Engineering Standard

SAES-B-014 29 February, 2004

Safety Requirements for Plant and Operations Support Buildings

Saudi Aramco DeskTop Standards

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1 Scope

SAES includes the minimum mandatory safety requirements governing the siting, design, and construction of (a) all onshore in-plant buildings, (b) out-of-plant buildings within 500 m of a plant perimeter fence, (c) offshore buildings, with SAES-B-009 taking precedence over SAES-B-014 in case of conflicts, and (d) service buildings, whether inside or outside of plants, that directly support in-plant operations, such as communications facilities, centralized computer facilities, and electrical substations. Where SAES-B-014 is in conflict with the specialized requirements of SAES-B-060 or SAES-B-070, those Standards shall govern.

2 Conflicts and Deviations

2.1 Any conflicts between this Standard and applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the company or buyer representative through the Manager, Loss Prevention Department of Saudi Aramco, Dhahran.

2.2 Direct all requests to deviate from this Standard in writing to the company or buyer representative, who shall follow internal company procedure SAEP-302 and forward such requests to the Manager, Loss Prevention Department of Saudi Aramco, Dhahran.

3 References

The selection of material and equipment and the design, construction, maintenance, and repair of buildings covered by this SAES shall meet the latest edition of the references listed below, unless otherwise noted.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

SAEP-302	*Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement*

Saudi Aramco Engineering Standards

SAES-B-006	*Fireproofing for Plants*
SAES-B-008	*Restrictions to use of Cellars, Pits, and Trenches*
SAES-B-009	*Fire Protection and Safety Requirements for Offshore Production Facilities*

SAES-B-017	*Fire Water System Design*
SAES-B-019	*Portable, Mobile, and Specialized Fixed Firefighting Equipment*
SAES-B-054	*Access, Egress, and Materials Handling for Plant Facilities*
SAES-B-055	*Plant Layout*
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SAES-B-068	*Electrical Area Classification*
SAES-B-070	*Bulk Plants and Air Fueling Terminals*
SAES-J-502	*Analyzer Shelters*
SAES-J-505	*Combustible Gas and Hydrogen Sulfide in Air Detection Systems*
SAES-J-801	*Control Buildings*
SAES-K-001	*Heating, Ventilation and Air Conditioning (HVAC)*
SAES-K-002	*Air Conditioning Systems for Essential Operating Facilities*
SAES-K-003	*Air Conditioning Systems for Communications Buildings*
SAES-K-100	*Saudi Aramco Mechanical (HVAC) Code*
SAES-L-100	*Applicable Codes and Standards for Pressure Piping Systems*
SAES-M-009	*Design Criteria for Blast Resistant Buildings*
SAES-M-100	*Saudi Aramco Building Code*
SAES-P-119	*Onshore Substations*
SAES-P-121	*Transformers, Reactors, Voltage Regulators*
SAES-S-020	*Industrial Drainage and Sewers*
SAES-T-916	*Telecommunications Building Cable Systems*

3.2 Industry Codes and Standards

American Petroleum Institute

API RP 752	*Management of Hazards Associated with Locations of Process Plant Buildings*

American Society for Testing & Materials

ASTM E814	*Fire Tests of Through-Penetration Fire Stops*

American Society of Mechanical Engineers

ASME Z97.1	*American National Standard for Safety Glazing Materials Used In Buildings - Safety Performance Specifications and Methods of Test*

Building Industry Consulting Services International

BICSI, TDMM	*Building Industry Consulting Services International, TDMM (Telecommunications Distribution Methods Manual)*

National Fire Protection Association

NFPA 13	*Installation of Sprinkler Systems*
NFPA 30	*Flammable and Combustible Liquids Code*
NFPA 45	*Fire Protection for Laboratories Using Chemicals*
NFPA 49	*Hazardous Chemicals Data*
NFPA 70	*National Electrical Code*
NFPA 72	*National Fire Alarm Code*
NFPA 75	*Protection of Electronic Computer / Data Processing Equipment*
NFPA 80	*Fire Doors and Fire Windows*
NFPA 90A	*Air Conditioning and Ventilating Systems*
NFPA 101	*Life Safety Code*
NFPA 231	*General Storage*
NFPA 231C	*Rack Storage of Materials*
NFPA 251	*Fire Endurance of Building Construction and Materials*
NFPA 255	*Surface Burning Characteristics of Building Materials*

4 Definitions

Classified Location: Per SAES-B-068, a location in which:

1) ignitable concentrations of combustible gases or vapors may exist under normal, abnormal, or upset conditions; or

2) ignitable concentrations of such gases or vapors may exist frequently because of leakage; or

3) breakdown or faulty operation of equipment or processes might release ignitable concentrations of combustible gases or vapors, and might also cause simultaneous failure of electric equipment.

Critical Communications Facilities: Facilities in support of telephone, radio, or other communications links that serve vital communication functions for Saudi Aramco, the loss of which will have serious and immediate impact on oil/gas operations or the ability to operate safely. This includes communication facilities in major locations (central office facilities) and any satellite facilities where there is no alternate routing or back-up equipment.

Firestops: Blocks of solid construction at regular intervals in concealed spaces to restrict passage of fire and smoke. For example, firestops are required in openings around electrical penetrations through fire-resistant rated walls, partitions, floors, or ceilings in order to maintain the fire resistance rating per NFPA 70.

Fire-Hazardous Zone: See SAES-B-006 for definition.

High-Population Building: Any building, such as a main office building, mosque, cafeteria, or training building, that can be expected to contain 25 or more people at any time.

Hot Cut-Over: The energizing of a new control system in conjunction with deactivation of the old system while the plant is operating.

I/O Rack Room: A room with essential electronics equipment to support the process facilities. Data acquisition and control functions are interpreted, translated, and controlled by this equipment. I/O refers to input/output, or sending and receiving of data.

In-Plant Buildings, also referred to as Plant Buildings: Buildings that are inside a plant perimeter fence (see plant perimeter definition below). Gate houses shall be treated as in-plant buildings. For the purposes of this Standard, buildings inside bulk plants and loading/unloading terminals governed by SAES-B-070 shall be considered in-plant buildings (see 5.8).

Listed: Equipment, materials, or services that have been tested and found suitable for the specified use by an independent testing lab such as Underwriter Laboratories (UL) or FM (Factory Mutual).

Main Office Building: An office building that contains offices for 25 or more people who perform engineering or administrative activities not directly supporting day-to-day operations of a plant.

Nonclassified Location: A location that is completely outside electrically classified locations; see SAES-B-068.

Noncombustible: Material that will not ignite, burn, supports combustion, or release flammable vapors when subjected to spark, fire or heat. No material shall be classed as noncombustible that is subject to an increase in combustibility or flame-spread rating through the effects of age, moisture, or other atmospheric condition.

Operator Shelter: A small single-level building or shelter used by, and usually only by, plant operators during regular working hours, usually located in the operating unit that they are attending.

Out-of-Plant Buildings: Buildings that are outside the plant perimeter fence.

Plant Perimeter Fence: A SSD type security fence or, in the absence of a SSD fence, the fence which completely surrounds a plant area designated by Saudi Aramco. See SAES-L-100 for other related definitions.

Process Interface Building (PIB): A building that houses essential electronics equipment for control function interface and monitoring of process facilities. These buildings serve the same purpose as I/O rack rooms.

Potentially Toxic Material: A liquid, gas, or solid with a total concentration of 5% or greater of materials with a Health Hazard Category rating of "2" or greater per NFPA 49 or the Saudi Aramco Chemical Hazards Bulletin at any operating conditions.

Satellite Instrument House (SIH): See Process Interface Building (PIB).

Temporary Buildings: Prefabricated buildings, modular buildings, trailers, or other structures used in support of construction or maintenance activities and not intended to be used for the life of the facility (see Section 12).

Team Building: An office building used by operations, maintenance, and support staff, and sometimes including other support functions such as maintenance shops.

Toxic Material: For the purposes of this Standard, toxic materials include ammonia, hydrogen sulfide, or any similar material. See SAES-B-014, Appendix A5.2 for more information about toxic hazards.

5 General Requirements

5.1 Nonessential Personnel

High-population buildings for personnel not essential to day-to-day plant operations shall be located 500 m or more outside the plant perimeter fence.

5.2 Building Risk Assessment

If any one of the following conditions are applicable, a building risk assessment shall be done:

a) A building is to be located inside the plant perimeter fence.

b) An out-of-plant building is located in a zone predicted to receive at least 3.5 kPa gauge (0.5 psig) peak side-on overpressure from a vapor cloud explosion if one were to occur.

c) Process units are added or existing process units are expanded. The building risk assessment required for new or expanded process units shall include all buildings exposed to a minimum of 3.5 kPa gauge (0.5 psig) side-on overpressure from the new or expanded process units.

d) Toxic materials released to the atmosphere in process plants can affect building occupants (Appendix A5.2 for more details).

e) An existing building is changed such that the new occupancy or building functionality would require a stage two assessment as outlined in Appendix I, Section A4.1.

Commentary Note:

New or expanded process units may result in unacceptable hazards to existing buildings. When new process units are added or existing process units are expanded, a building risk assessment of surrounding buildings is necessary to assess these hazards and identify any appropriate risk mitigation measures.

The building risk assessment shall evaluate the explosion, fire, and toxic release hazards using the three-stage process outlined by API RP 752. The assessment shall be prepared by an organization specializing in and experienced with API RP 752.

