704.2 Outdoor storage.** Outdoor storage of water-reactive solids and liquids in quantities exceeding the *maximum allowable quantity per control area* indicated in Table 5003.1.1(3) shall be in accordance with Sections 5001, 5003, 5004 and this chapter.

**6704.2.1 General.** Outdoor storage of water-reactive solids and liquids shall be within tanks or closed water-tight containers and shall be in accordance with Sections 6704.2.2 through 6704.2.5.

**6704.2.2 Class 3 distance to exposures.** Outdoor storage of Class 3 water-reactive solids and liquids shall not be within 75 feet (22 860 mm) of buildings, *lot lines*, public streets, public alleys, *public ways* or *means of egress*.

**6704.2.3 Class 2 distance to exposures.** Outdoor storage of Class 2 water-reactive solids and liquids shall not be within 20 feet (6096 mm) of buildings, *lot lines*, public streets, public alleys, *public ways* or *means of egress*. A 2-hour *fire barrier* without openings or penetrations, and extending not less than 30 inches (762 mm) above and to the sides of the storage area, is allowed in lieu of such distance. The wall shall either be an independent structure, or the exterior wall of the building adjacent to the storage area.

**6704.2.4 Storage conditions.** Class 3 water-reactive solids and liquids shall be limited to piles not greater than 500 cubic feet (14 m<sup>3</sup>).

Class 2 water-reactive solids and liquids shall be limited to piles not greater than 1,000 cubic feet (28 m<sup>3</sup>).

Aisle widths between piles shall not be less than one-half the height of the pile or 10 feet (3048 mm), whichever is greater.

**6704.2.5 Containment.** Secondary containment shall be provided in accordance with the provisions of Section 5004.2.2.

## Appendix C Selected NFPA 400 Excerpts

### Chapter 1 Administration

#### 1.1 Scope.

**1.1.1\* Applicability.** This code shall apply to the storage, use, and handling of the following hazardous materials in all occupancies and facilities:

- (1) Ammonium nitrate solids and liquids
- (2) Corrosive solids and liquids
- (3) Flammable solids
- (4) Organic peroxide formulations
- (5) Oxidizer — solids and liquids
- (6) Pyrophoric solids and liquids
- (7) Toxic and highly toxic solids and liquids
- (8) Unstable (reactive) solids and liquids
- (9) Water-reactive solids and liquids
- (10)\*Compressed gases and cryogenic fluids as included within the context of NFPA 55, *Compressed Gases and Cryogenic Fluids Code*

**1.1.1.1 Occupancies.** Unless otherwise specified in this code, all occupancy definitions and classifications shall be in accordance with the building code.

**1.1.1.2 Multiple Hazards.** Hazardous materials that are classified in more than one hazard category, as set forth in Section 4.1, shall conform to the code requirements for each hazard category.

#### 1.1.2 Exemptions.

**1.1.2.1** The quantity and arrangement limits in this code shall not apply to facilities that use ammonium perchlorate in the commercial manufacture of large-scale rocket motors.

**1.1.2.2** This code shall not apply to the following:

- (1) Storage or use of hazardous materials for individual use on the premises of one- and two-family dwellings
- (2) Explosives or blasting agents, which are regulated by NFPA 495, *Explosive Materials Code*, and display fireworks, 1.3 G, which are regulated by NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles*
- (3) Refrigerants and refrigerant oil contained within closed cycle refrigeration systems complying with the fire code and the mechanical code adopted by the jurisdiction
- (4) High hazard contents stored or used in farm buildings or similar occupancies and in remote locations for on-premises agricultural use
- (5) Corrosive materials in stationary batteries utilized for facility emergency power or uninterrupted power supply, or similar purposes, in accordance with NFPA 1, *Fire Code*
- (6) Aerosols complying with NFPA 30B, *Code for the Manufacture and Storage of Aerosol Products*
- (7) Consumer fireworks, 1.4G complying with NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles*
- (8) Corrosive materials displayed in original packaging in mercantile occupancies and intended for personal or household use or as building materials
- (9) Flammable and combustible liquids having no other physical or health hazard properties covered by this code
- (10) Organic peroxide formulations that are capable of detonation as manufactured or when unpackaged or in authorized shipping containers under conditions of fire exposure, when stored, manufactured, or used in accordance with NFPA 495, *Explosive Materials Code*
- (11) Combustible metals, as defined in NFPA 484, *Standard for Combustible Metals*
- (12) LP-Gas complying with NFPA 58, *Liquefied Petroleum Gas Code* or NFPA 59, *Utility LP-Gas Plant Code*
- (13) When approved, materials that have been satisfactorily demonstrated not to present a potential danger to public health, safety, or welfare, based upon the quantity or condition of storage

- (14) The off-site transportation of hazardous materials when in accordance with Department of Transportation (DOT) regulations

**1.3 Application.** Administrative, operational, and maintenance provisions of this code shall apply to the following:

- (1) Conditions and operations arising after the adoption of the code
- (2) Existing conditions and operations

**1.3.1 Conflicts.**

**1.3.1.1** Where requirements between this code and a referenced NFPA document differ, the requirements of this code shall apply.

**1.3.1.2** Where a conflict between a general requirement of this code and a specific requirement of this code exists, the specific requirement shall apply.

**1.3.2 Multiple Occupancies.** Where two or more classes of occupancy occur in the same building or structure and are so intermingled that separate safeguards are impracticable, means of egress facilities, construction, protection, and other safeguards shall comply with the most restrictive fire safety requirements of the occupancies involved.

**1.3.3 Vehicles and Marine Vessels.** Vehicles, marine vessels, or other similar conveyances, where in fixed locations and occupied as buildings, as described by Section 11.6 of NFPA 101, *Life Safety Code*, shall be treated as buildings and comply with this code.

**1.3.4 Buildings.**

**1.3.4.1** Buildings permitted for construction after the adoption of this code shall comply with the provisions stated herein for new buildings.

**1.3.4.2** Repairs, renovations, alterations, reconstruction, change of occupancy, and additions to buildings shall conform with NFPA 101, *Life Safety Code*, and the building code.

**1.3.4.3** Newly introduced equipment, materials, and operations regulated by this code shall comply with the requirements for new construction or processes.

**1.3.5 Severability.** If any provision of this code or the application thereof to any person or circumstance is held invalid, the remainder of the code and the application of such provision to other persons or circumstances shall not be affected thereby.

**1.10 Emergency Planning.**

**1.10.1 Emergency Action Plan.** An emergency action plan, consistent with the available equipment and personnel, shall be established to respond to fire and other emergencies in accordance with requirements set forth in NFPA 1, *Fire Code*.

**1.10.2 Activation.** The facility responsible for an unauthorized release shall activate the emergency action element of the Hazardous Materials Management Plan.

**1.11 Hazardous Materials Management Plan (HMMP).**

**1.11.1\*** When required by the AHJ, new or existing facilities that store, use, or handle hazardous materials covered by this code in amounts above the MAQ specified in 5.2.1.2 through 5.2.1.13 and 5.4.1.2 shall submit a hazardous materials management plan (HMMP) to the AHJ.

**1.11.2** The HMMP shall be reviewed and updated as follows:

- (1) Annually
- (2) When the facility is modified
- (3) When hazardous materials representing a new hazard category not previously addressed are stored, used, or handled in the facility

**1.11.3** The HMMP shall comply with the requirements of Chapter 6.

**1.12\* Hazardous Materials Inventory Statement (HMIS).**

**1.12.1** When required by the AHJ, a hazardous materials inventory statement (HMIS) shall be completed and submitted to the AHJ.

**1.12.2** The HMIS shall comply with the requirements in NFPA 1, *Fire Code*.

**1.13 Plan Review.**

**1.13.1** Where required by the AHJ for new construction, modification, or rehabilitation, construction documents and shop drawings shall be submitted, reviewed, and approved prior to the start of such work as provided in Section 1.13.

**1.13.2** The applicant shall be responsible for ensuring that the following conditions are met:

- (1) The construction documents include all of the fire protection requirements.
- (2) The shop drawings are correct and in compliance with the applicable codes and standards.
- (3) The contractor maintains an approved set of construction documents on-site.

**1.13.3** It shall be the responsibility of the AHJ to promulgate rules that cover the following:

- (1) Criteria to meet the requirements of Section 1.13
- (2) Review of documents and construction documents within established time frames for the purpose of acceptance or providing reasons for nonacceptance

**1.13.4** Review and approval by the AHJ shall not relieve the applicant of the responsibility of compliance with this code.

**1.13.5** When required by the AHJ, revised construction documents or shop drawings shall be prepared and submitted for review and approval to illustrate corrections or modifications necessitated by field conditions or other revisions to approved plans.

**1.14 Technical Assistance.**

**1.14.1** The AHJ shall be permitted, upon prior written notification to the applicant, building owner, or owner's agent, to require a review by an independent third party with expertise in the matter to be reviewed at the submitter's expense.

**1.14.2** The independent reviewer shall provide an evaluation and recommend necessary changes to the proposed design, operation, process, or new technology to the AHJ.

**1.14.3** The AHJ shall be authorized to require design submittals to bear the stamp of a professional engineer.

**1.14.4** The AHJ shall make the final determination as to whether the provisions of this code have been met.

**Chapter 4 Classification of Materials, Wastes, and Hazard of Contents**

**4.1\* Hazardous Material Classification.** Materials shall be classified into one or more of the following categories of hazardous materials, based on the definitions found in Chapter 3:

- (1) Corrosive solids, liquids, or gases
- (2) Flammable solids
- (3) Flammable gases
- (4) Flammable cryogenic fluids
- (5) Inert cryogenic fluids
- (6) Inert gases
- (7) Organic peroxide formulations
- (8) Oxidizer solids or liquids
- (9) Oxidizing gases
- (10) Oxidizing cryogenic fluids
- (11) Pyrophoric solids, liquids, or gases
- (12) Toxic or highly toxic solids, liquids, or gases
- (13) Unstable (reactive) solids, liquids, or gases
- (14) Water-reactive solids or liquids

**4.2 Classification of High Hazard Contents.****4.2.1 General.**

**4.2.1.1** High hazard contents shall include materials defined as hazardous material in Chapter 3, whether stored, used, or handled.

**4.2.1.2** High hazard contents shall include those materials defined as hazardous material solids, liquids, or gases limited to the hazard categories specified in 1.1.1 and classified in accordance with 4.2.1.2.1 through 4.2.1.2.4 whether stored, used, or handled.

