



ISPE

Beyond 2016

2016 Code Update based on the
International Building, Fire,
Plumbing and Mechanical Codes

Presented by



Reinhard Hanselka, PhD

Connecting a World of
Pharmaceutical Knowledge

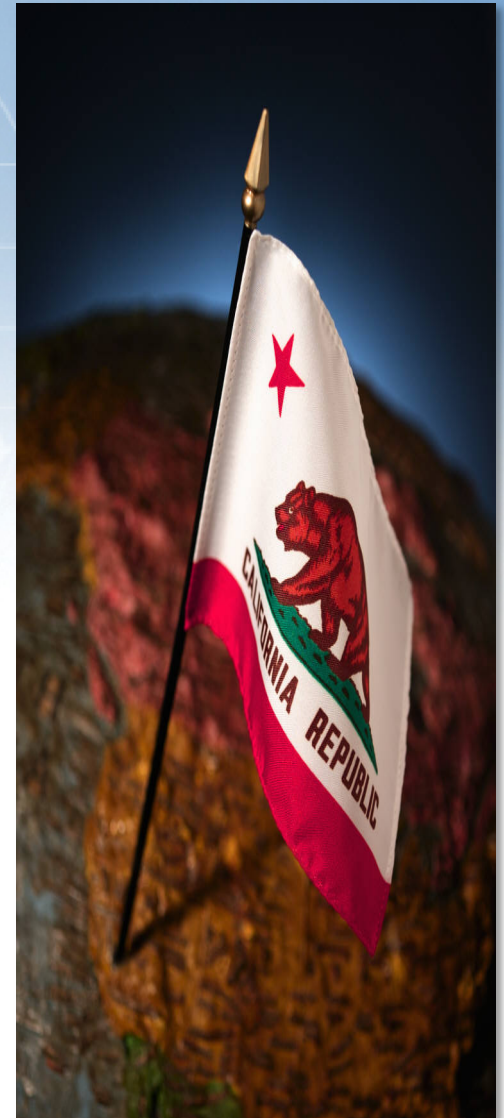
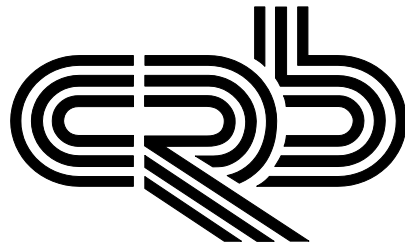


Beyond 2016

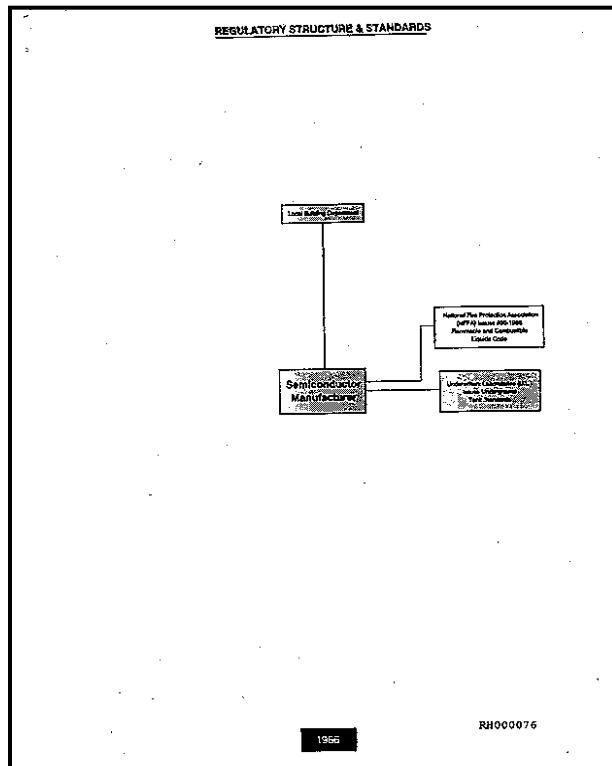
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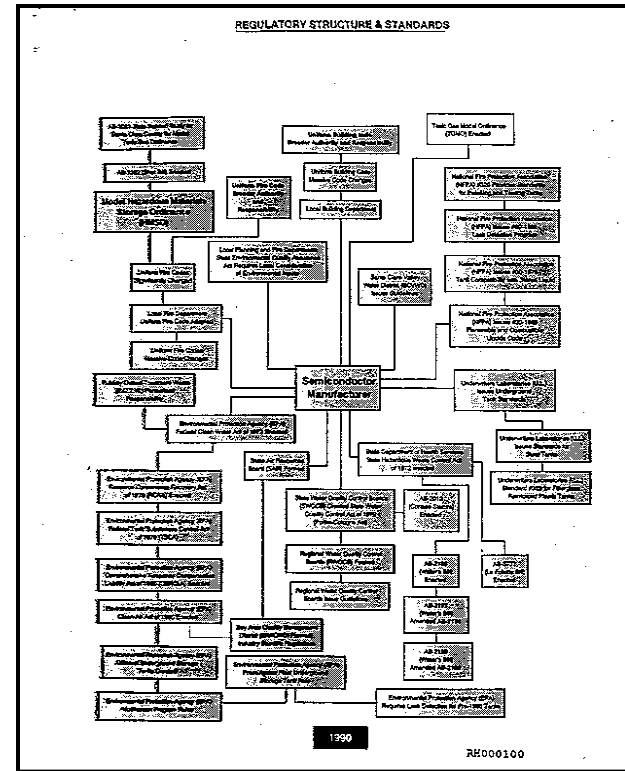
Reinhard Hanselka, PhD, REA