The building risk assessment shall identify and recommend risk-reduction measures for buildings that are subject to unacceptable consequences, whether to people or critical equipment, from potential vapor cloud explosion (VCE), fire, and toxic gas hazards. Future plant equipment that is planned or is likely to be installed shall be considered in the assessment.

Occupancy criteria, functionality criteria, consequence assessment limits, and other assessment criteria shall be as specified in Appendix 1. Additional guidance, if needed, shall be sought from the Chief Fire Prevention Engineer or his representative.

Risk reduction measures shall be implemented as needed and approved by the Chief Fire Prevention Engineer or his representative; the Supervisor, Civil Engineering Unit, Consulting Services Department (CSD), Dhahran; and the Proponent Operating Department.

Commentary Note:

For buildings that that were built without a risk assessment and would require screening now according to this Standard, those buildings should be assessed using the process outlined by API RP 752 and this Standard. This screening study should be introduced as an agenda item in each facility Safe Operations Committee (SOC). Recommendations from the completed screening study should then be prioritized and acted upon by the SOC.

5.3 Blast-Resistant Construction

5.3.1 In conjunction with the risk assessment above, simulation of potential blasts using a method acceptable to the Chief Fire Prevention Engineer or his representative shall be carried out and the results submitted for approval before the start of design. The simulation shall be used to select blast overpressure and duration for the structural design basis. The simulation shall take into account existing process equipment and future expansion.

5.3.2 Where blast-resistant construction is required for risk mitigation pursuant to the building risk assessment, the design shall meet SAES-M-009. Details shall be provided to the company representative for review and comment by the Supervisor, Civil Engineering Unit, Consulting Services Department (CSD), Dhahran, and by the Chief Fire Prevention Engineer or his representative. Any resulting recommendations shall be implemented in the location, orientation, or design of the building.

5.4 Building Location

5.4.1 Plant buildings shall be located on the periphery of process facilities at a predominately upwind or crosswind location when practicable. Prevailing wind direction shall be based on a wind rose diagram for that location.

5.4.2 Buildings shall not be located in electrically classified or fire-hazardous areas.

Exception:

Analyzer shelters may be located in such areas as permitted by SAES-J-502.

5.5 Building Code

All permanent buildings in the scope of this Standard shall meet the requirements of SAES-M-100 and this Standard. Where this Standard's requirements exceed those of SAES-M-100, this Standard shall govern. For temporary buildings, see Section 12.

5.6 Buildings with below-grade cellar, basement, or cable vault shall meet SAES-B-008.

5.7 Noncombustible Construction

In-plant buildings shall be constructed of noncombustible materials, except that a roof may contain combustible materials to the extent allowed in Section 5.9 of this Standard. Materials used for interior construction (suspended ceilings, partitions, interior doors, raised floors, etc.) shall be of noncombustible materials.

5.8 Windows

External windows are prohibited for in-plant buildings and all out-of-plant buildings located near enough to a plant where it is possible to receive 3.5 kPa gauge (0.5 psig) peak side-on overpressure or more from a vapor cloud explosion.

Exceptions:

a) If the risk assessment shows that the risk exposure of the building to overpressure is acceptably low as determined under Section 5.2.

b) Operator shelters that are specifically designed for personnel protection and for monitoring of a process facility or bulk plant operation such as truck loading. Personnel protection against any overpressures anticipated by the risk assessment shall be included in the sizing and design of the windows.

c) A small inspection window is allowed in analyzer shelter doors. The window shall not exceed 0.065 m^2 (100 in^2) in area.

d) Security gate and x-ray houses.

At a minimum, double glazing with tempered glass, internal lamination, a catch system for the glass using anchored cables or wrap bars, and paragraph 6.2.2

shall be met for windows allowed by this exception. The design details of these windows shall be provided to the company representative for approval by the Supervisor, Civil Engineering Unit, Consulting Services Department (CSD), Dhahran, and by the Chief Fire Prevention Engineer or his representative.

5.9 Roof and Decks

5.9.1 Roofing systems shall be restricted to listed Underwriters Laboratories (UL) Class A or B or Factory Mutual (FM) Class 1 or 2 systems. Only roofing systems with proven fire-resistive performance shall be used. Spray-applied foam systems are prohibited.

5.9.2 Roof decks shall be metal or concrete.

5.9.3 Roof systems shall be leak tested per SAES-M-100.

5.10 Documentation and Response Plans

5.10.1 Written instructions shall be provided for the initial start-up and continued operation of building fire detection and fire protection systems. Copies of relevant as-built P&IDs (Process and Instrument Diagrams), instrument loop drawings, vendor's manuals, and other required drawings shall be furnished to the Proponent Operating Department and to the Chief Fire Prevention Engineer or his representative. Additional copies of the as-built documentation shall be provided for the use of on-site operations and maintenance personnel.

5.10.2 Operations, maintenance, and operations engineering personnel shall receive initial and continued training on the fire detection and protection systems. Initial training shall be undertaken by the project installing the system. The Proponent Operating Department shall establish a program to continue training.

5.10.3 Proper operator response to smoke, fire, smoke alarms, fire alarms, or trouble alarms shall be described in a written response plan. The response plan shall be kept up-to-date.

Commentary Note:

For existing facilities, a response plan should be implemented if one does not exist. Areas that have a plan should review it every two to three years and keep it up-to-date.

5.10.4 A clearly labeled copy of the written response plan and instructions for operation of the fire detection and fire protection systems shall remain in the plant training area and in an appropriate on-site location.

5.10.5 Evacuation plans shall be provided inside complex control room buildings over 1000 m² to meet NFPA 75. The evacuation plan shall include drawings that show routing to the nearest exit and location of the associated building exterior assembly area. The drawings shall be posted in the main exit corridors and the control room.

5.10.6 These instructions shall be updated with all modifications in the fire detection and protection system. Redlined (up-to-date) copies of all revised drawings shall be kept on-site until formal revisions are issued to replace them.

5.11 Analyzer Shelters

Interiors of analyzer shelters handling flammable liquids or combustible gases shall be electrically classified to meet SAES-J-502. Gas alarms shall consist of interior and exterior local audible alarm and exterior beacon. Alarms shall be annunciated in an attended control building. Other requirements are in SAES-J-502.

5.12 Equipment Shelters

Air intakes to air compressors, internal combustion engines, inert gas generators, or other equipment within enclosed or partially enclosed buildings shall be located outside the building and at least 4.5 m above the classified electrical area and at least 7.5 m above grade.

Exception:

In facilities where no hydrocarbons are being handled, elevating the air intakes is not required and, provided that the building ventilation is designed adequately for it, the air intake may be inside a building.

5.13 Substations, motor control centers, and other rooms that contain electrical connect and disconnect equipment shall have doors that open outwards. Panic hardware shall be installed on the doors. Exceptions shall be approved by the Chief Fire Prevention Engineer or his representative.

5.14 Battery Rooms

a) Battery rooms shall be provided with an addressable spot-type smoke detection system.

b) False ceilings shall not be used.

c) An eye-wash with drain shall be installed to meet SAES-B-069.

d) All battery installations shall otherwise meet SAES-P-103, Section 6.

6 Fire Containment/Separation

6.1 Essential Electronics Equipment Rooms

6.1.1 Two-hour fire-resistant separation shall be provided to separate essential electronics equipment rooms such as communications rooms, I/O rack rooms, process interface equipment rooms in PIBs, computer rooms, and operator console rooms from other-use rooms in the same building. Examples of other-use rooms are store rooms, closets, libraries, kitchens, toilets, mechanical rooms, electrical switchgear rooms, laboratories, workshops, and offices or spaces which may be used as office space. The two-hour fire-resistant separation shall be of materials or assemblies that have withstood a fire test exposure per NFPA 251. Masonry construction is preferred. Any essential electronics equipment room shall not exceed 1,500 m^2. Any such room exceeding 1,500 m^2 shall be subdivided by a wall of two-hour fire-resistant construction, and any ducting penetrating this fire wall must be protected with smoke/fire dampers that activate on either smoke or heat from either side of the wall.

6.1.2 Essential electronics equipment rooms shall meet the requirements of NFPA 75.

Exceptions:

a) Materials of construction for in-plant buildings shall be noncombustible, per paragraph 5.7 of SAES-B-014. For out-of-plant buildings, the maximum allowable flame spread rating is 25; noncombustible materials are preferred.

b) Where other conflicts exist between NFPA 75 and SAES-B-014, the latter shall prevail.

6.1.3 Essential electronics equipment rooms shall not have steam, water (except for fire sprinkler piping), or horizontal drain piping located in the space above a suspended ceiling, over I/O racks, or over computer equipment.

6.1.4 Firestops shall be installed in openings around penetrations through fire-resistant rated walls, partitions, floors, or ceilings in order to maintain the fire resistance rating. Building communications cable and electrical penetration firestopping shall meet SAES-T-916, BICSI TDMM, SAES-M-100, and NFPA 70, as applicable. The firestop materials shall be listed for the specific application they are to be used for and shall meet ASTM E814 or other fire resistance test acceptable to the Chief Fire Prevention Engineer or his representative.

6.1.5 Fire-resistant separation shall extend from the subfloor slab to the underside of the next fire-rated floor above or to the underside of the roof.

6.1.6 Carpeting is prohibited in essential electronics equipment rooms, electrical substations, and switchgear rooms. Carpeting without rubber backing is allowed in adjacent other-use rooms such as offices and libraries.