**4.2.1.2.1 High Hazard Level 1 Contents.** High hazard Level 1 contents shall include materials that present a detonation hazard, including, but not limited to, the following hazard categories:

- (1) Class 4 oxidizers
- (2) Detonable pyrophoric solids or liquids
- (3) Class 3 detonable and Class 4 unstable (reactive) solids, liquids, or gases
- (4) Detonable organic peroxides

**4.2.1.2.2 High Hazard Level 2 Contents.** High hazard Level 2 contents shall include materials that present a deflagration hazard or a hazard from accelerated burning limited to the following hazard categories:

- (1) Combustible dusts stored, used, or generated in a manner creating a severe fire or explosion hazard
- (2) Class I organic peroxides
- (3) Class 3 solid or liquid oxidizers that are used or stored in normally open containers or systems or in closed containers or systems at gauge pressures of more than 15 psi (103.4 kPa)
- (4) Flammable gases
- (5) Flammable cryogenic fluids
- (6) Nondetonable pyrophoric solids, liquids, or gases
- (7) Class 3 nondetonable unstable (reactive) solids, liquids, or gases
- (8) Class 3 water-reactive solids and liquids

**4.2.1.2.3 High Hazard Level 3 Contents.** High hazard Level 3 contents shall include materials that readily support combustion or present a physical hazard limited to the following hazard categories:

- (1) Flammable solids, other than dusts classified as high hazard Level 2, stored, used, or generated in a manner creating a high fire hazard
- (2) Class II and Class III organic peroxides
- (3) Class 2 solid or liquid oxidizers
- (4) Class 3 solid or liquid oxidizers that are used or stored in normally closed containers or systems at gauge pressures of less than 15 psi (103.4 kPa)
- (5) Class 2 unstable (reactive) materials
- (6) Class 2 water-reactive solids, liquids or gases
- (7) Oxidizing gases
- (8) Oxidizing cryogenic fluids

**4.2.1.2.4 High Hazard Level 4 Contents.** High hazard Level 4 contents shall include materials that are acute health hazards limited to the following hazard categories:

- (1) Corrosive solids, liquids, or gases
- (2) Highly toxic solids, liquids, or gases
- (3) Toxic solids, liquids, or gases

**4.3 Mixtures.** Mixtures shall be classified in accordance with the hazards of the mixture as a whole by an approved, qualified organization, individual, or testing laboratory.

**4.4\* Multiple Hazards.** Hazardous materials that have multiple hazards shall conform to the code requirements for each applicable hazard category.

**4.5\* Classification of Waste.** Waste comprised of or containing hazardous materials shall be classified in accordance with Sections 4.1 through 4.4 as applicable.

**4.5.1\*** Waste classified in accordance with Sections 4.1 through 4.4 shall comply with the requirements of Chapters 1 through 9 and the material-specific requirements of Chapters 11 through 21 as applicable.

**5.3.7 Detached Building Required for High Hazard Level 2 and High Hazard Level 3 Materials.** Buildings required to comply with protection level 2 or 3 and containing quantities of high hazard contents exceeding the quantity limits set forth in Table 5.3.7 shall be in accordance with 6.2.3.4 or 6.2.4.4, as applicable.

**Table 5.3.7 High Hazard Level 2 and High Hazard Level 3 Materials — Detached Building Required**

| Material                               | Class           | Maximum Quantity Without a Detached Building |                                           |
|----------------------------------------|-----------------|----------------------------------------------|-------------------------------------------|
|                                        |                 | Solids and Liquids (tons)                    | Gases scf (Nm <sup>3</sup> ) <sup>a</sup> |
| Individual bulk compressed gas systems | N/A             | N/A                                          | 15,000 (425)                              |
| Oxidizers                              | 3               | 1,200                                        | N/A                                       |
|                                        | 2               | 2,000                                        | N/A                                       |
| Organic peroxides                      | II              | 25                                           | N/A                                       |
|                                        | III             | 50                                           | N/A                                       |
| Unstable (reactive) materials          | 3, nondetonable | 1                                            | 2,000 (57)                                |
|                                        | 2               | 25                                           | 10,000 (283)                              |
| Water-reactive materials               | 3               | 1                                            | N/A                                       |
|                                        | 2, deflagrating | 25                                           | N/A                                       |
| Pyrophoric gases                       |                 | N/A                                          | 2,000 (57)                                |

For SI units, 1 ton = 0.9 met ton.

N/A: Not applicable.

[55: Table 6.5]

\*See Table 21.2.5.

**6.2 Requirements for Occupancies Storing Quantities of Hazardous Materials Exceeding the Maximum Allowable Quantities per Control Area for High Hazard Contents.**

**6.2.1 Indoor Storage General Requirements.** The requirements set forth in 6.2.1 provide general design requirements for protection levels and shall apply to buildings, or portions thereof, that are required to comply with protection level 1 through protection level 4 where required by Section 5.3, [5000:34.3.2]

**6.2.1.1 Fire Protection Systems.** Buildings, or portions thereof, required to comply with protection level 1 through protection level 4 shall be protected by an approved automatic fire sprinkler system complying with Section 13.3 of NFPA 1, *Fire Code*, [5000:34.3.2.1]

**6.2.1.1.1** The design of the sprinkler system shall be not less than ordinary hazard group 2 in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, except as follows:

- (1) Where different requirements are specified in Chapters 11 through 21 of NFPA 400
- (2) Where the materials or storage arrangement requires a higher level of sprinkler system protection in accordance with nationally recognized standards
- (3) Where approved alternative automatic fire extinguishing systems are permitted

**6.2.1.1.2** Electronic supervision of supervisory signals shall be provided in accordance with Section 13.3 of NFPA 1, *Fire Code*, [5000:34.3.2.1.1]

**6.2.1.1.3** Waterflow alarms shall be monitored in accordance with Section 13.3 of NFPA 1, *Fire Code*, [5000:34.3.2.1.2]

**6.2.1.1.4** Rooms or areas that are of noncombustible construction with wholly noncombustible contents shall not be required to comply with 6.2.1.1. [5000:34.3.2.1.3]

**6.2.1.2 Building Height Exception.** The height of a single-story building, or portion thereof, containing only tanks or industrial process equipment shall not be limited based on the type of construction. [5000:34.3.2.2]

**6.2.1.3 Separation of Occupancies Having High Hazards.** The separation of areas containing high hazard contents from each other and from other use areas shall be as required by Table 6.2.1.3 and shall not be permitted to be reduced with the installation of fire protection systems as required by 6.2.1.1, [5000:34.3.2.3]

**6.2.1.4 Egress.** Egress from areas required to comply with protection level 1, protection level 2, protection level 3, or protection level 4 shall comply with Chapter 14 of NFPA 1, *Fire Code*. [5000:34.3.2.4]

**6.2.1.4.1 Travel Distance Limit.** Travel distance to an exit from areas required to comply with protection level 1 through protection level 4 shall not exceed the distance given in Table 6.2.1.4.1, measured as required in Chapter 14 of NFPA 1, *Fire Code*. [5000:34.3.2.4.1]

Table 6.2.1.4.1 Travel Distance Limits

| Protection Level | Distance |    |
|------------------|----------|----|
|                  | ft       | m  |
| 1                | 75       | 23 |
| 2                | 100      | 30 |
| 3                | 150      | 46 |
| 4                | 175      | 53 |
| 5                | 200      | 61 |

[5000: Table 34.3.2.4.1]

**6.2.1.4.2 Capacity of Means of Egress.** Egress capacity for high hazard contents areas shall be based on 0.7 in. (18 mm) per person for stairs or 0.4 in. (10 mm) per person for level components and ramps in accordance with 14.8.3 of NFPA 1, *Fire Code*. [5000:34.3.2.4.2]

**6.2.1.4.3 Number of Means of Egress.** Not less than two means of egress shall be provided from each building, or portion thereof, required to comply with Section 6.2, unless rooms or spaces do not exceed 200 ft<sup>2</sup> (18.6 m<sup>2</sup>), have an occupant load not exceeding three persons, and have a travel distance to the room door not exceeding 25 ft (7.6 m). [5000:34.3.2.4.3]

**6.2.1.4.4 Dead Ends.** Means of egress, for other than rooms or spaces that do not exceed 200 ft<sup>2</sup> (18.6 m<sup>2</sup>), have an occupant load not exceeding three persons, and have a travel distance to the room door not exceeding 25 ft (7.6 m), shall be arranged so that there are no dead ends in corridors. [5000:34.3.2.4.4]

**6.2.1.4.5 Doors.** Doors serving high hazard contents areas with occupant loads in excess of five shall be permitted to be provided with a latch or lock only if the latch or lock is panic hardware or fire exit hardware complying with 14.5.3.3 of NFPA 1, *Fire Code*. [5000:34.3.2.4.5]

**6.2.1.5 Ventilation.** Buildings, or portions thereof, in which explosive, flammable, combustible, corrosive, or highly toxic dusts, mists, fumes, vapors, or gases are, or might be, emitted shall be provided with mechanical exhaust ventilation or natural ventilation where natural ventilation can be shown to be acceptable for the materials as stored. [5000:34.3.2.5.1]

**6.2.1.5.1** Solids and liquids stored in closed containers shall not be required to comply with 6.2.1.5. [5000:34.3.2.5.1.2]

**6.2.1.5.2** Mechanical exhaust systems shall comply with the mechanical code. [5000:34.3.2.5.2]

**6.2.1.5.3** Mechanical ventilation shall be at a rate of not less than 1 ft<sup>3</sup>/min/ft<sup>2</sup> (5.1 L/s/m<sup>2</sup>) of floor area over areas required to comply with protection level 1 through protection level 4. [5000:34.3.2.5.3]

**6.2.1.5.4** Ventilation requirements shall be determined by calculations based on anticipated fugitive emissions or by sampling of the actual vapor concentration levels under normal operating conditions. [5000:34.3.2.5.5]

**6.2.1.5.5** Make-up air shall be provided, and provision shall be made for locating make-up air openings to avoid short-circuiting the ventilation. [5000:34.3.2.5.6]

**6.2.1.5.6** Ducts conveying explosives or flammable vapors, fumes, or dusts shall extend directly to the exterior of the building without entering other spaces. [5000:34.3.2.5.7]

Table 6.2.1.3 Required Separation of Occupancies Containing High Hazard Contents (hr)

| Occupancy                        | Protection Level 1 | Protection Level 2 | Protection Level 3* | Protection Level 4 | Protection Level 5 |
|----------------------------------|--------------------|--------------------|---------------------|--------------------|--------------------|
| Apartment buildings              | NP                 | 4                  | 3                   | 4                  | 4                  |
| Assembly ≤ 300                   | NP                 | 4                  | 3                   | 2                  | 4                  |
| Assembly > 300 and ≤ 1000        | NP                 | 4                  | 3                   | 2                  | 4                  |
| Assembly > 1000                  | NP                 | 4                  | 3                   | 2                  | 4                  |
| Board and care, small            | NP                 | 4                  | 3                   | 4                  | 4                  |
| Board and care, large            | NP                 | 4                  | 3                   | 4                  | 4                  |
| Business                         | NP                 | 2                  | 1                   | 1                  | 1                  |
| Day-care > 12                    | NP                 | 4                  | 3                   | 4                  | 4                  |
| Day-care homes                   | NP                 | 4                  | 3                   | 4                  | 4                  |
| Detention and correctional       | NP                 | 4                  | 3                   | 4                  | 4                  |
| Dwellings, one- and two-family   | NP                 | 4                  | 3                   | 4                  | 4                  |
| Educational                      | NP                 | 4                  | 3                   | 2                  | 3                  |
| Health care, ambulatory          | NP                 | 4                  | 4                   | 4                  | 4                  |
| Health care, nonambulatory       | NP                 | 4                  | 4                   | 4                  | 4                  |
| Hotels and dormitories           | NP                 | 4                  | 3                   | 4                  | 4                  |
| Industrial, general purpose      | NP                 | 2                  | 1                   | 1                  | 1                  |
| Industrial, special purpose      | NP                 | 2                  | 1                   | 1                  | 1                  |
| Lodging and rooming houses       | NP                 | 4                  | 3                   | 4                  | 4                  |
| Mercantile, Class A              | NP                 | 2                  | 1                   | 1                  | 1                  |
| Mercantile, Class B              | NP                 | 2                  | 1                   | 1                  | 1                  |
| Mercantile, Class C              | NP                 | 2                  | 1                   | 1                  | 1                  |
| Mercantile, covered mall         | NP                 | 2                  | 1                   | 1                  | 1                  |
| Mercantile, bulk retail          | NP                 | 2                  | 1                   | 1                  | 1                  |
| Protection Level 1               | —                  | NP                 | NP                  | NP                 | NP                 |
| Protection Level 2               | NP                 | —                  | 1                   | 2                  | 2                  |
| Protection Level 3               | NP                 | 1                  | —                   | 1                  | 1                  |
| Protection Level 4               | NP                 | 2                  | 1                   | —                  | 1                  |
| Protection Level 5               | NP                 | 2                  | 1                   | 1                  | —                  |
| Storage, low and ordinary hazard | NP                 | 2                  | 1                   | 1                  | 1                  |

NP: Not permitted.