Agency Requirements

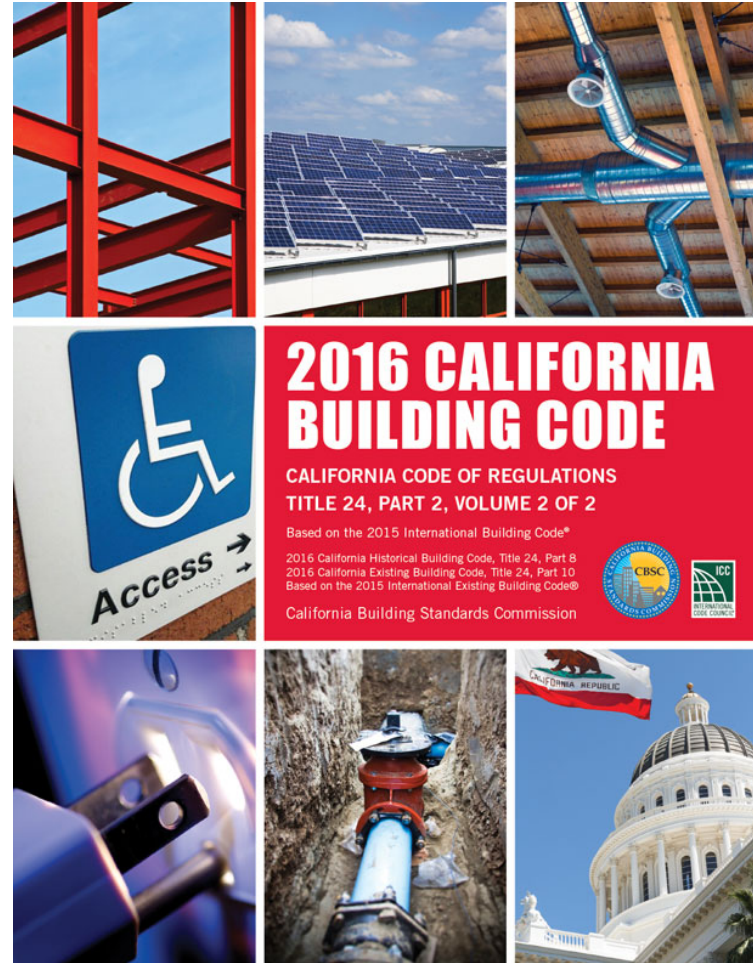


1981



1990

California Codes 2016



2016 CALIFORNIA BUILDING CODE

CALIFORNIA CODE OF REGULATIONS
TITLE 24, PART 2, VOLUME 2 OF 2

Based on the 2015 International Building Code®

2016 California Historical Building Code, Title 24, Part 8
2016 California Existing Building Code, Title 24, Part 10
Based on the 2015 International Existing Building Code®