6.1.7 Finishes such as wall coverings, wall panels and wall paints, and furnishings such as desks, area dividers, work station cabinetry, consoles, shrouds, enclosures, and cabinets in essential electronics equipment rooms, electrical substations and switchgear rooms shall be noncombustible. When use of a noncombustible finish item is not practicable, the flame spread index shall be 25 or less per NFPA 255. Combustibility of these items and consumable items such as for paper goods stock, records, and other combustibles shall also be minimized in all other-use areas adjacent to the above areas.

Exception:

There are no chairs that are rated to meet 6.1.7. However, chairs using fire resistant materials should be provided to the extent that it is possible.

6.1.8 Closeable metal cabinets shall be provided in essential electronics equipment rooms, electrical substations, and switchgear rooms for combustible materials needed for day-to-day operations. Metal self-extinguishing waste bins shall be used; combustible waste bins are prohibited. These essential electronics equipment areas shall be dedicated areas and shall not be used for other purposes, such as document storage or extra office space. Storage for paper goods stock, records, and other combustibles shall be provided elsewhere.

6.2 Doors and Windows in Fire Walls

6.2.1 Interior doors, door frames, and window frame assemblies shall be made of steel and fire-rated for the appropriate fire-separation rating of the fire wall they penetrate, as specified in SAES-M-100 and NFPA 80.

6.2.2 Internal and (where allowed) external windows shall have a minimum of 6 mm (¼ in) thick glass that is wired, tempered, or laminated safety glass. The glass shall meet all fire-resistive regulations and safety performance requirements of SAES-M-100 and ASME Z97.1 and shall be labeled as such by the supplier.

6.2.3 Exterior doors and all interior doors penetrating fire walls shall be equipped with automatic, quick-acting, adjustable door closers. The door closer shall be adjusted to close the door within five (5) seconds except that blast doors may be adjusted to close within fifteen (15) seconds. The doors shall be kept closed and sign-posted to meet the requirements of SAES-M-100.

6.3 Transformers

Oil-filled transformers shall meet the fire separation requirements in SAES-P-121, 6.4, and the drainage requirements of SAES-S-020 where applicable. For oil containment and collection requirements of electrical substations, refer to SAES-P-119.

6.4 HVAC

6.4.1 Smoke/fire dampers in HVAC ducts that penetrate fire walls shall meet the requirements of SAES-K-001 and NFPA 90A. Also see requirements under 6.1.1.

6.4.2 Air-conditioning for rooms that contain primarily installed and operating computer or data processing equipment, other than PCs, shall be dedicated, in accordance with NFPA 75. For other essential electronics equipment rooms such as communications rooms, I/O rack rooms, PIBs, and operator console rooms, air-conditioning shall be segregated from laboratories and substations. Individual exhaust air systems shall be provided for battery rooms, laboratories, and toilet areas. The exhaust duct from each of these rooms (battery, laboratory, toilet) shall not be combined with any other exhaust duct.

6.4.3 Circuit breakers for air-handling equipment shall be clearly identified with permanent labels that indicate which rooms and fire zones are served by each breaker.

6.5 In rooms with raised floors, an extra tile lifter reserved for emergency use only shall be mounted near the room entrance and in a well-marked mounted case. A car-sealed or break-glass-type case shall be used.

6.6 All debris shall be cleared from the ceiling and subfloor areas, and the subfloor area shall be vacuum-cleaned before plant startup or prior to hot cut-overs.

Commentary Note:

Modifications of existing buildings to improve fire separation are relatively low cost, yet very effective in keeping fire losses low. It is recommended that Section 6 requirements be applied to existing facilities as well as new ones, except that it

probably is not cost-effective to add fire walls in existing buildings (this is not to be interpreted as an exemption for fire walls required by NFPA 101 or SAES-M-100). Instead, analyze where fire separation may have been compromised and reinstate those separations. Replace fire doors that may have been removed from fire-rated corridors. Remove doorstops from fire doors. Confirm that firestops are located in cable runs where needed. Remove or seal nonrated windows and other penetrations that have been installed in fire walls. Minimize combustible materials in all subject areas.

7 Fire Detection and Alarm Systems

7.1 Control buildings, PIBs, SIHs, UPS rooms, and communications buildings/rooms shall have a fire detection and alarm system. Other buildings in the scope of this Standard shall have a fire detection and alarm system if required by SAES-M-100.

7.2 Signal initiation, transmission, notification, and annunciation shall be designed and installed to meet the levels of performance, extent of redundancy, and quality of installation required by NFPA 72. Drawings of this system shall bear the seal of the responsible registered professional engineer or chartered engineer, who shall have at least five years of experience in the design of fire detection and alarm systems.

7.3 Fire detection and alarm systems for in-plant buildings shall include a listed interior and exterior local audible alarm and listed exterior visual beacon. The beacon shall be positioned so that it is not blocked by adjacent buildings or structures to the extent possible. The system shall alarm at a local, dedicated, listed fire alarm panel in the building. All sensing devices shall be individually identifiable (addressable) at the local fire panel. If the building is not a control building, the system shall also send a common alarm to the control room for that plant area either via the plant DCS system or hardwired to a dedicated fire alarm annunciator in the control room.

Commentary Note:

Beacon color shall follow plant precedent; otherwise, fire alarm beacon color shall be red.

7.4 The local fire alarm panel for in-plant buildings shall be located at the building entrance or air lock, except that, for small stand-alone control rooms such as those at GOSPs, the local fire panel may be located in the control room near the exit door.

7.5 In communications facilities, control rooms, and I/O rack rooms, smoke detection shall continuously monitor subfloor spaces, room areas, and above suspended ceilings. The end devices shall be point-type addressable spot-type smoke detectors. All sensing devices shall be addressable (individually

identifiable) to the local panel. If these subfloor spaces and above suspended ceiling areas are used as air plenums, special consideration shall be given to design and spacing for warning of fire in high air-movement areas.

7.6 Interiors of floor-mounted I/O, ESD, UPS, and other digital cabinets containing power supplies shall be monitored by an addressable high-sensitivity air-sampling or point-type smoke detection system. The detection systems shall have at least two adjustable set points. All sensing devices shall be addressable to the local fire panel. Two or more cabinets bolted together side-by-side with free air movement between cabinets may need only one air-sampling tube per row of cabinets, as determined by the detection system designer. Doors to cabinets shall be provided with permanent labels or signs reading in Arabic and English, "In order to ensure proper operation of smoke detection system, keep cabinet door closed", or words to that effect. As an alternative to individual door labels, wall signs in Arabic and English may be installed in each cabinet area.

Commentary Notes:

For existing facilities, the retrofit of high-sensitivity smoke detection systems is recommended only if the existing detection system is failing and needs to be replaced. If a major upgrade is done to the facility, a high-sensitivity smoke detection system shall be installed at that time.

The signal from high-sensitivity smoke detection systems for the I/O, ESD, UPS, and other digital cabinets are normally alarm only; the signal should not control any other systems such as shut-down building air conditioning.

Each cabinet requires an individually identifiable smoke detection end device so that the fire panel will identify which specific cabinet is generating the alarm. This allows for the rapid manned response which is necessary for adequate protection.

All outputs, including the trouble signal, go to the local building fire alarm panel (FAP). The local FAP, per 7.3, will send a common alarm to the control room for that plant area either via the plant DCS system or hardwired to a dedicated fire alarm in the control room.

Air sampling tubes or pipes for high sensitivity smoke detection systems shall be steel or otherwise have a flame spread rating not over 25 without evidence of continued progressive combustion and a smoke developed rating no higher than 50 or otherwise be UL listed specifically for air sampling smoke detector service. Use of unrated PVC pipe or tubing is not allowed.

7.7 All telecommunications rooms (telecommunications entrance facilities, telecommunication equipment rooms, and telecommunications closets), whether critical or noncritical, shall have a fire detection and alarm system that includes

a high-temperature alarm indication relayed to the Networks Operations Control Center (NOCC).

7.8 Smoke Detection for Electrical Substations

Electrical substations over 100m² floor space shall have a fixed projected beam-type smoke detection system. The smoke detection system shall be an addressable system that meets the requirements of NFPA 72 and the manufacturer's documented instructions. These facilities shall have listed interior and exterior local audible alarm and listed exterior visual beacon visible from the roadway and personnel entrances to the building.

Exception:

If an electrical substation is in a remote location that is not patrolled, or it is not otherwise practicable for a fire to effectively be responded to, a smoke detection system is not required.

Commentary Note:

For existing substation buildings, the retrofit of projected beam-type smoke detectors is recommended only if the substation is considered critical by the operating department and there is no other smoke detection system installed. If a major upgrade is done to the substation, then the smoke detection system shall be upgraded at that time.

7.9 Fire Detection System Commissioning

All fire detection system testing shall be witnessed by a designated representative of the Area Lead Fire Prevention Engineer / Loss Prevention Department and the Area Fire Marshall / Fire Protection Department. At least 10 business days prior to commissioning of any new fire alarm system, the following deliverables shall be provided to the Area Lead Fire Prevention Engineer and the Area Fire Marshall:

a) Certified, as-built drawings for the fire alarm system.

b) Written certification from the designer that the installed fire alarm system is in compliance with NFPA 72. (A stamp of the registered engineer on the drawings with a statement stating that the system is in compliance with NFPA 72 shall be considered as meeting this requirement).

c) For air aspirated high sensitivity smoke detection systems utilizing sampling pipes, provide certified drawings of the piping network showing size and locations of all orifice holes in the sampling pipes and endcaps, and the location and specifications of all piping components. The design calculations or program output used to design the piping network shall also be provided.

d) Programming documentation for the fire alarm control panel.

e) For all high sensitivity smoke detection systems, the manufacturer or manufacturer's representative shall provide recommendations for the alarm and pre-alarm sensitivity settings.

f) Operating and programming manuals for the system.

g) Commissioning procedures.