\*Rooms in excess of 150 ft<sup>2</sup> (14 m<sup>2</sup>) storing flammable liquids, combustible liquids, or Class 3 oxidizers are required to be provided with not less than a 2-hour separation.

[5000: Table 34.3.2.3]

**6.2.1.5.6.1** Exhaust ducts shall not extend into or through ducts and plenums. [5000:34.3.2.5.7.1]

**6.2.1.5.6.2** Ducts conveying vapor or fumes having flammable constituents less than 25 percent of their lower flammability limit shall be permitted to pass through other spaces. [5000:34.3.2.5.7.2]

**6.2.1.5.7** Emissions generated by workstations shall be removed from the areas in which they are generated by means of local exhaust installed in accordance with the mechanical code.

**6.2.1.5.8** The location of supply and exhaust openings shall be in accordance with the mechanical code. [5000:34.3.2.5.9]

**6.2.1.5.9** Systems shall operate continuously unless alternate designs are approved. [5000:34.3.2.5.11]

**6.2.1.5.10** A manual shutoff control for ventilation equipment required by 6.2.1.5 shall be provided outside the room adjacent to the principal access door to the room. [5000:34.3.2.5.12]

**6.2.1.5.11** The shutoff control described in 6.2.1.5.10 shall be of the break-glass type and shall be labeled as follows:

VENTILATION SYSTEM EMERGENCY SHUTOFF

[5000:34.3.2.5.13]

**6.2.1.5.12** Exhaust ventilation shall be arranged to consider the density of the potential fumes or vapors released. [5000:34.3.2.5.14]

**6.2.1.5.12.1** For fumes or vapors that are lighter than air, exhaust shall be taken from a point within 12 in. (305 mm) of the high point of the room or area in which they are generated.

**6.2.1.5.12.2** For fumes or vapors that are heavier than air, exhaust shall be taken from a point within 12 in. (305 mm) of the floor. [5000:34.3.2.5.14.1]

**6.2.1.5.12.3** The location of both the exhaust and inlet air openings shall be arranged to provide air movement across all portions of the floor or room to prevent the accumulation of vapors. [5000:34.3.2.5.14.2]

**6.2.1.5.12.4** Exhaust ventilation shall not be recirculated within the room or building if the materials stored are capable of emitting hazardous vapors. [5000:34.3.2.5.14.3]

**6.2.1.5.12.5** Recirculation shall be permitted where it is monitored continuously using a fail-safe system that is designed to automatically sound an alarm, stop recirculation, and provide full exhaust to the outside in the event that vapor-air mixtures in concentrations over one-fourth of the lower flammable limit are detected. [5000:34.3.2.5.14.4]

**6.2.1.5.12.6** Air contaminated with explosive or flammable vapors, fumes, or dusts, or with radioactive materials, shall not be recirculated.

**6.2.1.6\* Explosion Control.** Buildings, or portions thereof, required to comply with protection level 1 through protection level 3 and containing materials shown in Table 6.2.1.6 shall be provided with a means of explosion control. [5000:34.3.2.6]

Table 6.2.1.6 Explosion Control Requirements

| Hazard Category                                 | Class                 | Protection Method              |
|-------------------------------------------------|-----------------------|--------------------------------|
| Combustible dust presenting an explosion hazard | NA                    | Explosion control <sup>†</sup> |
| Organic peroxides                               | Unclassified          | Barricade <sup>‡</sup>         |
|                                                 | Class 1               | Barricade <sup>‡</sup>         |
| Oxidizer liquids and solids                     | Class 4               | Barricade <sup>‡</sup>         |
| Unstable (reactive)                             | Class 4               | Barricade <sup>‡</sup>         |
|                                                 | Class 3, detonating   | Barricade <sup>‡</sup>         |
|                                                 | Class 3, deflagrating | Explosion control <sup>†</sup> |
| Water-reactive liquids and solids               | Class 3               | Explosion control <sup>†</sup> |
|                                                 | Class 2, deflagrating | Explosion control <sup>†</sup> |

NA: Not applicable.

<sup>†</sup>Explosion control is required to be a deflagration prevention method, such as combustible concentration reduction or oxidant concentration reduction, or a deflagration control method complying with NFPA 69, *Standard on Explosion Prevention Systems*, or an approved, engineered deflagration-venting method.

<sup>‡</sup>Barricades are required to comply with NFPA 495, *Explosive Materials Code*.

[5000: Table 34.3.2.6]

**6.2.1.7 Limit Controls.** Limit controls shall be provided in accordance with 6.2.1.7.1 and 6.2.1.7.2.

**6.2.1.7.1 Temperature Control.** Materials that must be kept at temperatures other than normal ambient temperatures to prevent a hazardous reaction shall be provided with an approved means to maintain the temperature within a safe range.

**6.2.1.7.1.1** Redundant temperature control equipment that will operate on failure of the primary temperature control system shall be provided.

**6.2.1.7.1.2** The use of alternative means that prevent a hazardous reaction shall be permitted subject to the approval of the AHJ.

**6.2.1.7.2 Pressure Control.**

**6.2.1.7.2.1** Stationary tanks and equipment containing hazardous material liquids that can generate pressures exceeding design limits due to exposure fires or internal reaction shall have some form of construction or other approved means that will relieve excessive internal pressure.

**6.2.1.7.2.2** The termination point for piped vent systems used for the purpose of operational or emergency venting shall be located to prevent impingement exposure on the system served and to minimize the effects of high-temperature thermal radiation or the effects of contact with the material being vented from the escaping plume on the supply system, personnel, adjacent structures, and ignition sources.

**6.2.1.8 Standby and Emergency Power.**

**6.2.1.8.1** Where mechanical ventilation, treatment systems, temperature control, alarm, detection, or other electrically operated safety systems are required by this code or the building code, such systems shall be provided with standby power or emergency power as required by 6.2.1.8. [5000:34.3.2.7.1]

**6.2.1.8.2** Standby power for mechanical ventilation, exhaust treatment, and temperature control systems shall not be required where such systems are engineered and approved as fail-safe. [5000:34.3.2.7.2]

**6.2.1.8.3** The secondary source of power shall be an approved means of legally required standby power in accordance with NFPA 70, *National Electrical Code*.

**6.2.1.9 Spill Control and Secondary Containment for Hazardous Materials Liquids and Solids.**

**6.2.1.9.1 General.** Buildings, or portions thereof, required to comply with Protection Level 1 through Protection Level 4 shall be provided with spill control and secondary containment in accordance with 6.2.1.9.2 and 6.2.1.9.3, except for outdoor storage on containment pallets complying with 6.2.7.3.3.

**6.2.1.9.2 Spill Control.**

**6.2.1.9.2.1** Buildings, or portions thereof, used for storage of hazardous materials liquids in individual containers having a capacity of more than 55 gal (208.2 L) shall be provided with spill control to prevent the flow of liquids to adjoining areas.

**6.2.1.9.2.2** Where spill control is required, floors in indoor locations and similar surfaces in outdoor locations shall be constructed to contain a spill from the largest single vessel by one of the following methods:

- (1) Liquidtight sloped or recessed floors in indoor locations or similar areas in outdoor locations
- (2) Liquidtight floors in indoor locations or similar areas in outdoor locations provided with liquidtight raised or recessed sills or dikes
- (3) Sumps and collection systems

**6.2.1.9.2.3** Except for surfacing, the floors, sills, dikes, sumps, and collection systems shall be constructed of noncombustible material, and the liquidtight seal shall be compatible with the material stored.

**6.2.1.9.2.4** Where liquidtight sills or dikes are provided, they shall not be required at perimeter openings that are provided with an open-grate trench across the opening that connects to an approved collection system.

**6.2.1.9.3 Secondary Containment.**

**6.2.1.9.3.1** Buildings, or portions thereof, used for any of the following shall be provided with secondary containment:

- (1) Storage of liquids where the capacity of an individual vessel exceeds 55 gal (208.2 L) or the aggregate capacity of multiple vessels exceeds 1000 gal (3785 L)
- (2) Storage of solids where the capacity of an individual vessel exceeds 550 lb (248.8 kg) or the aggregate capacity of multiple vessels exceeds 10,000 lb (4524.8 kg)

**6.2.1.9.3.2** Buildings, or portions thereof, containing only hazardous materials in listed secondary containment tanks or systems shall not be required to comply with 6.2.1.9.3.1.

**6.2.1.9.3.3** Buildings, or portions thereof, containing only ammonium nitrate solids, organic peroxide solids, flammable solids, pyrophoric solids, or corrosive solids shall not be required to comply with 6.2.1.9.3.1.

**6.2.1.9.3.4** The building, room, or area shall contain or drain the hazardous materials and fire protection water through the use of one of the following methods:

- (1) Liquidtight sloped or recessed floors in indoor locations or similar areas in outdoor locations
- (2) Liquidtight floors in indoor locations or similar areas in outdoor locations provided with liquidtight raised or recessed sills or dikes
- (3) Sumps and collection systems
- (4) Drainage systems leading to an approved location

**6.2.1.9.3.5** Where incompatible materials are present in open containers or systems, such materials shall be separated from each other in the secondary containment system.

**6.2.1.9.3.6** Secondary containment for indoor storage areas shall be designed to contain a spill from the largest vessel plus the design flow volume of fire protection water calculated to discharge from the fire-extinguishing system over the minimum required system design area, or area of the room or area in which the storage is located, whichever is smaller, for a period of 20 minutes.

**6.2.1.9.3.7** A monitoring method shall be provided to detect hazardous materials in the secondary containment system.

**6.2.1.9.3.8** The monitoring method specified in 6.2.1.9.3.7 shall be permitted to be visual inspection of the primary or secondary containment or other approved means.

**6.2.1.9.3.9** Where secondary containment is subject to the intrusion of water, a monitoring method for detecting water shall be provided.

**6.2.1.9.3.10** Where monitoring devices are provided, they shall be connected to distinct visual or audible alarms.

**6.2.1.9.3.11** Where remote containment systems are provided, drainage systems shall be in accordance with the plumbing code, as referenced in Chapter 2, and the following provisions also shall be met:

- (1) The slope of floors in indoor locations to drains or similar areas in outdoor locations shall be not less than 1 percent.

- (2) Drains from indoor storage areas shall be sized to carry the volume of the fire protection water, as determined by the design density discharged from the automatic fire-extinguishing system over the minimum required system design area, or area of the room or area in which the storage is located, whichever is smaller.
- (3) Materials of construction for drainage systems shall be compatible with the materials stored.
- (4) Separate drainage systems shall be provided to avoid mixing incompatible materials where such materials are present in an open-use condition.
- (5) Drains shall terminate in an approved location away from buildings, valves, means of egress, fire access roadways, adjoining property, and storm drains.