California Building Standards Commission



Connecting a World of
Pharmaceutical Knowledge



California Special Requirements

- Hazardous Materials – Chapters
- 50 to 67, + NFPA 30, 55, 400 and
- ASME - BPE
- Flammable Liquids – Chapters 57 through 61, NFPA 30.45 +
- Toxic Gas Ordinance (TGO) + Laboratory Use Std.

CA Issues

- Special issues:
 - Inventory Reporting – No Exceptions
www.unidocs.org/gov
 - Backflow Testing
 - Power Systems -
 - Emergency & Stand-by

Ventilation

- Key Mitigator – For Most Hazardous Conditions
- CMC Code Change
- Capture Velocity –
 - Vapor Pressure ?
- Consistent with ACGIH -

Improper Ventilation



Emergency & Standby Power Systems

- 2016 CFC ,Section 604
 - Smoke Control Systems - S power
 - Group A voice alarm - E Power
 - Exit signs and Egress Illum.- E Power
 - Elevators – S Power
 - Egress platform lifts – S Power

Powered Systems

- Horizontal Sliding Doors – S Power
- H- Health Hazard Facilities- E Power
- Membrane Structures –
 E Power for Exit Systems
 Inflation Systems S Power

Powered Systems

- Underground Buildings
 - S Power for – Smoke Cont.,
Ventilation, Fire Pumps, Elevators
60 sec. pick up time
 - E Power for – Emergency Voice and Fire
Alarm systems, auto Fire Detection,
Elev. Lighting, egress lights

Powered Systems

- Maintenance per NFPA 110 and 111
 - Per Schedule + written record
 - Switch maintenance
 - Operational Testing
 - Transfer switch testing
 - Supervision by trained individual
- **LIABILITY**

Building Code

- Effective Use of the Code and Intent

“Code Applications”

CBC Chapter 2

Definitions:

- AM&M
- Horizontal Exit = compartmentalize
 - Accessibility
 - Grade- Basements?
 - Non-Combustibility
 - Platform - safe stage

Chapter 4 – Control Areas

- 23 Control Areas
- IBC 414.2.2
- “L” Occupancies
- “H” Occupancies

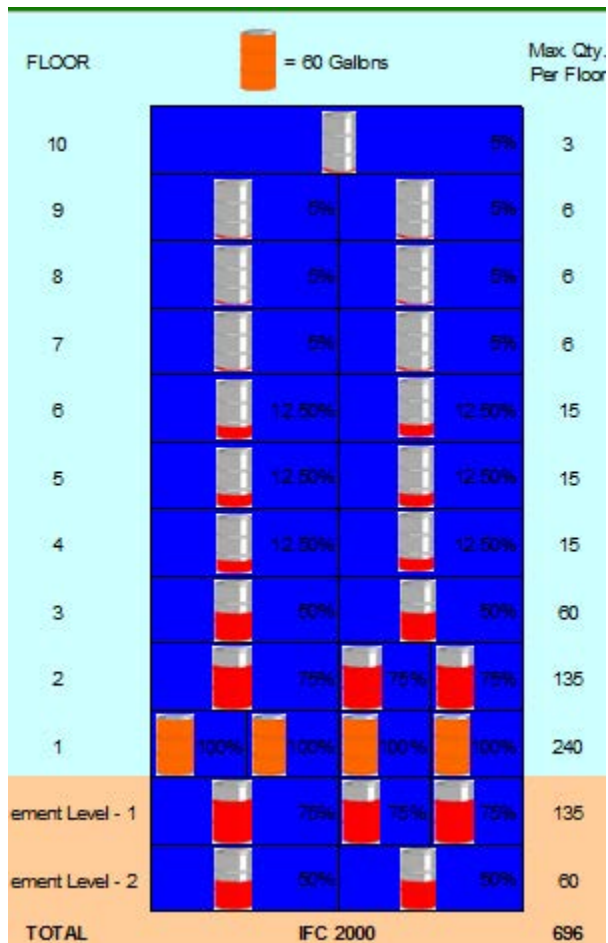
CBC Chapter 3 - “L” Occupancy

- Not an “H”
- 1 - 2 Hour Separations
- Lower Allowable Quantities
- Egress importance
- 2018 IFC – University Code ?