8 Fire Protection and Fire Suppression Systems

8.1 Fixed gas-type fire suppression systems are not required in new facilities.

Exception:

A fixed gas-type fire suppression system is required in the following facilities if they are not protected by an automatic sprinkler system:

a) Communications rooms in critical communications facilities.

b) Computer rooms in central computer facilities.

Designs of fixed gas-type fire suppression systems and fire suppression agent to be used shall be approved by the Chief Fire Prevention Engineer.

Commentary Note:

For existing manned facilities protected by Halon 1301 where operators are adequately trained to (a) respond to smoke alarms, (b) use portable fire extinguishers, and (c) activate fixed extinguishing systems when necessary if agreed to by the manager of the Proponent Operating Department, it is recommended that the Halon system should be kept on manual (bypass) rather than on automatic.

8.2 For existing Halon 1301 systems, when the bottles are due for hydrotest, the Chief Fire Prevention Engineer or his representative shall evaluate the need for each Halon suppression system.

Commentary Note:

The decision to retain or delete an existing Halon system will be based on several factors, the most important of which are (a) fire separation and general building layout, (b) current, voltage, and numbers of subfloor cabling, (c) type and coverage of smoke detection, (d) training of operators, (e) quantity of combustible materials present, (f) fire truck response time, and (g) criticality of facility.

8.3 A performance test shall be satisfactorily completed prior to the acceptance of any fire protection system. Representatives of the Fire Protection and Loss Prevention Departments shall witness this test. Testing shall be in conformance

with tests specified by NFPA. For other building fire protection requirements, see SAES-B-009, SAES-B-017, and SAES-B-019.

8.4 Fire protection for maintenance shops, storage areas, laboratories, and warehouse facilities, if required, shall meet the applicable requirements of SAES-B-017, SAES-B-019, SAES-M-100, NFPA 13, NFPA 45, NFPA 231, and NFPA 231C.

8.5 In electrical substations, switchgear rooms, motor control centers, GOSP control rooms, and PIBs, install two fire blankets (SAP Material # 1000124087) and one basket type litter (SAP Material # 1000128490, splint stretcher).

9 Pressurization

9.1 In addition to the requirements of SAES-J-801 and SAES-K-002, pressurization of buildings shall be used when required by the risk assessment of paragraph 5.2. When pressurization is required, the level of pressurization shall be indicated by the risk assessment (refer to SAES-K-002 for guidelines).

9.2 Design and installation of HVAC systems, including pressurization requirements, air intake location for buildings in hazardous areas, gas detection in air intakes, chemical filtering of air intakes, and integration of ventilation with building construction shall meet the requirements of SAES-K-001, SAES-K-002, SAES-K-003, SAES-K-100, SAES-J-502, SAES-J-505, SAES-J-801, and NFPA 90A.

9.3 Air-handling units providing building pressurization shall be provided with 100% standby units that are powered by separate power sources such as an emergency generator bus. An independent emergency power supply shall also be provided to energize the HVAC Direct Digital Controller (DDC) panel in the event of normal power supply outage.

9.4 Air intake of a pressurized building shall be located in a nonclassified area, be at least 4.5 m above any classified electrical area, and at least 7.5 m above grade. Buildings that require pressurization and elevated air intakes will be identified during the risk assessment.

Exception:

Air intakes for analyzer shelters shall satisfy SAES-J-502.

10 Access and Egress

10.1 Access and egress design and installation shall meet SAES-M-100, NFPA 101, and SAES-B-054.

10.2 Doors shall face away from process areas whenever possible.

11 Maintenance Shops

11.1 Office doors shall not open directly into the shop area.

Exception:

A single or dual office for the sole use of dedicated workshop personnel is allowed. Interior doors and door frames shall be made of steel and fire-rated for the appropriate fire-separation rating of the fire wall they penetrate, as specified in SAES-M-100. The door shall be fitted with a closer adjusted to close the door within five (5) seconds.

11.2 Flammable or combustible liquid storage shall be limited per NFPA 30 and shall be kept in listed flammable liquid storage cabinets and containers.

11.3 Compressed Gas Cylinder Storage

11.3.1 Compressed gas cylinder storage shall have an area with restraining devices to prevent the cylinder from toppling over. Cylinders shall be stored upright.

11.3.2 A minimum spacing of 6 m or a ½-hour fire-rated wall at least 1.5 m high shall be provided between oxygen cylinders and acetylene cylinders while in storage.

11.4 Shop Welding Area

11.4.1 Indoor welding shall be allowed only in an area of the shop designed for that purpose.

11.4.2 The dedicated welding area shall be provided with noncombustible welding curtains or partitions.

11.4.3 Special enhanced ventilation shall be designed for this purpose.

11.4.4 The fire detection and alarm, fixed fire suppression system, and other fire protection equipment provided shall be specifically designed for a welding area.

12 Temporary Buildings

12.1 Temporary buildings with metal or noncombustible exteriors and metal or noncombustible outside doors are permitted for the support of construction or major maintenance jobs such as turnarounds. Temporary buildings, shelters, or other structures having combustible exteriors are prohibited.

12.2 Interiors of temporary buildings may be of combustible materials.

12.3 Storage of flammable liquids and combustible gases (see SAES-B-006 for definitions) for such jobs shall be either outdoors in an approved location or in dedicated metal or noncombustible buildings or lockers.

12.4 Location of flammable storage, temporary buildings, and related fire protection equipment shall be approved by the Chief Fire Prevention Engineer or his representative. Temporary buildings shall meet the requirements of Section 5.4 of this Standard.

12.5 Use of the temporary building is not allowed to exceed six months.

13 Construction Buildings for Grassroots Facilities

13.1 Buildings for use by Saudi Aramco Project Management, contractors, and commissioning personnel in the course of building grassroots facilities must meet normal standards (such as SAES-B-019) for life safety and fire protection but are otherwise not required to meet SAES-B-014. This exemption from SAES-B-014 requirements applies only to construction buildings that are 500 m outside the security fence and outside a zone predicted to receive at least 3.5 kPa gauge (0.5 psig) peak side-on overpressure.

13.2 In the case of construction buildings proposed for locations near operating pipelines, Loss Prevention concurrence shall be obtained in the course of processing the Land Use Permit.

13.3 Construction buildings shall be reviewed by the Chief Fire Prevention Engineer or his representative prior to introduction of hydrocarbons into the new facility in order to determine whether mitigation measures are needed, such as applying fire-resistive coatings to outer combustible surfaces, covering windows with steel sheets, or building relocation.

13.4 Use of construction buildings is not allowed to exceed six months beyond the introduction of hydrocarbons or toxic materials into the new facility unless buildings are 500 m outside the plant perimeter fence and outside a zone predicted to receive at least 3.5 kPa gauge (0.5 psig) peak side-on overpressure or the occupants will not be affected by a toxic material release.

Revision Summary

29 February, 2004 Revised the "Next Planned Update". This revision was requested at the Haradh Project post-project review of Standards.

Appendix 1 – Guidelines for Implementing Section 5.2 Building Risk Assessments

A1 Objective

This appendix provides guidelines for assessing the hazards and risks associated with buildings in process plant areas, as required by SAES-B-014, Section 5.2. These guidelines apply to building risk assessments associated with either new projects or existing buildings. They complement the methodologies contained in API RP 752, "Management of Hazards Associated with Location of Process Plant Buildings" and the Center for Chemical Process Safety (CCPS) Publication, "Guidelines for Evaluating Process Plant Buildings for External Explosions and Fires." These guidelines shall govern if there is a conflict with API RP 752 or the CCPS Guidelines.

A2 Background

SAES-B-014, Section 5.2 requires an assessment of the hazards associated with the siting of process plant buildings. The intent of SAES-B-014 is to ensure that people in plant buildings are not exposed to an unacceptable risk in the event of an accidental fire, explosion or toxic release. In addition, the Standard ensures that the hazards to buildings considered critical to sustained operations are evaluated and mitigated as necessary to meet the target levels of operational redundancy and reliability. Depending upon the project, this Standard may require the assessment of process interface buildings (PIBs) and utility buildings, such as substations.

This assessment should be made early in the project while modifications may be made without excessive cost and schedule impacts. However, this assessment can also be applied to existing buildings at anytime in their life (refer to the commentary in Section 5.2).

A3 Overview of Building Risk Assessment Methodology

The building risk assessment methodology consists of three stages, as shown in Figure A1. The complexity and required resources of the analysis increase with each stage. The intent is to screen out buildings at the lowest stage possible in order to provide an efficient, yet comprehensive, analysis. Each of the stages is discussed in detail in the following sections.

Stage-one screens the building on the basis of population and function to determine if a stage-two building evaluation is warranted based on Saudi Aramco specific criteria. Hazards to the building from fires, explosions, and toxic releases, are evaluated in stage-two. Appropriate mitigation and risk-

reduction measures are identified at this stage. For unusual cases where risk-reduction measures are not clearly appropriate, a Stage-three Risk Management Assessment is made to evaluate the acceptability of the risks associated with buildings of concern. The information requirements and the resources necessary for conducting the assessment increase with each stage. Typical information needed for each stage is summarized in Table A1 of Section A4 below.