**6.2.1.10 Floors in Storage Rooms.** Floors in storage areas for ammonium nitrate, organic peroxides, oxidizers, pyrophoric materials, unstable (reactive) materials, water-reactive solids and liquids, corrosive materials, and toxic and highly toxic materials shall be of liquidtight, noncombustible construction.

**6.2.1.11 Supervision of Alarm, Detection, and Automatic Fire-Extinguishing Systems.** Alarm, detection, and automatic fire-extinguishing systems required by Chapter 6 or other chapters of this code regulating hazardous materials shall be supervised by an approved central, proprietary, or remote station service or shall initiate audible and visual signals at a constantly attended on-site location.

## **6.2.2 Protection Level 1.**

**6.2.2.1 General.** Buildings, or portions thereof, required to comply with protection level 1 shall comply with 6.2.2 and the building code.

### **6.2.2.2 Detached Building Required.**

**6.2.2.2.1\*** Buildings required to comply with protection level 1 shall be used for no other purpose, shall not exceed one story in height, and shall be without basements, crawl spaces, or other under-floor spaces. [5000:34.3.3.2.1]

**6.2.2.2.2** Roofs of buildings described in 6.2.2.2.1 shall be of lightweight construction with suitable thermal insulation to prevent sensitive material from reaching its decomposition temperature. [5000:34.3.3.2.2]

**6.2.2.2.3** Buildings required to comply with both protection level 1 and protection level 4 shall comply with the most restrictive requirements for both protection levels. [5000:34.3.3.2.3]

**6.2.2.3 Minimum Distance to Property Lines or Horizontal Separation.** Buildings required to comply with protection level 1 shall be set back from property lines, or be provided with a horizontal separation in accordance with *NFPA 5000, Building Construction and Safety Code*, by a distance of not less than 75 ft (23 m) and of not less than that required by Table 6.2.2.3. [5000:34.3.3.3]

**6.2.2.3.1** Explosives that are in accordance with NFPA 495, *Explosive Materials Code*, shall not be required to comply with 6.2.2.3. [5000:34.3.3.3.1]

**6.2.2.3.2** Distances shall be measured from the perimeter wall to property lines, including those on a public way. [5000:34.3.3.3.2]

**6.2.2.3.3** Quantities of explosives used in applying Table 6.2.2.3 shall be based on equivalent pounds (kilograms) of TNT. [5000:34.3.3.3.3]

**6.2.2.4 Frangible Building.** Frangible buildings complying with 7.4.1.3.5.3 of *NFPA 5000, Building Construction and Safety Code*, shall not be required to be protected with an automatic sprinkler system. [5000:34.3.3.4]

**6.2.3 Protection Level 2.**

**6.2.3.1 General.** Buildings, or portions thereof, required to comply with protection level 2 shall comply with 6.2.1 and 6.2.3.2 through 6.2.3.5.2. [5000:34.3.4.1]

**6.2.3.2 Exterior Wall Required.**

**6.2.3.2.1** Buildings, or portions thereof, required to comply with protection level 2 shall be located on property such that not less than 25 percent of the perimeter wall is an exterior wall. [5000:34.3.4.2.1]

**6.2.3.2.2** Rooms utilized for the use, dispensing, mixing, and storage of flammable and combustible liquids having a floor area of not more than 500 ft<sup>2</sup> (46.5 m<sup>2</sup>) shall not be required to be located on the outer perimeter of the building where such rooms comply with NFPA 30, *Flammable and Combustible Liquids Code*. [5000:34.3.4.2.2]

**6.2.3.3 Minimum Distance to Property Lines or Horizontal Separation.**

**6.2.3.3.1** Buildings, or portions thereof, required to comply with protection level 2 shall be set back from property lines, or be provided with a horizontal separation in accordance with 7.3.4.2 of NFPA 5000, *Building Construction and Safety Code*, at the following distances:

- (1) Not less than 30 ft (9.1 m) where the area of the occupancy exceeds 1000 ft<sup>2</sup> (93 m<sup>2</sup>) and a detached building is not required
- (2) Not less than 50 ft (15 m) where a detached building is required by Table 5.3.7.
- (3) Not less than the distances required by Table 6.2.2.3 for buildings containing materials with explosive characteristics

[5000:34.3.4.3.1]

**6.2.3.3.2** Distances shall be measured from the walls enclosing the protection level 2 area to property lines, including those on a public way, or in accordance with 7.3.4.2 of NFPA 5000, *Building Construction and Safety Code*, for buildings on the same lot. [5000:34.3.4.3.2]

**6.2.3.4 Detached Building Required.**

**6.2.3.4.1\*** Buildings required to comply with protection level 2 and containing quantities of high hazard contents exceeding the quantity limits set forth in Table 5.3.7 shall be used for no other purpose, shall not exceed one story in height, and shall be without basements, crawl spaces, or other under-floor spaces. [5000:34.3.4.4.1]

**6.2.3.4.2** Buildings that contain high hazard level 2 contents also shall be permitted to contain high hazard level 3 or high hazard level 4 contents, provided that the materials are separated as otherwise required by the provisions of this code and NFPA 1, *Fire Code*. [5000:34.3.4.4.2]

**6.2.3.4.3** The roofs of buildings specified in 6.2.3.4.1 shall be of lightweight construction.

**6.2.3.5 Water-Reactive Materials.**

**6.2.3.5.1** Rooms or areas containing Class 2 or Class 3 water-reactive materials shall be resistant to water penetration. [5000:34.3.4.5.1]

**6.2.3.5.2** Piping for conveying water, other than fire protection piping, shall not route over or through areas containing Class 2 or Class 3 water-reactive materials, unless isolated by approved liquidtight construction. [5000:34.3.4.5.2]

**6.2.4 Protection Level 3.**

**6.2.4.1 General.** Buildings, or portions thereof, required to comply with protection level 3 shall comply with 6.2.1 and 6.2.4.2 through 6.2.4.7.2. [5000:34.3.5.1]

**6.2.4.2 Exterior Wall Required.**

**6.2.4.2.1** Buildings, or portions thereof, required to comply with protection level 3 shall be located on property such that not less than 25 percent of the perimeter wall is an exterior wall. [5000:34.3.5.2.1]

**6.2.4.2.2** Rooms utilized for the use, dispensing, mixing, and storage of flammable and combustible liquids having a floor area of not more than 500 ft<sup>2</sup> (46.5 m<sup>2</sup>) shall not be required to be located on the outer perimeter of the building where such rooms are in accordance with NFPA 30, *Flammable and Combustible Liquids Code*. [5000:34.3.5.2.2]

**6.2.4.3 Minimum Distance to Property Lines or Horizontal Separation.**

**6.2.4.3.1** Buildings, or portions thereof, required to comply with protection level 3 shall be set back from property lines, or be provided with a horizontal separation in accordance with 7.3.4.2 of NFPA 5000, *Building Construction and Safety Code*, at the following distances:

Table 6.2.2.3 The American Table of Distances for Storage of Explosives

| Quantity of Explosive Materials <sup>1,2,3,4</sup> |                 | Distances in Feet                |               |                                                                            |               |                                                                                                           |               |                                       |               |
|----------------------------------------------------|-----------------|----------------------------------|---------------|----------------------------------------------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------|---------------|---------------------------------------|---------------|
|                                                    |                 | Inhabited Buildings <sup>9</sup> |               | Public Highways Traffic Volume of 3,000 Vehicles/Day or Less <sup>11</sup> |               | Passenger Railways — Public Highways with Traffic Volume of More Than 3,000 Vehicles/Day <sup>10,11</sup> |               | Separation of Magazines <sup>12</sup> |               |
|                                                    |                 |                                  |               |                                                                            |               |                                                                                                           |               |                                       |               |
| Pounds Over                                        | Pounds Not Over | Barricaded <sup>6,7,8</sup>      | Un-barricaded | Barricaded <sup>6,7,8</sup>                                                | Un-barricaded | Barricaded <sup>6,7,8</sup>                                                                               | Un-barricaded | Barricaded <sup>6,7,8</sup>           | Un-barricaded |
| 0                                                  | 5               | 70                               | 140           | 30                                                                         | 60            | 51                                                                                                        | 102           | 6                                     | 12            |
| 5                                                  | 10              | 90                               | 180           | 35                                                                         | 70            | 64                                                                                                        | 128           | 8                                     | 16            |
| 10                                                 | 20              | 110                              | 220           | 45                                                                         | 90            | 81                                                                                                        | 162           | 10                                    | 20            |
| 20                                                 | 30              | 125                              | 250           | 50                                                                         | 100           | 93                                                                                                        | 186           | 11                                    | 22            |
| 30                                                 | 40              | 140                              | 280           | 55                                                                         | 110           | 103                                                                                                       | 206           | 12                                    | 24            |
| 40                                                 | 50              | 150                              | 300           | 60                                                                         | 120           | 110                                                                                                       | 220           | 14                                    | 28            |
| 50                                                 | 75              | 170                              | 340           | 70                                                                         | 140           | 127                                                                                                       | 254           | 15                                    | 30            |
| 75                                                 | 100             | 190                              | 380           | 75                                                                         | 150           | 139                                                                                                       | 278           | 16                                    | 32            |
| 100                                                | 125             | 200                              | 400           | 80                                                                         | 160           | 150                                                                                                       | 300           | 18                                    | 36            |
| 125                                                | 150             | 215                              | 430           | 85                                                                         | 170           | 159                                                                                                       | 318           | 19                                    | 38            |
| 150                                                | 200             | 235                              | 470           | 95                                                                         | 190           | 175                                                                                                       | 350           | 21                                    | 42            |
| 200                                                | 250             | 255                              | 510           | 105                                                                        | 210           | 189                                                                                                       | 378           | 23                                    | 46            |
| 250                                                | 300             | 270                              | 540           | 110                                                                        | 220           | 201                                                                                                       | 402           | 24                                    | 48            |
| 300                                                | 400             | 295                              | 590           | 120                                                                        | 240           | 221                                                                                                       | 442           | 27                                    | 54            |
| 400                                                | 500             | 320                              | 640           | 130                                                                        | 260           | 238                                                                                                       | 476           | 29                                    | 58            |
| 500                                                | 600             | 340                              | 680           | 135                                                                        | 270           | 253                                                                                                       | 506           | 31                                    | 62            |
| 600                                                | 700             | 355                              | 710           | 145                                                                        | 290           | 266                                                                                                       | 532           | 32                                    | 64            |
| 700                                                | 800             | 375                              | 750           | 150                                                                        | 300           | 278                                                                                                       | 556           | 33                                    | 66            |
| 800                                                | 900             | 390                              | 780           | 155                                                                        | 310           | 289                                                                                                       | 578           | 35                                    | 70            |
| 900                                                | 1,000           | 400                              | 800           | 160                                                                        | 320           | 300                                                                                                       | 600           | 36                                    | 72            |
| 1,000                                              | 1,200           | 425                              | 850           | 165                                                                        | 330           | 318                                                                                                       | 636           | 39                                    | 78            |
| 1,200                                              | 1,400           | 450                              | 900           | 170                                                                        | 340           | 336                                                                                                       | 672           | 41                                    | 82            |
| 1,400                                              | 1,600           | 470                              | 940           | 175                                                                        | 350           | 351                                                                                                       | 702           | 43                                    | 86            |
| 1,600                                              | 1,800           | 490                              | 980           | 180                                                                        | 360           | 366                                                                                                       | 732           | 44                                    | 88            |
| 1,800                                              | 2,000           | 505                              | 1,010         | 185                                                                        | 370           | 378                                                                                                       | 756           | 45                                    | 90            |
| 2,000                                              | 2,500           | 545                              | 1,090         | 190                                                                        | 380           | 408                                                                                                       | 816           | 49                                    | 98            |
| 2,500                                              | 3,000           | 580                              | 1,160         | 195                                                                        | 390           | 432                                                                                                       | 864           | 52                                    | 104           |
| 3,000                                              | 4,000           | 635                              | 1,270         | 210                                                                        | 420           | 474                                                                                                       | 948           | 58                                    | 116           |
| 4,000                                              | 5,000           | 685                              | 1,370         | 225                                                                        | 450           | 513                                                                                                       | 1,026         | 61                                    | 122           |
| 5,000                                              | 6,000           | 730                              | 1,460         | 235                                                                        | 470           | 546                                                                                                       | 1,092         | 65                                    | 130           |
| 6,000                                              | 7,000           | 770                              | 1,540         | 245                                                                        | 490           | 573                                                                                                       | 1,146         | 68                                    | 136           |
| 7,000                                              | 8,000           | 800                              | 1,600         | 250                                                                        | 500           | 600                                                                                                       | 1,200         | 72                                    | 144           |
| 8,000                                              | 9,000           | 835                              | 1,670         | 255                                                                        | 510           | 624                                                                                                       | 1,248         | 75                                    | 150           |
| 9,000                                              | 10,000          | 865                              | 1,730         | 260                                                                        | 520           | 645                                                                                                       | 1,290         | 78                                    | 156           |
| 10,000                                             | 12,000          | 875                              | 1,750         | 270                                                                        | 540           | 687                                                                                                       | 1,374         | 82                                    | 164           |
| 12,000                                             | 14,000          | 885                              | 1,770         | 275                                                                        | 550           | 723                                                                                                       | 1,446         | 87                                    | 174           |
| 14,000                                             | 16,000          | 900                              | 1,800         | 280                                                                        | 560           | 756                                                                                                       | 1,512         | 90                                    | 180           |
| 16,000                                             | 18,000          | 940                              | 1,880         | 285                                                                        | 570           | 786                                                                                                       | 1,572         | 94                                    | 188           |
| 18,000                                             | 20,000          | 975                              | 1,950         | 290                                                                        | 580           | 813                                                                                                       | 1,626         | 98                                    | 196           |
| 20,000                                             | 25,000          | 1,055                            | 2,000         | 315                                                                        | 630           | 876                                                                                                       | 1,752         | 105                                   | 210           |
| 25,000                                             | 30,000          | 1,130                            | 2,000         | 340                                                                        | 680           | 933                                                                                                       | 1,866         | 112                                   | 224           |
| 30,000                                             | 35,000          | 1,205                            | 2,000         | 360                                                                        | 720           | 981                                                                                                       | 1,962         | 119                                   | 238           |
| 35,000                                             | 40,000          | 1,275                            | 2,000         | 380                                                                        | 760           | 1,026                                                                                                     | 2,000         | 124                                   | 248           |
| 40,000                                             | 45,000          | 1,340                            | 2,000         | 400                                                                        | 800           | 1,068                                                                                                     | 2,000         | 129                                   | 258           |
| 45,000                                             | 50,000          | 1,400                            | 2,000         | 420                                                                        | 840           | 1,104                                                                                                     | 2,000         | 135                                   | 270           |
| 50,000                                             | 55,000          | 1,460                            | 2,000         | 440                                                                        | 880           | 1,140                                                                                                     | 2,000         | 140                                   | 280           |
| 55,000                                             | 60,000          | 1,515                            | 2,000         | 455                                                                        | 910           | 1,173                                                                                                     | 2,000         | 145                                   | 290           |
| 60,000                                             | 65,000          | 1,565                            | 2,000         | 470                                                                        | 940           | 1,206                                                                                                     | 2,000         | 150                                   | 300           |
| 65,000                                             | 70,000          | 1,610                            | 2,000         | 485                                                                        | 970           | 1,236                                                                                                     | 2,000         | 155                                   | 310           |
| 70,000                                             | 75,000          | 1,655                            | 2,000         | 500                                                                        | 1,000         | 1,263                                                                                                     | 2,000         | 160                                   | 320           |