NFPA 45 Laboratories- AM&M

- > 400 sq. ft.
 - 2 exits – “Exit Access”
 - With 75 ft. of Exit
 - Door swing in direction of travel if Hazardous Materials are present
- Special Hardware
- Laboratory TGO Guidelines

FL-1B Use Open



ACCESSIBILITY

- Uses the Old format
- Chapter 11 B- CBC
- Total rewrite for 2013 -2016

Chapter 12

- Interior environment
 - Special regulation
 - Ventilation
 - Recirculation
 - CMC 407.4-Clean to less Clean

Chapter 16

Seismic and Wind Load

- $I = 1.0, 1.25, 1.5$
- To current code!
- ASCE 7

2016 UMC by IAMPO



CMC Chapter 1

- Maintenance – As Constructed
- Moved Equipment = New
- Unsafe Equipment!

CMC Chapter 2

- Standards of quality
- Approved qualified welder
ASME B 31
- Refrigerants
 - Recycled
 - Recovered
 - Reclaimed

Chapter 5

- Product Conveying @25% LEL
- Sprinklers ???
- Equipment AHU
- Motors & Fans

Chapter 6

- Ducting Systems
 - Quality Standards
 - Metal Duct
 - Installation
 - Flame Spread
 - Galvanized Sheet Metal
 - Alarm System - Fire, Smoke, etc....
 - Smoke Control

Chapter 11

- Refrigeration no CFC Chapter
- Safety Classifications
 - Purity
 - New, Recovered & Reclaimed
 - Emergency Ventilation Control
 - Discharge @1/2 IDLH
 - NH_3 , C_3H_8 , Propene

Chapter 11

- High Probability
- Low Probability
- Machinery Room –
- Monitoring at 25 % LEL or @PEL

Chapter 12

- Hydronics
 - Steam & Water
 - Material
 - Fabrication
 - Testing
 - >50 psi pressure



Chapter 14

- Special Piping and Storage Systems
 - (Formerly Process Piping)
- Inspection:
 - >100 psi
 - >1.5 x Max Oper. Pressure



Service Life

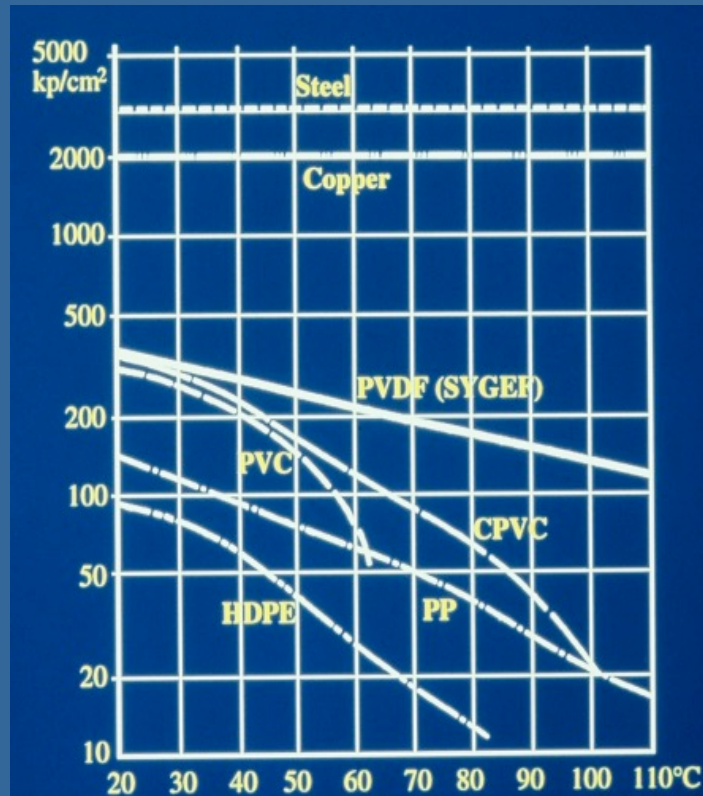
Comparison OF Strength Characteristics Of Metal And Plastics From 20 °C to 110 °C