A4 Stage-One Building and Hazard Identification

A stage-one building and hazard identification is needed if a building risk assessment is required by SAES-B-014, Section 5.2. The objective is to identify buildings of concern and eliminate other buildings from additional study. The stage-one assessment decision tree, adapted and modified from API RP 752, is shown in Figure A2. If the stage-one results indicate that a stage-two assessment is not required, no additional analysis is necessary to meet the intent of SAES-B-014, Section 5.2. A checklist for the building should be completed and any deficiencies corrected. Figure A9 contains a sample format for reporting the results of a stage-one building and hazard identification.

Table A1 – Project Information Needed for Building Risk Assessments

Stage	Typical Information Needed for Assessment
1	Material Safety Data Sheets Building Occupancy Emergency Role of Building Process Criticality of the Building
2	Inventories of materials Process Temperatures, Pressures, and Flow Rates Building Construction, materials, dimensions Distances between process units and buildings Size of Process Units
3	Description of active and passive mitigation systems

A4.1 Criteria for Stage-One Building and Hazard Identification

A4.1.1 Occupancy Criteria

A stage-two building evaluation is required if a building is considered occupied. A building is considered occupied, for the purposes of occupancy screening, if the building occupancy load is 300 or more man-hours per week or if, during peak occupancy, 5 people or more are routinely expected in the building for at least one hour.

A4.1.2 Building Functionality

A stage-two building evaluation is required if a building is functionally significant. A building is defined as functionally significant if either:

- People are expected to remain or take refuge in the building during an emergency. Possible reasons for people to remain in a building include a lack of suitable evacuation options or the need for occupants to perform emergency shutdown procedures.
- The building is required for emergency response, such as fire stations or clinics.
- The building is necessary for continued operation of plant units that may be able to continue to operate or may be unaffected by an incident in another area. This includes control buildings, process interface buildings (PIBs), or substations that control or provide power to multiple process units.

The economic impact on operations of loss of the building is significant.

A5 Stage-Two Building Evaluations

Stage-two building evaluations examine the explosion, toxic, flammable cloud, and fire hazards that expose buildings, as shown in Figure A3. The following sections provide specific information for evaluating the consequences of each hazard in terms of impact to the building and its occupants.

A5.1 Explosion Consequence Analysis

Figure A4 provides the overall approach for a stage-two explosion consequence analysis. Specific information is provided in subsequent sections.

Notes for Explosion Consequence Analysis

A5.1.1 Site-Specific Conditions

The potential for a vapor cloud explosion (VCE) is determined by the degree of congestion and confinement, the spacing between areas, and the potential for a release of large quantities of flammable material that will form a gaseous cloud.

Hydrocarbon plant areas anticipated in SAES-B-014 would feature areas that could result in a VCE. However, there are areas, such as most bulk plants, where site-specific conditions, such as the materials processed or the plant layout, may preclude the occurrence of a VCE.

A5.1.2 Consequence Analysis

Consequence assessment of vapor cloud explosion hazards shall be based on current revisions of proven VCE modeling methodologies. These include, but are not limited to:

Multi Energy

CAMS

Baker-Strehlow-Tang (BST)

The type of methodology used to model a VCE and the revision of any software tool used to perform the evaluation shall always be approved by the Loss Prevention Department.

Parameters used to develop a model should be based on site-specific conditions. They must be clearly and concisely stated in the final study report. If generic industry data is used to develop VCE models, in lieu of site-specific data, it must first be reviewed and approved by the Supervisor, Technical Services Unit, Loss Prevention Department.

A5.1.3 Building Adequacy

All buildings have some degree of resistance to blast effects. Various references provide guidance in determining the response of buildings to anticipated blast effects.[1] If the building will withstand the anticipated blast effects with only minor or moderate structural damage and with no potential resultant loss of life or major injury, the building is not considered a significant concern, and no additional analysis is required for explosion hazard.

A program available to Saudi Aramco, Building Evaluation and Screening Tool - BEAST, developed by the Petroleum & Chemical Processing Industry Technology Cooperative, screens the response of conventional buildings to blast effects. For

[1] *Guidelines for Evaluating the Process Plant Buildings for External Explosions and Fires*, Center for Chemical Process Safety of the American Institute of Chemical Engineers, NY, 1996.

information on this program, contact Consulting Services Department, Civil Engineering Unit or Loss Prevention Department, Technical Services Unit. Building damage levels of 2B or higher predicted by BEAST are unacceptable, and additional analysis or mitigation measures are required.

A5.1.4 Mitigating Measures

If a proposed building is insufficient to withstand the anticipated blast effects, the building design and the spacing from the process unit should be modified until the building design and layout is sufficient to withstand anticipated blast effects. In some cases, minor modifications to the building design details may provide sufficient blast capacity. In other cases, it may be necessary to relocate the building or provide a different design that is sufficient for the anticipated blast effects.

A5.2 Toxic Hazard Assessment

Toxic materials released to the atmosphere in process plants can affect building occupants. The toxic vapors may enter a building and cause impairment or physiological harm to the occupants, depending upon the material released, its concentration, and the exposure duration. Figure A5 illustrates the stage-two analysis process for toxic releases.

Notes for Toxic Hazard Assessment

A5.2.1 Toxic Materials of Interest

Toxic materials include ammonia, hydrogen sulfide, or any other acutely toxic material specified in 29 CFR 1910.119, Appendix A.

Guidelines for toxic material concentration thresholds are provided by the American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPG). For example, the ERPG-2 threshold hydrogen sulfide concentration of concern inside buildings is 30 ppm. ERPG threshold concentrations for other materials are available from the AIHA. The ERPG-2 is defined as the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health

effects or symptoms that could impair their abilities to take protective action.

A5.2.2 Hazard Inside the Building

A release of materials containing hydrogen sulfide or other toxic material will generate a toxic cloud. The hazards of such a cloud should be assessed using appropriate vapor cloud dispersion models. The Unified Dispersion Model (UDM) methodology is the vapor cloud dispersion model used in Saudi Aramco. Other dispersion models may be used provided that prior approval is given by the Supervisor, Technical Services Unit, Loss Prevention Department.

Parameters used to develop the model shall be based on site-specific conditions. The parameters must be clearly stated in the final study report. If generic industry data is used to develop the model, in lieu of site-specific data, it must first be approved by the Supervisor, Technical Services Unit, Loss Prevention Department.

For stage-two assessments, dispersion calculations should be based on the worst-case release, a wind velocity of 1.5 m/s, and "F" atmospheric stability. The worst-case release may be a full bore rupture of a pipe containing sour gas or other toxic materials. The study must clearly identify the basis of selecting the release scenario. Toxic material may infiltrate the building through unprotected openings or ventilation systems. If the analysis shows that the ERPG-2 levels are exceeded inside the building, there is a potential toxic hazard to building occupants.

A5.2.3 Mitigation Systems

A ventilation system, equipped with a toxic gas detection alarm, that controls fresh air supply and provides air intake shutdown capability will limit the ingress of toxic materials. Severe conditions may require provision of positive pressure inside the building to prevent the infiltration of toxic materials.

Commentary Note:

This should be taken as a general comment and is not meant to imply authorization to deviate from a Saudi Aramco Engineering Standard.

A5.3 Flammable Cloud Hazard Assessment

Flammable materials released to the atmosphere in process plants can affect building occupants. The flammable vapors may enter a building and form a flammable vapor-air mixture in the building. Figure A6 illustrates the stage-two analysis process for a stage-two flammable cloud hazard assessment.

Notes for Flammable Cloud Hazard Assessment

A5.3.1 Flammable Materials

Materials of interest include flammable gases and flammable materials handled above their atmospheric boiling points which may be released and form vapor clouds which expose populated buildings.

A5.3.2 Hazard Inside the Building

A release of flammable gases or liquefied gases will result in a flammable vapor cloud. Dispersion of the vapor cloud should be modeled, based on a wind velocity of 1.5 m/s with "F" atmospheric stability and a worst-case release as described in Section A5.2.1.2. The concentration of the flammable material in the building should be calculated, based on expected air infiltration rates and the effect of any air handling systems. If this analysis indicates that 25% of the lower flammable limit (LFL) is possible inside the building, there is a flammable vapor-air hazard inside the building.

A5.3.3 Mitigation Systems

A properly engineered and maintained HVAC system may limit the ingress of flammable materials. The system may require combustible gas detection interlocked with an elevated fresh air intake. Severe conditions may require provision of positive pressure inside the building to prevent the infiltration of flammable or toxic materials.

Commentary Note:

This should be taken as a general comment and is not meant to imply authorization to deviate from a Saudi Aramco Engineering Standard.

An emergency response plan should include appropriate measures for building occupants to take in the event of a flammable or toxic gas release. These actions may include remaining in the building or evacuation to a safe location that is upwind or crosswind from the release.

A5.4 Fire Hazard Assessment

The fire hazard assessment reviews building location and construction in relation to the requirements of SAES B-055, Plant Layout. In addition, any potential jet fire exposures should be considered. Figure A7 summarizes a stage-two fire hazard assessment.

A5.5 Building Checklist

A building checklist, provided in Figure A8, should be completed and reviewed for each building as recommended in the stage-two building evaluations. Other checklists as appropriate may supplement the building checklist that is provided. The completed checklists should be included in the risk assessment report.

A5.6 Loss Prevention Program Diligence

Sustained safe operations require an effective loss prevention program that embraces the broad spectrum of design, operation, maintenance, and engineering issues. An ongoing loss prevention program will include periodic reviews to ensure the basis for the risk assessment remains valid. If a building function or occupancy changes, a re-assessment will be needed.