Table 6.2.2.3 Continued

| Quantity of Explosive Materials <sup>1,2,3,4</sup> |                 | Distances in Feet                |               |                                                                            |               |                                                                                                           |               |                                       |               |
|----------------------------------------------------|-----------------|----------------------------------|---------------|----------------------------------------------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------|---------------|---------------------------------------|---------------|
|                                                    |                 | Inhabited Buildings <sup>9</sup> |               | Public Highways Traffic Volume of 3,000 Vehicles/Day or Less <sup>11</sup> |               | Passenger Railways — Public Highways with Traffic Volume of More Than 3,000 Vehicles/Day <sup>10,11</sup> |               | Separation of Magazines <sup>12</sup> |               |
|                                                    |                 |                                  |               |                                                                            |               |                                                                                                           |               |                                       |               |
| Pounds Over                                        | Pounds Not Over | Barricaded <sup>6,7,8</sup>      | Un-barricaded | Barricaded <sup>6,7,8</sup>                                                | Un-barricaded | Barricaded <sup>6,7,8</sup>                                                                               | Un-barricaded | Barricaded <sup>6,7,8</sup>           | Un-barricaded |
| 75,000                                             | 80,000          | 1,695                            | 2,000         | 510                                                                        | 1,020         | 1,293                                                                                                     | 2,000         | 165                                   | 330           |
| 80,000                                             | 85,000          | 1,730                            | 2,000         | 520                                                                        | 1,040         | 1,317                                                                                                     | 2,000         | 170                                   | 340           |
| 85,000                                             | 90,000          | 1,760                            | 2,000         | 530                                                                        | 1,060         | 1,344                                                                                                     | 2,000         | 175                                   | 350           |
| 90,000                                             | 95,000          | 1,790                            | 2,000         | 540                                                                        | 1,080         | 1,368                                                                                                     | 2,000         | 180                                   | 360           |
| 95,000                                             | 100,000         | 1,815                            | 2,000         | 545                                                                        | 1,090         | 1,392                                                                                                     | 2,000         | 185                                   | 370           |
| 100,000                                            | 110,000         | 1,835                            | 2,000         | 550                                                                        | 1,100         | 1,437                                                                                                     | 2,000         | 195                                   | 390           |
| 110,000                                            | 120,000         | 1,855                            | 2,000         | 555                                                                        | 1,110         | 1,479                                                                                                     | 2,000         | 205                                   | 410           |
| 120,000                                            | 130,000         | 1,875                            | 2,000         | 560                                                                        | 1,120         | 1,521                                                                                                     | 2,000         | 215                                   | 430           |
| 130,000                                            | 140,000         | 1,890                            | 2,000         | 565                                                                        | 1,130         | 1,557                                                                                                     | 2,000         | 225                                   | 450           |
| 140,000                                            | 150,000         | 1,900                            | 2,000         | 570                                                                        | 1,140         | 1,593                                                                                                     | 2,000         | 235                                   | 470           |
| 150,000                                            | 160,000         | 1,935                            | 2,000         | 580                                                                        | 1,160         | 1,629                                                                                                     | 2,000         | 245                                   | 490           |
| 160,000                                            | 170,000         | 1,965                            | 2,000         | 590                                                                        | 1,180         | 1,662                                                                                                     | 2,000         | 255                                   | 510           |
| 170,000                                            | 180,000         | 1,990                            | 2,000         | 600                                                                        | 1,200         | 1,695                                                                                                     | 2,000         | 265                                   | 530           |
| 180,000                                            | 190,000         | 2,010                            | 2,010         | 605                                                                        | 1,210         | 1,725                                                                                                     | 2,000         | 275                                   | 550           |
| 190,000                                            | 200,000         | 2,030                            | 2,030         | 610                                                                        | 1,220         | 1,755                                                                                                     | 2,000         | 285                                   | 570           |
| 200,000                                            | 210,000         | 2,055                            | 2,055         | 620                                                                        | 1,240         | 1,782                                                                                                     | 2,000         | 295                                   | 590           |
| 210,000                                            | 230,000         | 2,100                            | 2,100         | 635                                                                        | 1,270         | 1,836                                                                                                     | 2,000         | 315                                   | 630           |
| 230,000                                            | 250,000         | 2,155                            | 2,155         | 650                                                                        | 1,300         | 1,890                                                                                                     | 2,000         | 335                                   | 670           |
| 250,000                                            | 275,000         | 2,215                            | 2,215         | 670                                                                        | 1,340         | 1,950                                                                                                     | 2,000         | 360                                   | 720           |
| 275,000                                            | 300,000         | 2,275                            | 2,275         | 690                                                                        | 1,380         | 2,000                                                                                                     | 2,000         | 385                                   | 770           |

Superscript numerals refer to explanatory footnotes.

**Explanatory Notes Essential to the Application of the American Table of Distances for Storage of Explosives.**

(1) "Explosive materials" means explosives, blasting agents, and detonators.

(2) "Explosives" means any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion. A list of explosives determined to be within the coverage of Title 18, United States Code, Chapter 40, "Importation, Manufacture, Distribution and Storage of Explosive Materials," is issued at least annually by the Director of the Bureau of Alcohol, Tobacco, and Firearms of the Department of the Treasury. For quantity and distance purposes, detonating cord of 50 grains per foot should be calculated as equivalent to 8 lb (3.7 kg) of high explosives per 1000 ft (305 m). Heavier or lighter core loads should be rated proportionately.

(3) "Blasting agents" means any material or mixture consisting of fuel and oxidizer, intended for blasting, and not otherwise defined as an explosive, provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a No. 8 test blasting cap where unconfined.

(4) "Detonator" means any device containing any initiating or primary explosive that is used for initiating detonation. A detonator may not be permitted to contain more than 10 g of total explosives by weight, excluding ignition or delay charges. The term includes, but is not limited to, electric blasting caps of instantaneous and delay types, blasting caps for use with safety fuses, detonating cord delay connectors, and nonelectric instantaneous and delay blasting caps that use detonating cord, shock tube, or any other replacement for electric leg wires. All types of detonators in strengths through No. 8 cap should be rated at 1½ lb (0.7 kg) of explosives per 1000 caps.

(5) For strengths higher than No. 8 cap, the manufacturer should be consulted.

(6) "Magazine" means any building, structure, or container, other than an explosives manufacturing building, approved for the storage of explosive materials.

(7) "Natural barricade" means natural features of the ground, such as hills, or timber of sufficient density that the surrounding exposures that need protection cannot be seen from the magazine when the trees are bare of leaves.

(8) "Artificial barricade" means an artificial mound or revetted wall of earth of a minimum thickness of 3 ft (0.9 m).

(9) "Barricaded" means the effective screening of a building containing explosive materials from the magazine or another building, a railway, or a highway by a natural or an artificial barrier. A straight line from the top of any sidewall of the building containing explosive materials to the eave line of any magazine or other building or to a point 12 ft (3.7 m) above the center of a railway or highway shall pass through such barrier.

(10) "Inhabited building" means a building regularly occupied in whole or part as a habitation for human beings, or any church, schoolhouse, railroad station, store, or other structure where people are accustomed to assemble, but does not include any building or structure occupied in connection with the manufacture, transportation, storage, or use of explosive materials.

(11) "Railway" means any steam, electric, or other railroad or railway that carries passengers for hire.

(12) "Public highway" means any road, street, or way, whether on public or private property, open to public travel.