2008 Code Update

ASME BPE

Slide 48

- Minimum Breaking Strain For One Year's Service Life
- Temperature in °C
- $Kp/cm^2 = 14.22 \text{ psi}$
($Kp = \text{Kilogram of Force}$)



Chapter 14

- HPP Fluids
 - In Accordance with Fire Code
 - Excess Flow Control
 - All Welded
 - Gas Detection

CFC Chapter 1

- Supplemental Rules & Regulations
 - Chief is required to make regulations
 - Available to the public
- Alternate Methods
- Threshold Quantities
- Existing Conditions
- Unsafe Building
- Stop Uses

Definitions– Chapter 2

- Definitions
 - Inert Gas
 - B and F Occupancies Expanded
 - L Occupancy Defined
 - MAQ for UR Gases increased to 750scf



Chapter 3 - 4 - 5

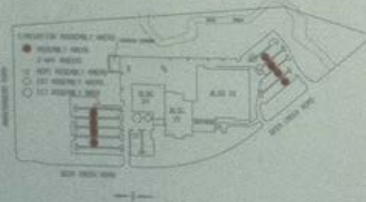
- General Fire Safety Conditions
 - Combustible Waste & Debris
 - 10 FEET Min.
 - Approved Open Flames
 - Vacant Premise Security
 - Conditions Hazardous to Fire Fighters

Chapter 10

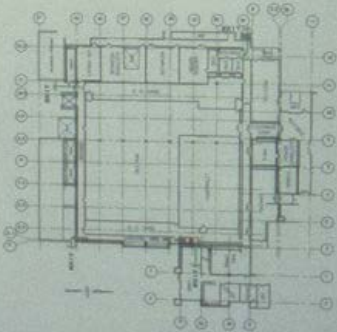
HEWLETT
PACKARD

EMERGENCY EVACUATION PLAN

<h3>EVACUATION</h3> <p>WHEN YOU HEAR THE ALARM BELL Leave The Building By The Fastest Safe Route Proceed To Your Designated Outside Assembly Area (Area marked ●) Report Injuries And Missing Personnel To Your Manager Do Not Return To Building Until All Clear Is Given</p> <p>WHEN YOU HEAR THE ALARM HORN Leave The Lab By The Fastest Safe Route Proceed To Your Designated Inside Assembly Area Report Apparent Cause Of Alarm Or Emergency Telephone Ext 2222</p>	<h3>EMERGENCY TELEPHONE</h3> <p>Dial 2222</p> <p>In Case Of Emergency Provide The Emergency Operator</p> <p>Your Name Location Of Emergency Nature Of Emergency Type Of Assistance Needed Nearest Telephone Number Where You Can Be Reached Remain On The Line Until Operator Hangs Up</p>	<h3>EARTHQUAKE PROCEDURE</h3> <p>Take Cover Under Sturdy Object L.e. Table, Desk, Or Doorway Do Not Use Elevator Do Not Attempt To Run Outside Evacuate After Earthquake Has Stopped Assist Injured Or Trapped Personnel Report Injuries And Missing Personnel To Your Manager Use Telephone Only In Extreme Emergency</p>
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SITE PLAN



BUILDING 24-FAB LEVEL

Chapter 5 - 6

- Fire Service Features
 - Facility ID
 - Access Gates Approved
 - Fire Command Center
 - Egress increases – Atrium and egress stair

Chapter 6

- Building Services & Systems
 - Battery Systems
 - Emergency & Stand-By Power
 - Electrical Wiring
 - Refrigeration Systems



Chapter 7

- Fire-Resistance-Rated Construction
 - Fire Walls
 - Fire Barriers
 - Fire Rated Partitions