A6 Stage Three Risk Management

This stage of analysis reviews the risks associated with the identified hazards. It is anticipated that new projects should rarely require stage three analysis because it is feasible to mitigate the hazards identified in stage two by proper attention to building design and location. If a stage-three analysis is required, LPD/TSU must review and approve the scope, methodology, and results of the analysis. Details regarding stage-three assessments will be determined on a case-by-case basis after the conclusion of stage-two studies.

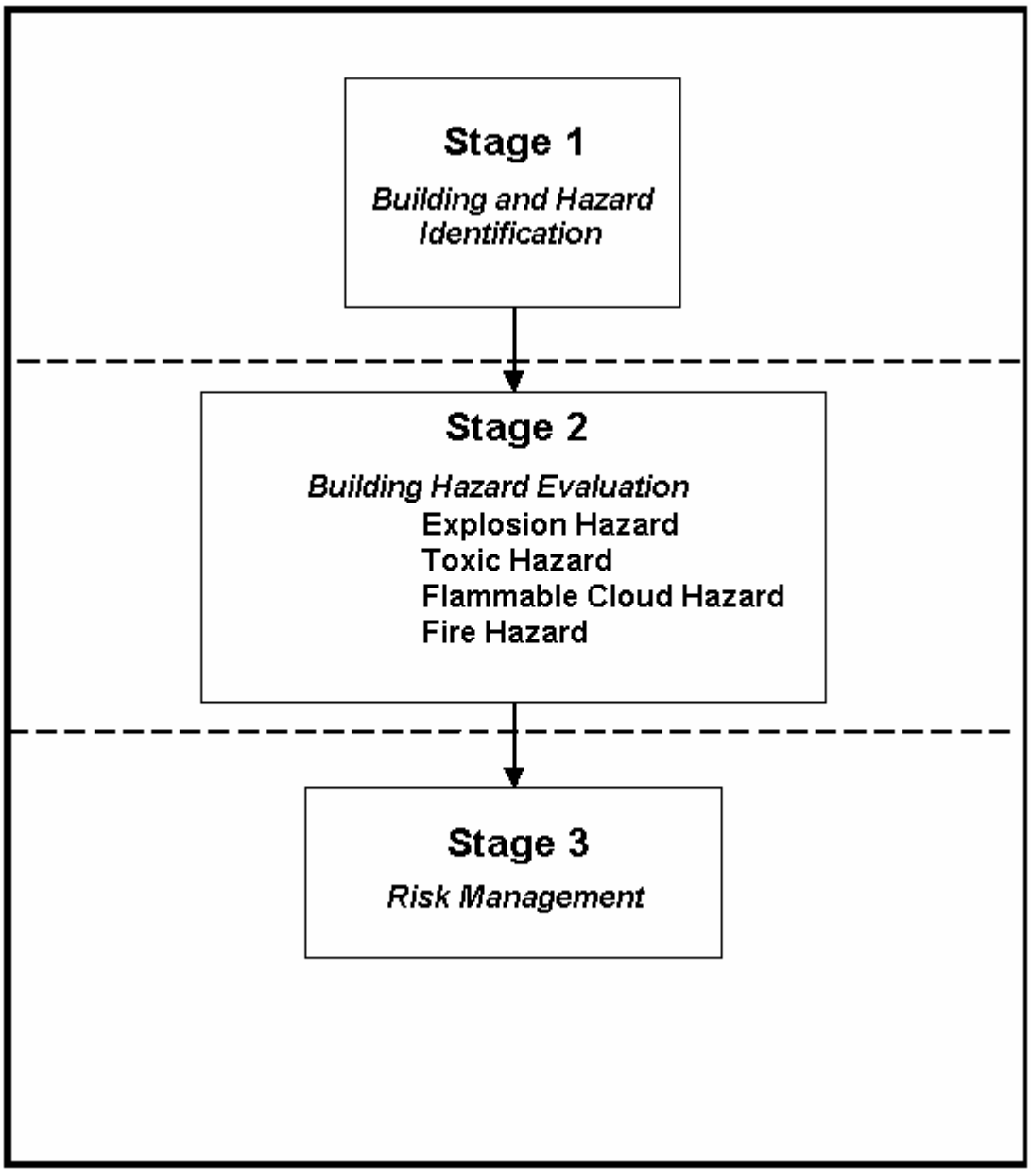

Figure A1 – Three Stage Methodology for Assessing Hazards & Risks Associated with Process Plant Buildings