(13) Where two or more storage magazines are located on the same property, each magazine shall comply with the minimum distances specified from inhabited buildings, railways, and highways, and, in addition, they should be separated from each other by not less than the distances shown for "separation of magazines," except that the quantity of explosive materials contained in detonator magazines shall govern with regard to the spacing of said detonator magazines from magazines containing other explosive materials. If any two or more magazines are separated from each other by less than the specified "separation of magazines" distances, such magazines, as a group, shall be considered as one magazine, and the total quantity of explosive materials stored in such group shall be treated as if stored in a single magazine located on the site of any magazine of the group, and shall comply with the minimum specified distances from other magazines, inhabited buildings, railways, and highways.

(14) Storage in excess of 300,000 lb (136,200 kg) of explosive materials in one magazine generally is not necessary for commercial enterprises.

(15) This table applies only to the manufacture and permanent storage of commercial explosive materials. It is not applicable to the transportation of explosives or any handling or temporary storage necessary or incident thereto. It is not intended to apply to bombs, projectiles, or other heavily encased explosives.

(16) Where a manufacturing building on an explosive materials plant site is designed to contain explosive materials, the building shall be located at a distance from inhabited buildings, public highways, and passenger railways in accordance with the American Table of Distances based on the maximum quantity of explosive materials permitted to be in the building at one time.

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[495: Table 9.4.1 (b)]

- (1) Not less than 30 ft (9.1 m) where the area of the occupancy exceeds 1000 ft<sup>2</sup> (93 m<sup>2</sup>) and a detached building is not required
- (2) Not less than 50 ft (15 m) where a detached building is required by Table 5.3.7
- (3) Not less than the distances required by Table 34.3.3.3 of *NFPA 5000, Building Construction and Safety Code*, for buildings containing materials with explosive characteristics

[5000:34.3.5.3.1]

**6.2.4.3.2** Distances shall be measured from the walls enclosing the protection level 3 area to property lines, including those on a public way, or in accordance with 7.3.4.2 of *NFPA 5000, Building Construction and Safety Code*, for buildings on the same lot. [5000:34.3.5.3.2]

**6.2.4.4 Detached Building Required.**

**6.2.4.4.1\*** Buildings required to comply with protection level 3 and containing quantities of high hazard contents exceeding the quantity limits set forth in Table 5.3.7 shall be used for no other purpose, shall not exceed one story in height, and shall be without basements, crawl spaces, or other under-floor spaces. [5000:34.3.5.4.1]

**6.2.4.4.2** Buildings that contain high hazard level 3 contents also shall be permitted to contain high hazard level 2 or high hazard level 4 contents, provided that the materials are separated as otherwise required by the provisions of this code and NFPA 1, *Fire Code*. [5000:34.3.5.4.2]

**6.2.4.5 Detached Unprotected Building.** Where acceptable to the AHJ, based on a determination that a protected building is not practical and an assessment of acceptable risk, storage buildings required to comply with protection level 3 shall be permitted without fire protection systems, provided that the following provisions are met:

- (1) The building, or portions thereof, shall have a horizontal separation of at least 200 ft (61 m) from exposed business, industrial, mercantile, and storage occupancies on the same lot and from any property line that is or can be built upon. Where protection for exposures is provided in accordance with 6.2.4.5(9), the horizontal separation shall be at least 100 ft (30.5 m).
- (2) The building, or portions thereof, shall have a horizontal separation of at least 1000 ft (305 m) from exposed occupancies other than business, industrial, mercantile, and storage occupancies on the same lot and from any property line that is or can be built upon. Where protection for exposures is provided in accordance with 6.2.4.5(9), the horizontal separation shall be at least 500 ft (150 m).
- (3) The building shall not exceed one story in height.
- (4) The building shall not have basements, crawl spaces, or other under-floor accessible spaces.
- (5) Egress from the building shall not exceed 50 percent of the distances listed in Table 6.2.1.4.1, measured as required in 11.6.2 of *NFPA 5000, Building Construction and Safety Code*, and in compliance with 34.3.2.4.2 through 34.3.2.4.5 of *NFPA 5000, Building Construction and Safety Code*.
- (6) The building shall comply with the requirements of the following:
  - (a) 34.3.2.2 of *NFPA 5000, Building Construction and Safety Code*, for building height
  - (b) 6.2.1.5 for ventilation
  - (c) 6.2.1.6 for explosion control
  - (d) 6.2.1.8 for standby and emergency power
  - (e) 6.2.1.10 for floor construction
  - (f) Table 34.3.2.10 of *NFPA 5000, Building Construction and Safety Code*, for unprotected vertical openings

- (7) Spill control shall comply with 6.2.1.9.
- (8) Secondary containment shall comply with 6.2.1.9.3, except that containment for fire protection water shall not be required if the building is not provided with a fire protection sprinkler system.
- (9) Where credit is taken for protection for exposures in accordance with 34.3.5.5(1) and 34.3.5.5(2) of *NFPA 5000, Building Construction and Safety Code*, protection of exposures shall consist of fire protection for structures on property adjacent to the storage building that is provided by (1) a public fire department or (2) a private fire brigade maintained on the property adjacent to the storage building, either of which shall be capable of providing cooling water streams to protect the property adjacent to the storage building.

[5000:34.3.5.5]

**6.2.4.6 Roofs.** The roofs of buildings specified in 6.2.4.4.1 shall be of lightweight construction.

**6.2.4.7 Water-Reactive Materials.**

**6.2.4.7.1** Rooms or areas containing Class 2 or Class 3 water-reactive materials shall be resistant to water penetration. [5000:34.3.5.7.1]

**6.2.4.7.2** Piping for conveying water, other than fire protection piping, shall not route over or through areas containing Class 2 or Class 3 water-reactive materials, unless isolated by approved liquidtight construction. [5000:34.3.5.7.2]

**6.2.5 Protection Level 4.**

**6.2.5.1** Buildings, or portions thereof, required to comply with protection level 4 shall comply with 6.2.1 and 6.2.5.2. [5000:34.3.6]

**6.2.5.2 Highly Toxic Solids and Liquids.** Highly toxic solids and liquids not stored in approved hazardous materials storage cabinets shall be isolated from other hazardous materials storage by a 1-hour fire barrier. [5000:34.3.6.2]

**6.2.6 Protection Level 5.** In addition to the requirements set forth elsewhere in *NFPA 5000, Building Construction and Safety Code*, buildings, and portions thereof, required to comply with protection level 5 shall comply with NFPA 1, *Fire Code*, and NFPA 318, *Standard for the Protection of Semiconductor Fabrication Facilities*. [5000:34.3.7.1]

**6.2.7 Outdoor Storage.** Outdoor storage areas shall be in accordance with the requirements of Chapters 11 through 21, as applicable.

**6.2.7.1 Clearance from Combustibles.** Clearance from combustibles shall comply with 6.1.15(2).

**6.2.7.2 Weather Protection.** Where weather protection is provided for sheltering outside hazardous material storage areas, such storage areas shall be considered outside storage areas, provided that all of the following conditions are met: [5000:34.2.6]

- (1) The overhead structure shall be approved noncombustible construction with a maximum area of 1500 ft<sup>2</sup> (140 m<sup>2</sup>) except that area increases based on location or fire protection systems under the requirements of the building code shall be allowed.
- (2) Supports and walls shall not obstruct more than one side or more than 25 percent of the perimeter of the storage area.
- (3) The distance from the structure and the structural supports to buildings, lot lines, or public egress to a public way shall not be less than the distance required by Chapters 11 through 21 for an outside hazardous material storage area without weather protection.
- (4) Weather protection structures containing storage of explosive or detonable materials shall be considered indoor storage.

**6.2.7.3 Secondary Containment.**

**6.2.7.3.1 General.** Where secondary containment is required, it shall be in accordance with 6.2.1.9.3.

**6.2.7.3.2 Where Required.** Where required by Table 6.2.7.3.2, outdoor storage areas used for hazardous materials solids or liquids shall be provided with secondary containment in accordance with 6.2.1.9.3.

**6.2.7.3.3 Containment Pallets.** Where used as a substitute for spill control and secondary containment for outdoor storage in accordance with 6.2.1.9.1, containment pallets shall comply with the following:

- (1) A liquidtight sump accessible for visual inspection shall be provided.
- (2) The sump shall be designed to contain not less than 66 gal (249.8 L).
- (3) Exposed surfaces shall be compatible with the material stored.
- (4) Containment pallets shall be protected to prevent collection of rainwater within the sump.

## Chapter 15 Oxidizer Solids and Liquids

### 15.1 General.

**15.1.1** The requirements of this chapter shall apply to the storage, use, and handling of oxidizer solids or liquids when the amount of oxidizer solids or liquids exceeds the MAQ as set forth in Chapter 5 except as set forth in 15.1.1.1 and 15.1.1.2.

**15.1.1.1** The requirements of 15.3.2.1 shall apply to storage of Class 1 oxidizers where stored in quantities in excess of 4000 lb (1814.4 kg), irrespective of whether the amount of oxidizer solids or liquids exceeds the MAQs permitted in control areas.

**15.1.1.2** The requirements of 15.3.5 shall apply to the display and storage, of Class 1 through Class 3 oxidizers in mercantile, storage, or industrial occupancies where the general public has access to the material for sale and to the storage of oxidizing materials in such occupancies in areas that are not accessible to the public.

**15.1.2** The storage, use, and handling of oxidizer solids or liquids in any quantity shall also comply with the requirements of Chapters 1 through 4 and the applicable requirements of Chapters 5 through 10.

**15.1.3 Construction Requirements.** Buildings, or portions thereof, in which oxidizing liquids and solids are stored, handled, or used shall be constructed in accordance with the building code.

**15.1.4\*** The quantity and arrangement limits in this code shall not apply to the transient storage of oxidizers in process areas at plants where oxidizers are manufactured.

**15.1.5** The construction requirements of this code shall not apply retroactively to the storage of solid and liquid oxidizers in existing buildings used for the storage of oxidizers at manufacturing plants.

**15.1.6** Each class of oxidizer shall be considered independent of the others, and a facility shall be permitted to carry up to the maximum quantity for each class of material.

### 15.2 General Requirements for Storage.

**15.2.1 Spill Control.** Spill control shall be provided for oxidizer liquids in accordance with 6.2.1.9.2.

**15.2.1.1\*** Where Class 2, Class 3, or Class 4 liquid oxidizers are stored, means shall be provided to prevent the liquid oxidizer from flowing out of a storage area into an area containing incompatible materials.

**15.2.1.2\*** Spilled oxidizers, reacting oxidizers, and leaking or broken containers shall be removed immediately by a competent individual to a safe, secure, dry outside area or to a location designated by the competent individual to await disposal, in conformance with applicable regulations and manufacturer's and processor's instructions.

**15.2.1.3** Spilled materials shall be placed in a clean, separate container and shall not be returned to the original container.

**15.2.1.4** The disposal of spilled materials shall not be combined with that of ordinary trash.

**15.2.2 Drainage.** Where provided, drainage shall be in accordance with 6.2.1.9.3.11.

**15.2.3 Secondary Containment.** Secondary containment shall be provided for oxidizer solids and liquids in accordance with 6.2.1.9.3.

**15.2.4 Ventilation.** Ventilation shall be provided for Class 4 oxidizers in open containers in accordance with 6.2.1.5.