Chapter 8

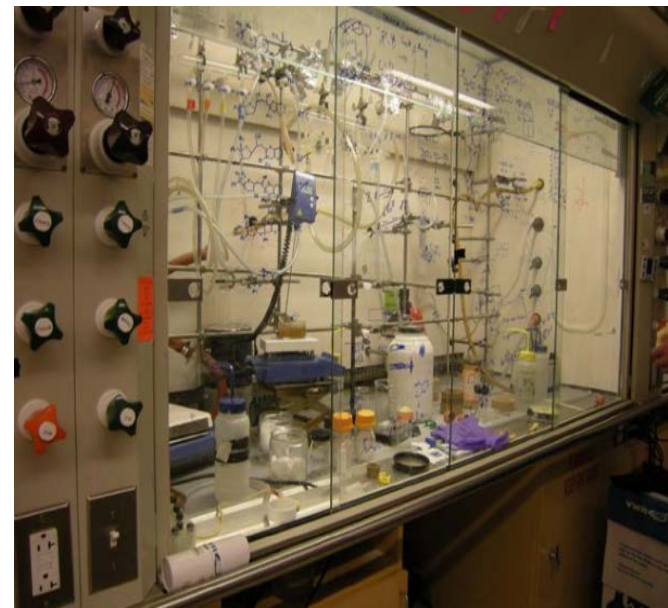
- Interior Finish – Decorative Materials
- ASTM E84 & UL 723
- NFPA 286
- Combustible Decorative Materials
- Station Night Club Fire



Chapter 9

Fire Protection Systems

- All Public Schools
- Annual Inspection
- Fume Hoods Fire Protected
- Water Mist Systems
- Sprinklers / Water Reactives?
- Explosion Control
- CO Detectors



Chapter 10

- Means of Egress NFPA 101
 - 4in. Protrusion
 - Areas of Refuge
 - Sliding Doors OK non H
 - Occupant load factors revised

Chapter 33

Fire Safety During Construction, Alteration and Demolition

- Access Roads
- Fire Protection
- Stand Pipes – 4 Stories
- Heating Devices



San Jose Mercury News

A fire broke out Monday afternoon, August 19, at Santana Row, a \$750,000,000 retail and residential complex under construction in west San Jose. Flying embers set several homes and apartments to the south on fire, displacing over a hundred residents. A total of 11 alarms responded to all related fires. More than a dozen neighboring fire departments assisted San Jose in controlling the blaze...



Chapter 23

Repair Garages

- Flammable Gas Requirements
 - H_2 , CH_4 , C_3H_8
- Adequate Ventilation
- Gas Detection @25% LEL
- Local - Detector Annunciation
- H_2 Regulations

Chapter 23 – Fuel Dispensing

Static Charge Ignition



Chapter 31

- Tents & Membrane Structures
 - Applies to 10+ people
 - Cooking Rules



Chapter 35



- Welding & Hot Work
 - Cutting, Welding, Open Torch, Brazing, Glass Blowing & Similar Operations
 - 30 Minute fire watch when combustibles are present
 - Permit required
 - Hot Work Inspector

Chapter 35

- 20 ft. separation + 15 psi limit
- New Cylinder Regulations
- Cart Separations

Chapter 50

Hazardous Material

- HMIS & HMMP -changes
- Physical Hazard Change
- Control Area Rating Exception
- Elevator Carts
- Chemical Transport Elevator + com

Chapter 50

- Emergency Ventilation Switch
NOT required
- System Design for Dispensing

Chapter 53

Compressed Gasses

- NFPA 99 – 2005
 - Color Coding
 - O₂ – Green
 - N₂O – Light Blue
- Chrome Plated Cylinder – Tagged & Labeled
- Tube Trailers
- Isolated & Declassified Med. Gas Storage

Chapter 55

- Cryogenic Fluids- NFPA 55
 - Foundation & Support
 - Temperature Effects
 - Pressure Relief Devices
 - Clearly Labeled
 - Shutoffs
- ANSI/ASME A 13.1- 1996

Pickup truck on which the cylinder was being transported



Cylinder exploded at 12:40 PM while transport vehicle was parked on busy interstate highway



Chapter 57

- Flammable & Combustible Liquids
 - Special Fire Protection
 - **Maintenance to Current Code**
 - Spill Control – All Quantities
 - Secondary Containment – All Quantities

Chapter 57

- Flammable & Combustible Liquids (cont.)
 - Backflow Valves into Tanks
 - Manual Control Valve at Approved Location
 - Welded Concealed Joints
 - Support for Tanks and Pipe – 2hrs.