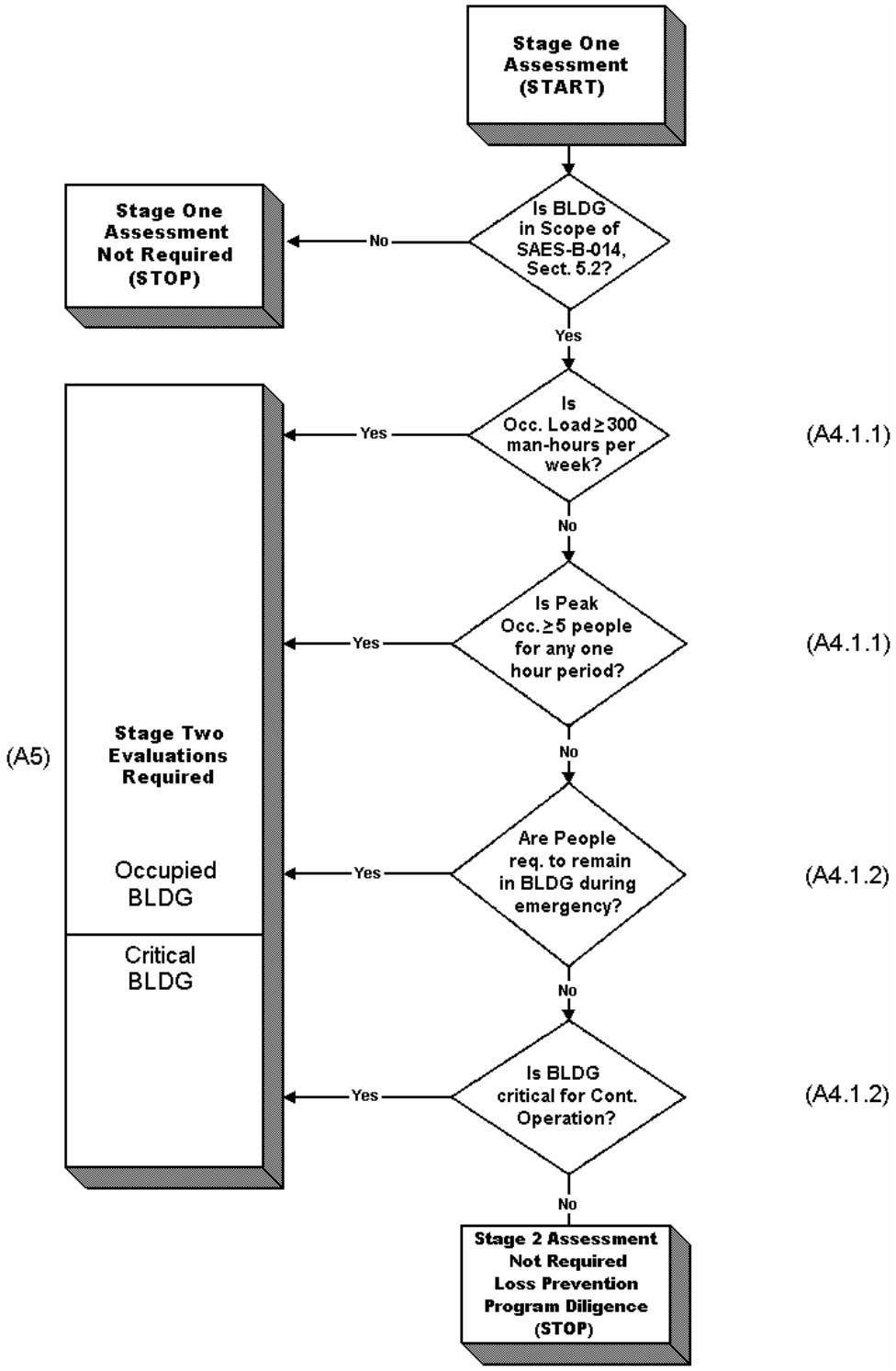

Figure A2 – Stage One Building and Hazard Identification Assessment

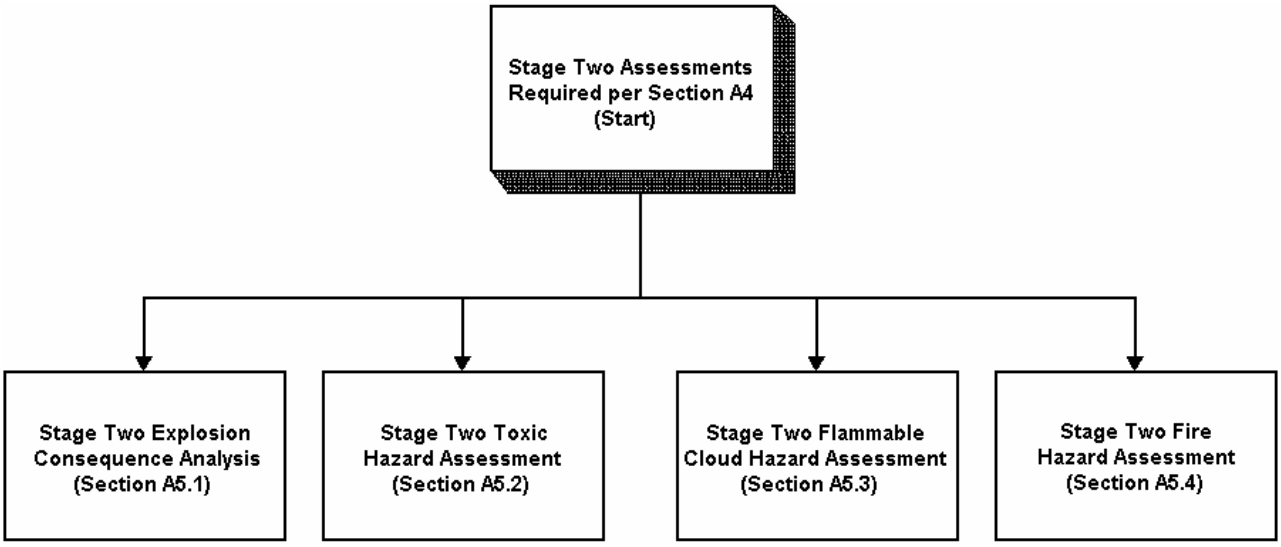

Figure A3 – Stage-Two Assessments

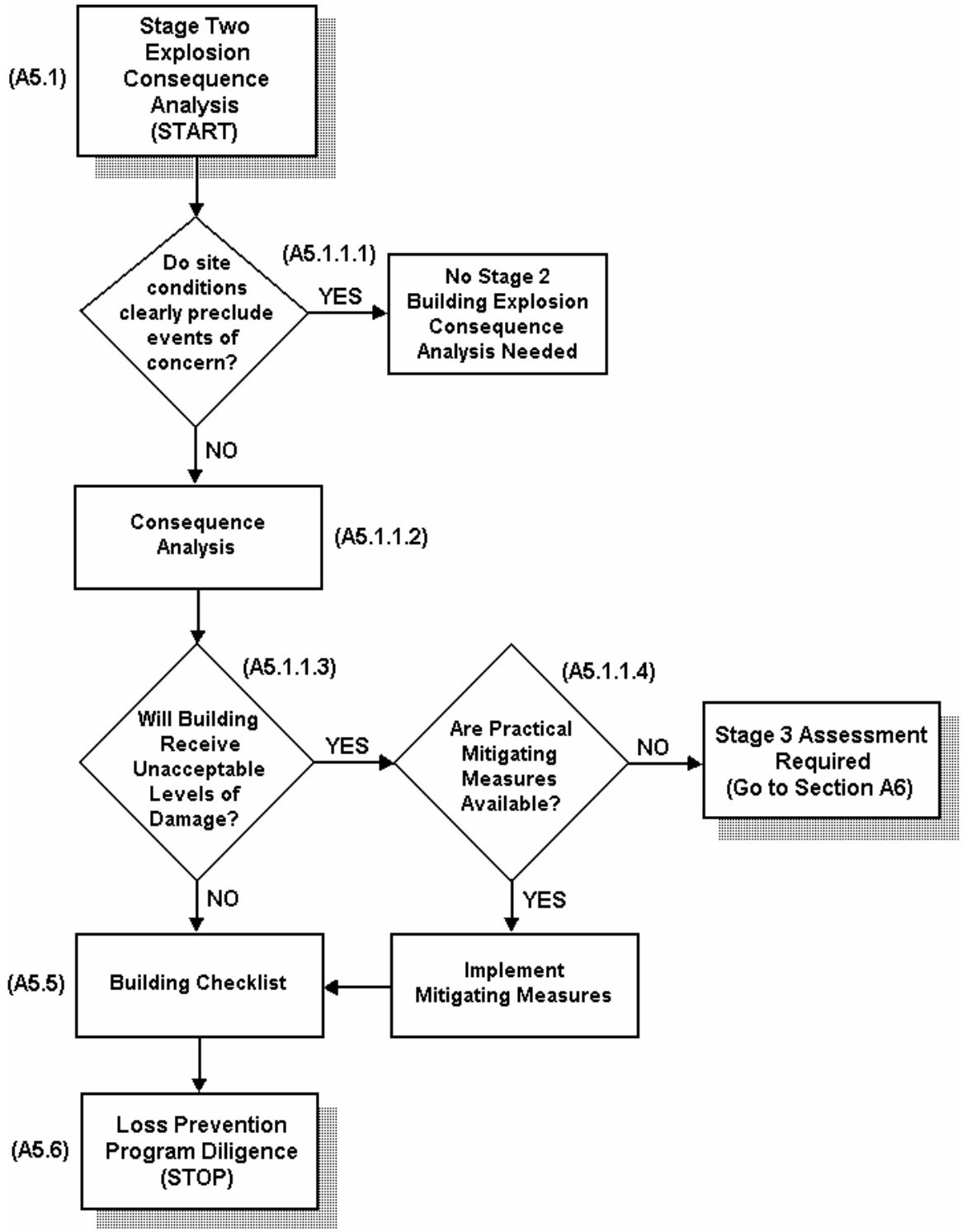

Figure A4 – Stage-Two Explosion Hazard Assessment

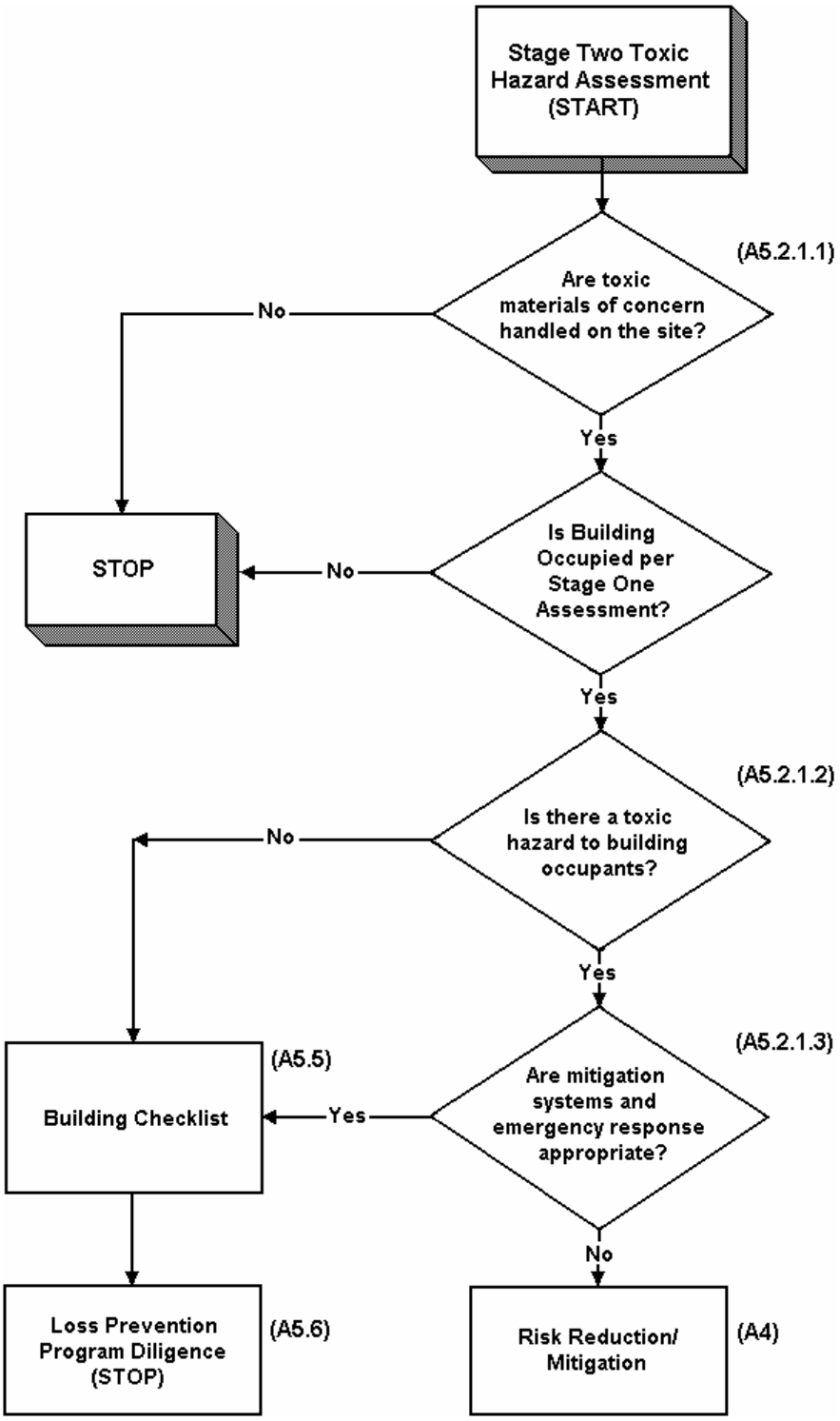

Figure A5 – Stage-Two Toxic Hazard Assessment

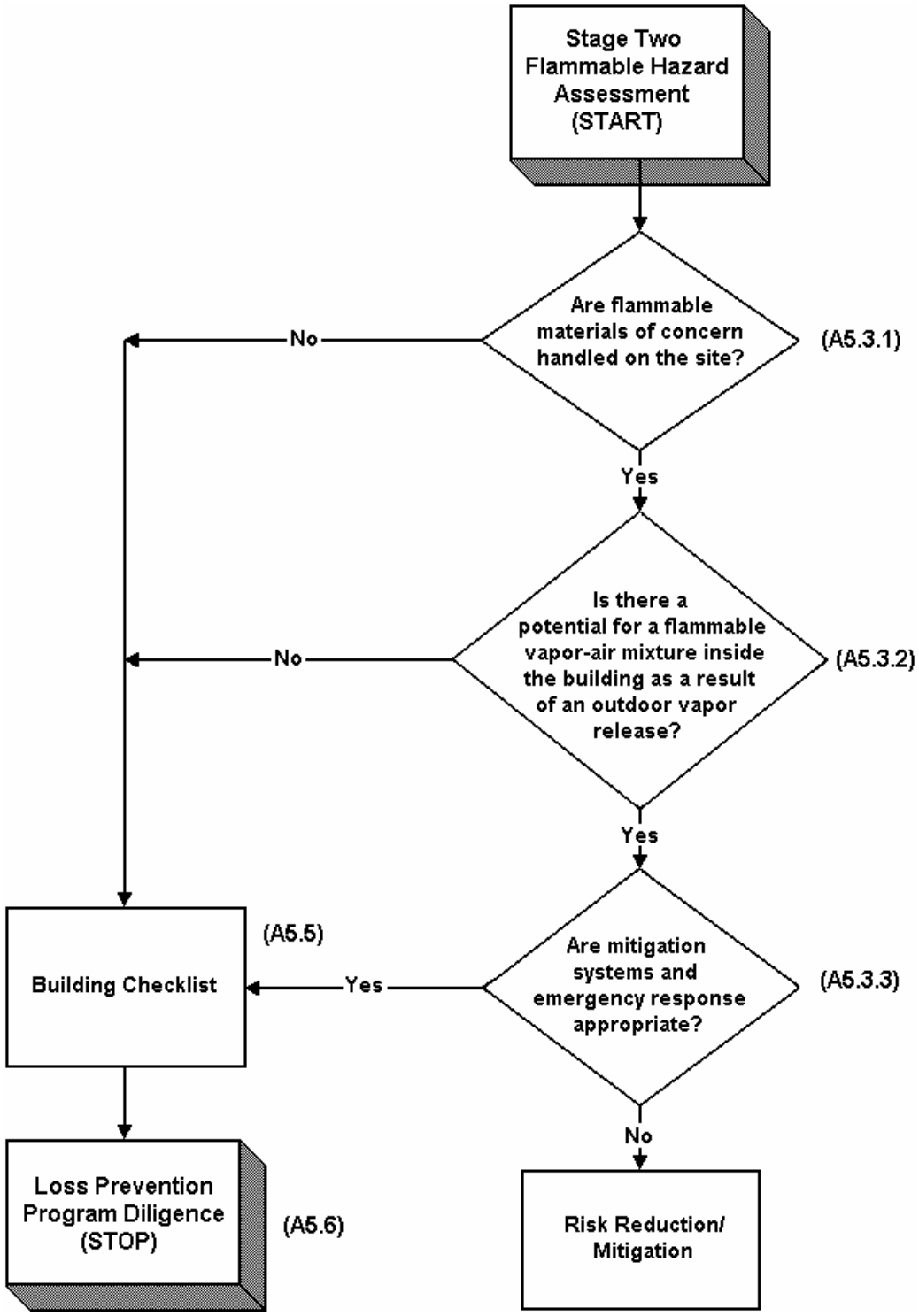

Figure A6 – Stage-Two Flammable Hazard Assessment

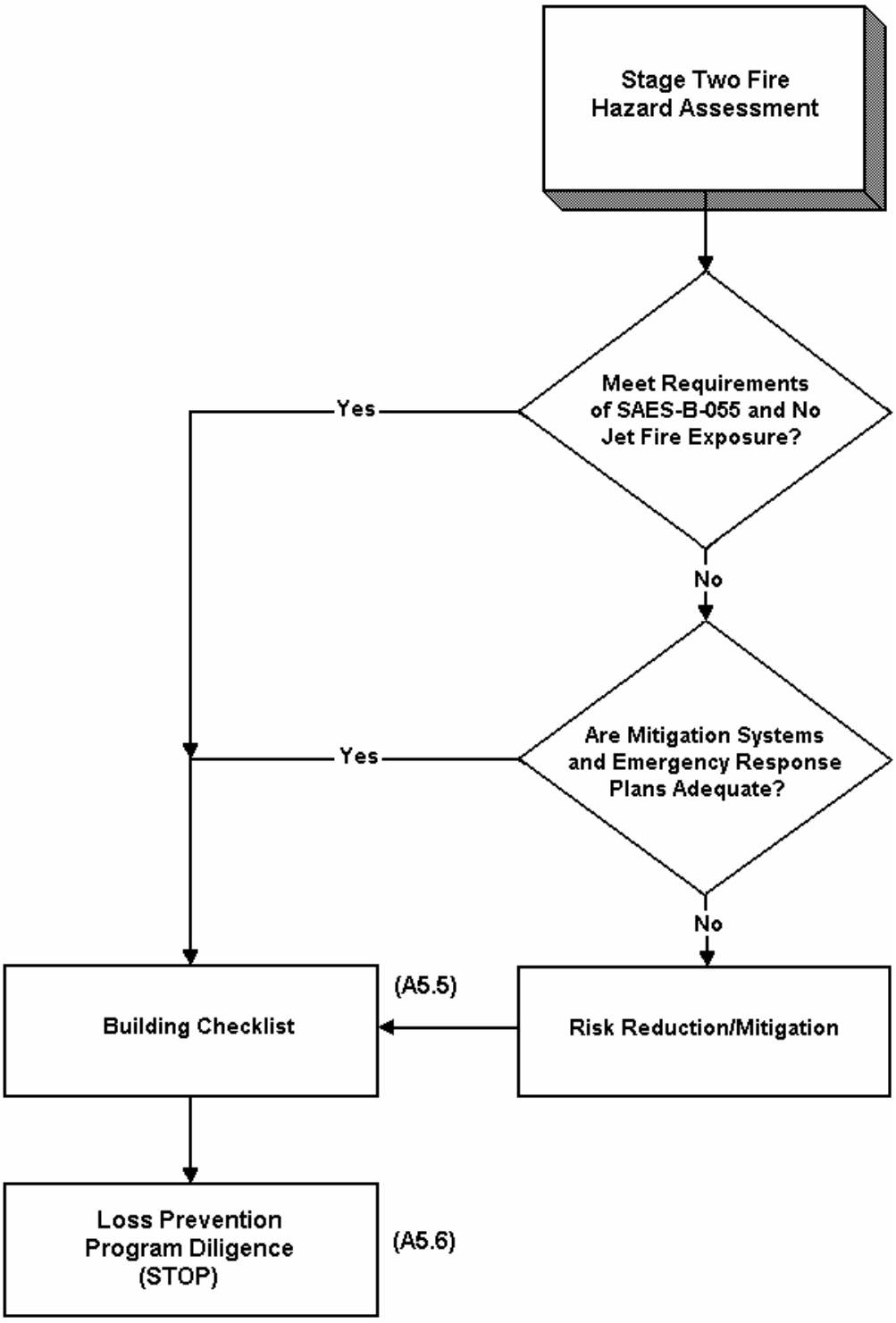

Figure A7 – Stage-Two Fire Hazard Assessment

PROCESS PLANT BUILDING CHECKLIST

Building:					
E, F, T*	**Questions**	**Y**	**N**	**NA**	**Remarks**
FT	1. Is the building located upwind of the hazard?				
EFT	2. Is the building included in an emergency response plan for fire and toxic release? Are the occupants trained on emergency response procedures? Are evacuation instructions posted?				
E	3. Are large office equipment or stacks of materials within the building adequately secured?				
E	4. Are the lighting fixtures, ceilings, or wall-mounted equipment well supported? Are process controls mounted on interior walls?				
E	5. Is there heavy material stored on the ground floor only?				
E	6. Have all the exterior windows been assessed for potential injury to occupants?				
EFT	7. Are there doors on the sides of the building opposite from an expected explosion, fire source, or toxic release?				
FT	8. Is there exterior and interior fire suppression equipment available to the building?				