**15.2.5\* Treatment Systems. (Reserved)**

**15.2.6\* Fire Protection Systems.** An automatic fire sprinkler system shall be provided in accordance with 6.2.1.1, 15.3.2, and 15.3.5.

**15.2.6.1\* Dry Pipe and Preaction Sprinkler Systems.**

**15.2.6.1.1** Dry pipe and double-interlock preaction (DIPA) sprinkler systems shall not be permitted for protection of buildings or areas containing oxidizers except as provided for in 15.2.6.1.2 through 15.2.6.1.4.

**15.2.6.1.2** Dry pipe and DIPA systems shall be permitted for protection of Class 1 oxidizers in Type I through Type IV building construction and Class 2 and Class 3 oxidizers in detached storage in Type I and Type II construction, as specified in the building code.

**15.2.6.1.3** Dry pipe and DIPA sprinkler systems shall be permitted in mercantile occupancies when the oxidizers are stored in open-air environments, such as retail garden centers and buildings without exterior walls.

**15.2.6.1.4** For Class 3 oxidizers, the location of dry pipe and DIPA sprinkler systems shall be approved by the AHJ.

**15.2.6.2 Fire Protection Water Supplies.**

**15.2.6.2.1\*** Water supplies shall be adequate for the protection of the oxidizer storage by hose streams and automatic sprinklers.

**15.2.6.2.2** The water system shall be capable of providing not less than 750 gpm (2840 L/min) where protection is by means of hose streams, or 500 gpm (1890 L/min) for hose streams in excess of the automatic sprinkler water demand.

**15.2.6.2.3** The duration of the water supply shall be a minimum of 2 hours.

**15.2.6.3 Portable Extinguishers.**

**15.2.6.3.1\*** **Dry Chemical and CO<sub>2</sub> Extinguishers.** The placement and use of carbon dioxide (CO<sub>2</sub>) or dry chemical extinguishers containing ammonium compounds (Class A:B:C) shall be prohibited in areas where oxidizers that can release chlorine or bromine are stored.

**15.2.6.3.2\*** **Halon Extinguishers.** Halon extinguishers shall not be used in areas where oxidizers are stored.

**15.2.6.3.3\*** **Halocarbon Clean Agent Extinguishers.** Halocarbon clean agent extinguishers shall not be used in areas where oxidizers are stored, unless they have been tested to the satisfaction of the AHJ.

**15.2.7 Explosion Control.** The requirements of 6.2.1.6 shall not apply.

**15.2.8 Emergency and Standby Power.** Standby power shall be provided when required by 6.2.1.8.

**15.2.9 Limit Controls.** Limit controls shall be provided when required by 6.2.1.7.

**15.2.9.1** Oxidizers shall be separated from sources of heat, such as heating units, piping, or ducts, so that they cannot be heated to within 25°F (14°C) of their decomposition temperature or to 125°F (52°C), whichever is lower and in accordance with the manufacturer's recommendations.

**15.2.9.2** Oxidizers shall be stored so that the storage temperature cannot be within 25°F (14°C) of their decomposition temperature or 125°F (52°C), whichever is lower and in accordance with the manufacturer's recommendations.

**15.2.10\* Alarms. (Reserved)**

**15.2.11 Monitoring/Supervision.** Supervision shall be provided in accordance with 6.2.1.11.

**15.2.12\* Special Requirements.** This subsection contains specific requirements not found in Chapter 6.

**15.2.12.1** Solid oxidizers shall not be stored directly beneath liquids.

**15.2.12.2** Hydrogen peroxide (Class 2 through Class 4) stored in drums shall not be stored on wooden pallets.

**15.2.12.3** At least one side of each pile of oxidizer shall be on an aisle.

**15.2.12.4** Accumulation of combustible waste in oxidizer storage areas shall be prohibited.

**15.2.12.5** Used, empty, combustible containers that previously contained oxidizers shall be stored in a detached or sprinklered area.

**15.2.12.6** Storage shall be managed to prevent excessive dust accumulation.

**15.2.12.7 Personnel Training and Procedures.** Training and procedures shall be in accordance with 6.1.4.

**15.2.12.8 Storage Containers, Tanks, and Bins.**

**15.2.12.8.1 Shipping Containers.** Where a storage container for solid and liquid oxidizers also functions as the shipping container, the container shall meet the requirements of the U.S. Department of Transportation, 49 CFR 100 to end, or the *Canadian Ministry of Transport Regulations* (Transport Canada).

**15.2.12.8.2 Tanks and Bins.** Tanks for the storage of bulk liquid oxidizers and bins for the storage of bulk solid oxidizers shall meet the following requirements:

- (1) Materials of construction shall be compatible with the oxidizer being stored.
- (2) Tanks and bins shall be designed and constructed in accordance with federal, state, and local regulations or, as a minimum, in accordance with nationally recognized engineering practices [e.g., American Society of Mechanical Engineers (ASME), American Petroleum Institute (API)].
- (3) Tanks and bins shall be equipped with a vent or other relief device to prevent overpressurization due to decomposition or fire exposure.

**15.2.12.9 Materials Not Included.** Incompatible materials shall not include approved packaging materials, pallets, or other dunnage.

**15.2.12.10\* Contact with Water.** Oxidizers shall be stored to prevent contact with water, which can affect either container integrity or product stability.

**15.2.12.11\* Absorptive combustible packing materials** used to contain water-soluble oxidizers that have become wet during either fire or nonfire conditions, and wooden pallets that are exposed to water solutions of an oxidizer, shall be relocated to a safe outside area and shall be disposed of properly.

**15.2.12.12 Mercantile Signage for Different Classifications.** Where oxidizers having different classifications are stored in the same area, the area shall be marked for the most severe hazard class present.

**15.2.12.13 Clearance from Combustibles.** Clearance from combustible materials shall be in accordance with 6.1.15.

**15.2.12.13.1** The following shall apply where oxidizers are in segregated storage with flammable and combustible liquids:

- (1) The oxidizer containers and flammable and combustible liquid containers shall be separated by at least 25 ft (7.6 m).
- (2) The separation shall be maintained by dikes, drains, or floor slopes to prevent flammable liquid leakage from encroaching on the separation.

### 15.3 Indoor Storage.

#### 15.3.1\* Detection Systems. (Reserved)

**15.3.2 Storage Conditions/Arrangement.** Storage conditions and storage arrangements, when required, shall be in accordance with 15.3.2.

##### 15.3.2.1 Bulk Storage of Class 1 Oxidizers.

**15.3.2.1.1\* Combustible Building Materials.** Bulk storage in combustible buildings shall not come into contact with combustible building members, unless the members are protected by a compatible coating to prevent their impregnation by the oxidizer.

**15.3.2.1.2 Bulk Storage Separation.** Bulk storage, either in permanent bins or in piles, shall be separated from all other materials.

**15.3.2.1.3 Bins.** Bins shall be of noncombustible construction.

**15.3.2.1.4 Wooden Bins.** Wooden bins shall be permitted to be protected with a compatible coating to prevent impregnation of the combustible material by the oxidizer.

**15.3.2.1.5** The MAQs of oxidizer shall not be limited when the building is protected by an approved fire sprinkler system in accordance with NFPA 1, *Fire Code*, Section 13.3.

**15.3.2.2 Storage Arrangements of Class 1 Oxidizers.**

**15.3.2.2.1 Nonsprinklered Buildings.** For Class 1 oxidizers stored in nonsprinklered buildings, the minimum aisle width shall be equal to the pile height.

**15.3.2.2.2 Class 1 Oxidizers.**

**15.3.2.2.2.1 Application.** Paragraph 15.3.2.2 shall apply to storage of Class 1 oxidizers where stored in quantities in excess of 4000 lb (1814 kg), irrespective of whether the amount of oxidizer solids or liquids exceeds the MAQ.

**15.3.2.2.2.2 Storage Arrangements.** Storage in quantities identified in Table 5.2.1.1.3, Table 5.2.1.2 through Table 5.2.1.8, Table 5.2.1.10.1, Table 5.2.1.13.3(a), and Table 15.3.2.2.2(A)(a) shall be permitted in nonsprinklered buildings.

**(A) Storage of Class 1 Oxidizers.** Storage of Class 1 oxidizers shall be in accordance with Table 15.3.2.2.2(A)(a) when stored in nonsprinklered or detached unprotected buildings or in accordance with Table 15.3.2.2.2(A)(b) when stored in sprinklered buildings.

**Table 15.3.2.2.2(A)(a) Storage of Class 1 Oxidizers in a Nonsprinklered or Detached Unprotected Building**

| Storage Configurations and Allowable Distances                 | Detached Storage |              |
|----------------------------------------------------------------|------------------|--------------|
|                                                                | U.S. Units       | Metric Units |
| Building limit                                                 | NL               | NL           |
| Pile limit                                                     | 20 tons          | 18 met ton   |
| Storage height                                                 | 8 ft             | 2.4 m        |
| Pile width                                                     | 16 ft            | 4.9 m        |
| Maximum distance from any container to a working aisle         | 8 ft             | 2.4 m        |
| Distance to next pile*                                         |                  |              |
| Distance to wall†                                              | 4 ft             | 1.2 m        |
| Distance to incompatible materials and combustible commodities | NP               | NP           |

NL: Not limited. NP: Not permitted.

\*See 15.3.2.2.2(C).

†See 15.3.2.2.2(D).

**(B)** For Class 1 oxidizers stored in nonsprinklered buildings, the minimum aisle width shall be equal to the pile height.

**(C)** For Class 1 oxidizers stored in sprinklered buildings, the minimum aisle width shall be equal to the pile height, but the aisle width shall be not less than 4 ft (1.2 m) and not greater than 8 ft (2.4 m).

**(D)** There shall be no minimum distance from the pile to a wall for amounts less than 9000 lb (4082 kg).

**(E)** Class 1 oxidizers shall be permitted to be separated from ordinary combustible and incompatible materials by a solid noncombustible barrier or by a horizontal distance in accordance with Table 15.3.2.2.2(A)(a) or Table 15.3.2.2.2(A)(b).

**15.3.2.2.3\* Sprinkler Protection — Class 1.** For applying the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, Class 1 oxidizers shall be designated as follows:

- (1) Class 1 oxidizers in noncombustible or combustible containers (paper bags or noncombustible containers with removable combustible liners) shall be designated as a Class I commodity.
- (2) Class 1 oxidizers contained in fiber drums, wooden or fiber boxes or barrels, or noncombustible containers in combustible packaging shall be designated as a Class II commodity.
- (3) Class 1 oxidizers contained in plastic containers shall be designated as a Class III commodity.

**15.3.2.2.4 Class 1 Detached Storage.**

**15.3.2.2.4.1** To be considered detached, a building for storage of Class 1 oxidizers shall be separated from the following:

- (1) Flammable or combustible liquid storage
- (2) Flammable gas storage
- (3) Combustible material in the open
- (4) Any building, passenger railroad, public highway, or other tanks

**15.3.2.2.4.2** The minimum separation distance shall be 25 ft (7.6 m).

**15.3.2.3 Class 2 Oxidizers.**

**15.3.2.3.1** Paragraph 15.3.2.3 shall apply to Class 2 oxidizers where stored in quantities in excess of the MAQ permitted in control areas.

**15.3.2.3.2 Storage Arrangements of Class 2 Oxidizers.** Class 2 oxidizers shall be permitted to be separated from ordinary combustible and incompatible materials by a solid noncombustible barrier or by a horizontal distance in accordance with Table 15.3.2.3.2.3(a) when stored in detached, unprotected buildings in accordance with the building code, or in accordance with Table 15.3.2.3.2.3(b).