Chapter 57

- Design & Fabrication – Standards
- 5703 -Low Melt / Approve Ground
 - 1981 ° F
- Ventilation Piping Requirements
 - Emergency & Normal
 - **60 gallons !**

Chapter 57

- Foams – When Required by AHJ
- Pallets - combustibility
- NFPA 30 – full supplement
- 5703.6.3 – Testing per ASME B31.9
- Vent line flame arrestors
- Emergency Venting - Never in Building

Protected Aboveground Tanks



Protected Aboveground Tanks



Flammable Liquid Cabinet



Flammable Liquid Cabinet After Fire



Chapter 58

- Flammable Gases & Cryogenic Fluids
- H₂ Rules & Metal Hydrides
- ESO
- Pressure Relief Devices

Pressure/Vacuum Relief Vents



Chapter 60

- Highly Toxic and Toxic Materials
 - Containment Vessels
 - EFV – Excess Flow Valve
 - Definitions - HT and T
 - O3 – Ozone Regulations
 - PEL for California
 - >15 psig

Chapter 5307

- **CO₂ > 100lbs**
- **1 cfm/sq ft**
- **12” of Floor**
- **Gas Detection at 5000ppm**

Explosive Limits

<u>Chemical</u>	<u>LEL</u>	<u>UEL</u>	<u>Optimal</u>
Acetone	2.5%	15%	5.0%
Acetylene	2.5%	83%	8.0%
Ammonia	15%	28%	17%
Gasoline	1.4%	7.6%	1.6%
Hydrogen	4.0%	75%	8.0%
Methane	5.0%	15%	9.0%
Toluene	1.2%	7.1%	2.5%

Practical Application



Chapter 50

- Hazardous Materials
 - Applies to all materials at any quantity
 - Approved Designs
 - Road Map...
 - **308 NFPA Standards now apply**
 - **NFPA 45 ?**

Chapter 50

- Hazardous Materials (cont.)
 - Equipment and Machinery Listed or Approved
 - Defective Equipment Removed from Service

Separation



Chapter 50

- Design and Construction
 - Piping , tubing, valves, fittings and related components used for hazardous materials shall be in accordance with the following:
 - Piping, tubing, valves, fittings and related components shall be designed and fabricated from materials COMPATIBLE with the product material and...
 - Seismic