FT	9. Is there a detection system within the building or in the fresh air intake to detect hydrocarbons, smoke, or toxic materials?				
FT	10. Is the air intake properly located?				
FT	11. Can the ventilation system prevent air ingress or air movement within the building? Are there hydrocarbon or toxic detectors that shut down the air intake? Does the building have a pressurization system?				
FT	12. Are there wind socks visible from all sides of the building?				
EFT	13. Is there a building or facility alarm or communication system to warn building occupants of an emergency?				
EFT	14. Are sewers connected to the building properly sealed to prevent ingress of vapors?				

* E=Explosion; F=Fire; T=Toxic

Source: API RP 752, Management of Hazards Associated with Location of Process Plant Buildings, May 1995.

Note: This is an example and should reviewed and modified to fit the situation.

Figure A8 – Building Checklist

The following table provides a sample format for presenting data obtained during a stage-one screening study for a building hazard and risk assessment. This table contains the minimum information that should be contained in a study report.

Building Risk
Assessment

Stage-one
Screening Study

Facility Name: Gas Plant

Location			Data			Results		
NAME OF BUILDING	**BLDG #**	**PLANT #**	**Peak Occ.**	**Occ. Load [hours/week]**	**Functionally Significant**	**OCCUPIED**	**High Occupancy**	**Stage 2 Assessments Needed?**
Shelter	1	1	4	200	No	N	No	No
Shop	2	1	20	500	No	Y	No	Yes
PIB	3	1	2	100	Yes	N	No	Yes

Figure A9 – Format for Stage-one Screening Study