**Table 15.3.2.2.2(A)(b) Storage of Class 1 Oxidizers in a Sprinklered Building**

| Storage Configurations and Allowable Distances                                                | U.S. Units | Metric Units |
|-----------------------------------------------------------------------------------------------|------------|--------------|
| Building limit                                                                                | NL         | NL           |
| Pile limit                                                                                    | 200 tons   | 181 met ton  |
| Storage height                                                                                | 20 ft      | 6.1 m        |
| Pile width                                                                                    | 24 ft      | 7.3 m        |
| Maximum distance from any container to a working aisle                                        | 12 ft      | 3.7 m        |
| Distance to next pile*                                                                        |            |              |
| Distance to wall†                                                                             | 2 ft       | 0.6 m        |
| Distance to incompatible materials and combustible commodities greater than NFPA 13 Class III | 8 ft       | 2.4 m        |

NL: Not limited.

Note: If the storage is to be considered sprinklered, see Section 5.3.

\*See 15.3.2.2.2(C).

†See 15.3.2.2.2(D).

**15.3.2.3.2.1** The storage of Class 2 oxidizers shall be in a control area and at the appropriate protection level or shall be detached.

**15.3.2.3.2.2** Walls shall have a fire resistance rating as required by the building code.

**15.3.2.3.2.3 Storage of Class 2 Oxidizers.** Storage of Class 2 oxidizers shall be in accordance with Table 15.3.2.3.2.3(a) when stored in nonsprinklered or detached, unprotected buildings or in accordance with Table 15.3.2.3.2.3(b) when stored in sprinklered buildings.

**15.3.2.3.2.4** For Class 2 oxidizers stored in nonsprinklered buildings, the minimum aisle width shall be equal to the pile height.

**15.3.2.3.2.5** For Class 2 oxidizers stored in sprinklered buildings, the minimum aisle width shall be equal to the pile height, but the aisle width shall be not less than 4 ft (1.2 m) and not greater than 8 ft (2.4 m).

**15.3.2.3.2.6** For protection-level storage or detached storage under 4500 lb (2041 kg), there shall be no minimum separation distance between the pile and any wall.

**15.3.2.3.2.7\*** The building limit shall be permitted to be four times the quantities shown in Table 15.3.2.3.2.3(b) for protection level storage if noncombustible containers are used and buildings are of Type I or Type II construction as specified in the building code.

**15.3.2.3.2.8** Storage in glass carboys shall not be more than two carboys high.

**15.3.2.3.2.9 Basement Storage.**

(A) Storage in basements shall be prohibited.

(B) Where the oxidizer is stored in stationary tanks, storage in basements shall be permitted.

**15.3.2.3.2.10 Maximum Height of Storage.**

(A) Maximum storage height for nonsprinklered buildings shall be in accordance with Table 15.3.2.3.2.3(a).

(B) Maximum storage height for sprinklered buildings shall be in accordance with Table 15.3.2.3.2.3(b).

**15.3.2.3.3 Building Construction.**

**15.3.2.3.3.1** Construction materials that can come into contact with oxidizers shall be noncombustible.

**15.3.2.3.3.2** All construction materials used in stories or basements below the storage of liquid oxidizers shall be noncombustible.

**15.3.2.3.4 Sprinkler Protection.**

**15.3.2.3.4.1** Sprinkler protection for Class 2 oxidizers shall be designed in accordance with Table 15.3.2.3.2.10(B).

**15.3.2.3.4.2** Ceiling sprinklers shall be high-temperature sprinklers.

**15.3.2.3.4.3 Storage Protection with In-Rack Sprinklers.**

(A) In-rack sprinklers shall be quick-response sprinklers with an ordinary-temperature rating and have a K-factor of not less than K = 8.0.

(B) In-rack sprinklers shall be designed to provide 25 psi (172 kPa) for the six most hydraulically remote sprinklers on each level.

(C) The in-rack sprinklers shall be 8 ft to 10 ft (2.4 m to 3.0 m) spacings in the longitudinal flue space at the intersection of the transverse flue spaces.

**15.3.2.3.5 Detached Storage.**

**15.3.2.3.5.1** To be considered detached, a building for storage of Class 2 oxidizers shall be separated from the following:

- (1) Flammable or combustible liquid storage
- (2) Flammable gas storage
- (3) Combustible material in the open
- (4) Any building, passenger railroad, public highway, or other tanks

**15.3.2.3.5.2** The minimum separation distance shall be in accordance with NFPA 5000, *Building Construction and Safety Code*.

## Chapter 20 Water-Reactive Solids and Liquids

**20.1 General.** The requirements of this chapter shall apply to the storage, use, and handling of water-reactive solids or liquids when the amount of water-reactive solids or liquids exceeds the MAQ as set forth in Chapter 5. The storage, use, and handling of water-reactive solids or liquids in any quantity shall also comply with the requirements of Chapters 1 through 4 and the applicable requirements of Chapters 5 through 10.

**20.1.1 Construction Requirements.** Buildings, or portions thereof, in which water-reactive solids or liquids are stored, handled, or used shall be constructed in accordance with the building code.

### 20.2 General Requirements for Storage.

**20.2.1 Spill Control.** Spill control shall be provided for water-reactive liquids in accordance with 6.2.1.9.2.

**20.2.2 Drainage.** When provided, drainage shall be in accordance with 6.2.1.9.3.11.

**20.2.3 Secondary Containment.** Secondary containment shall be provided for water-reactive solids or liquids in accordance with 6.2.1.9.3.

**20.2.4 Ventilation.** Ventilation shall be provided for open containers in accordance with 6.2.1.5.

### 20.2.5\* Treatment Systems. (Reserved)

**20.2.6 Fire Protection Systems.** An automatic fire sprinkler system shall be provided in accordance with 6.2.1.1.

**20.2.7 Explosion Control.** Explosion control shall be provided for Class 3 and Class 2, deflagrating water-reactives in accordance with 6.2.1.6.

**20.2.8 Emergency and Standby Power.** Standby power shall be provided when required by 6.2.1.8.

**20.2.9 Limit Controls.** Limit controls shall be provided when required by 6.2.1.7.

### 20.2.10\* Alarms. (Reserved)

**20.2.11 Monitoring/Supervision.** Supervision shall be provided in accordance with 6.2.1.11.

### 20.2.12\* Special Requirements. (Reserved)

## 20.3 Indoor Storage.

### 20.3.1\* Detection Systems. (Reserved)

### 20.3.2\* Storage Conditions/Arrangement. (Reserved)

### 20.3.2.1\* Storage Limitations. (Reserved)

**20.3.3 Floors.** Floors shall be in accordance with 6.2.1.10.

**20.3.4 Detached Storage.** Detached storage shall be provided for Class 3 and Class 2, deflagrating water-reactive solids and liquids when required by 6.2.2.2, 6.2.3.4, 6.2.4.4, or 6.2.4.5.

Table 15.3.2.3.2.3(a) Storage of Class 2 Oxidizers in a Nonsprinklered or Detached Unprotected Building

| Storage Configurations and Allowable Distances                 | Control Area Storage |              | Protection Level Storage |              | Detached Storage |              |
|----------------------------------------------------------------|----------------------|--------------|--------------------------|--------------|------------------|--------------|
|                                                                | U.S. Units           | Metric Units | U.S. Units               | Metric Units | U.S. Units       | Metric Units |
| Building limit                                                 | 2,250 lb             | 1,022 kg     | 9,000 lb                 | 4,086 kg     | 100,000 lb       | 45,400 kg    |
| Pile limit                                                     |                      |              |                          |              | 20,000 lb        | 9,080 kg     |
| Storage height                                                 | 6 ft                 | 1.8 m        | 8 ft                     | 2.4 m        | 8 ft             | 2.4 m        |
| Pile width                                                     | 8 ft                 | 2.4 m        | 12 ft                    | 3.7 m        | 16 ft            | 4.9 m        |
| Maximum distance from any container to a working aisle         | 4 ft                 | 1.2 m        | 6 ft                     | 1.8 m        | 8 ft             | 2.4 m        |
| Distance to next pile*                                         |                      |              |                          |              |                  |              |
| Distance to wall                                               | 4 ft                 | 1.2 m        | 4 ft                     | 1.2 m        | 4 ft             | 1.2 m        |
| Distance to incompatible materials and combustible commodities | 12 ft                | 3.7 m        | NP                       | NP           | NP               | NP           |

NP: Not permitted.

\*See 15.3.2.3.2.4.

Table 15.3.2.3.2.3(b) Storage of Class 2 Oxidizers in a Sprinklered Building

| Storage Configurations and Allowable Distances                 | Control Area Storage |              | Protection Level Storage |              | Detached Storage |              |
|----------------------------------------------------------------|----------------------|--------------|--------------------------|--------------|------------------|--------------|
|                                                                | U.S. Units           | Metric Units | U.S. Units               | Metric Units | U.S. Units       | Metric Units |
| Building limit                                                 | MAQ                  | MAQ          | 2000 tons                | 1814 met ton | NL               | NL           |
| Pile limit                                                     | NA                   | NA           | 100 tons                 | 91 met ton   | 200 tons         | 181 met ton  |
| Storage height <sup>a</sup>                                    |                      |              |                          |              |                  |              |
| Pile width                                                     | 16 ft                | 4.9 m        | 25 ft                    | 7.6 m        | 25 ft            | 7.6 m        |
| Maximum distance from any container to a working aisle         | 8 ft                 | 2.4 m        | 12 ft                    | 3.7 m        | 12 ft            | 3.7 m        |
| Distance to next pile <sup>b</sup>                             |                      |              |                          |              |                  |              |
| Distance to wall <sup>c</sup>                                  | 2 ft                 | 0.6 m        | 2 ft                     | 0.6 m        | 2 ft             | 0.6 m        |
| Distance to incompatible materials and combustible commodities | 12 ft                | 3.7 m        | NP                       | NP           | NP               | NP           |

MAQ: Maximum allowable quantity. NL: Not limited. NA: Not applicable. NP: Not permitted.

Note: If the storage is considered to be sprinklered, see 15.3.2.3.4.

<sup>a</sup>See 15.3.2.3.2.10(A) and Table 15.3.2.3.2.10(B).<sup>b</sup>See 15.3.2.3.2.5.<sup>c</sup>See 15.3.2.3.2.6.

Table 15.3.2.3.2.10(B) Ceiling Sprinkler Protection for Class 2 Oxidizers in Palletized or Bulk and Rack Storage Areas

| Type of Storage    | Ceiling Sprinklers |     |                     |                       |                     |                | In-Rack Sprinklers                                         |
|--------------------|--------------------|-----|---------------------|-----------------------|---------------------|----------------|------------------------------------------------------------|
|                    | Storage Height     |     | Density             |                       | Area of Application |                |                                                            |
|                    | ft                 | m   | gpm/ft <sup>2</sup> | L./min/m <sup>2</sup> | ft <sup>2</sup>     | m <sup>2</sup> |                                                            |
| Palletized or bulk | 8                  | 2.4 | 0.20                | 8                     | 3750                | 348            | —                                                          |
| Palletized or bulk | 12                 | 3.7 | 0.35                | 14                    | 3750                | 348            | —                                                          |
| Rack               | 12                 | 3.7 | 0.20                | 8                     | 3750                | 348            | One line above each level of storage, except the top level |
| Rack               | 16                 | 4.9 | 0.30                | 12                    | 2000                | 186            | One line above each level of storage, except the top level |