Piping Expansion Loop ASME B 31.3



Special Alloys

- Monel
- Nickel
- Hastelloy-B,C.D
- Titanium
- Aluminum - cryo

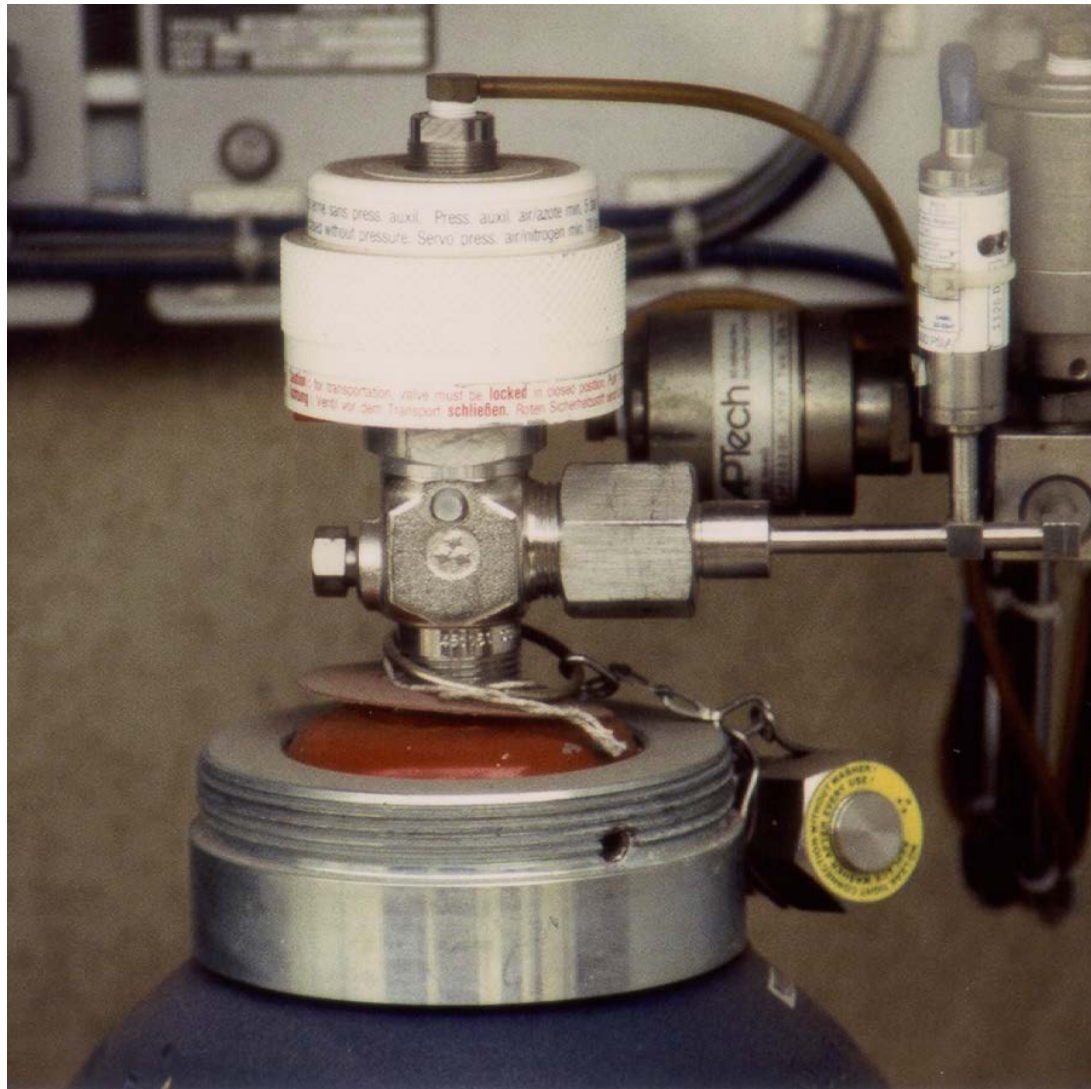
Emergency Controls



Chapter 50

- Storage
 - Liquid Cabinet Details
 - Seismic Secure Shelves
 - Treatment System Exceptions
 - Gas Tight Valve Caps
 - Secured Handles
 - Coffins – Training Req.

Pneumatic Cylinder Valve



Chapter 63

- Oxidizing Gases & Cryogenics
- LOX
- Home Health Care
- >15 Feet From Buildings
- Incompatible Separation

Dentist Office Fire Cylinder Storage Location



Cylinder Remnants



Chapter 64

- Pyrophoric Materials
- Secondary Containment Provisions
- Unstable Reactives 2= Flammable
 - SiH₄ – Special Regulations

Special

- Appendix
 - Fire Flow
 - Classification
 - LC 50 for Mixtures – TGO Guide
 - Hazard Ranking
 - Cryogenics Weight & Volume

Biotech

- Biosafety in Microbiological and Biomedical Laboratories
- “B”, “H” or “L” - Occupancy
- Biosafety Levels – 1,2,3,4



Fume Hoods



Laboratory fume hoods may be closed systems

Bio-Safety hoods may also be closed systems when exhausted outside the building



Concerns

- GLPc
- Increase in HPLC use
- High throughput HPLC's



Regulatory Concerns

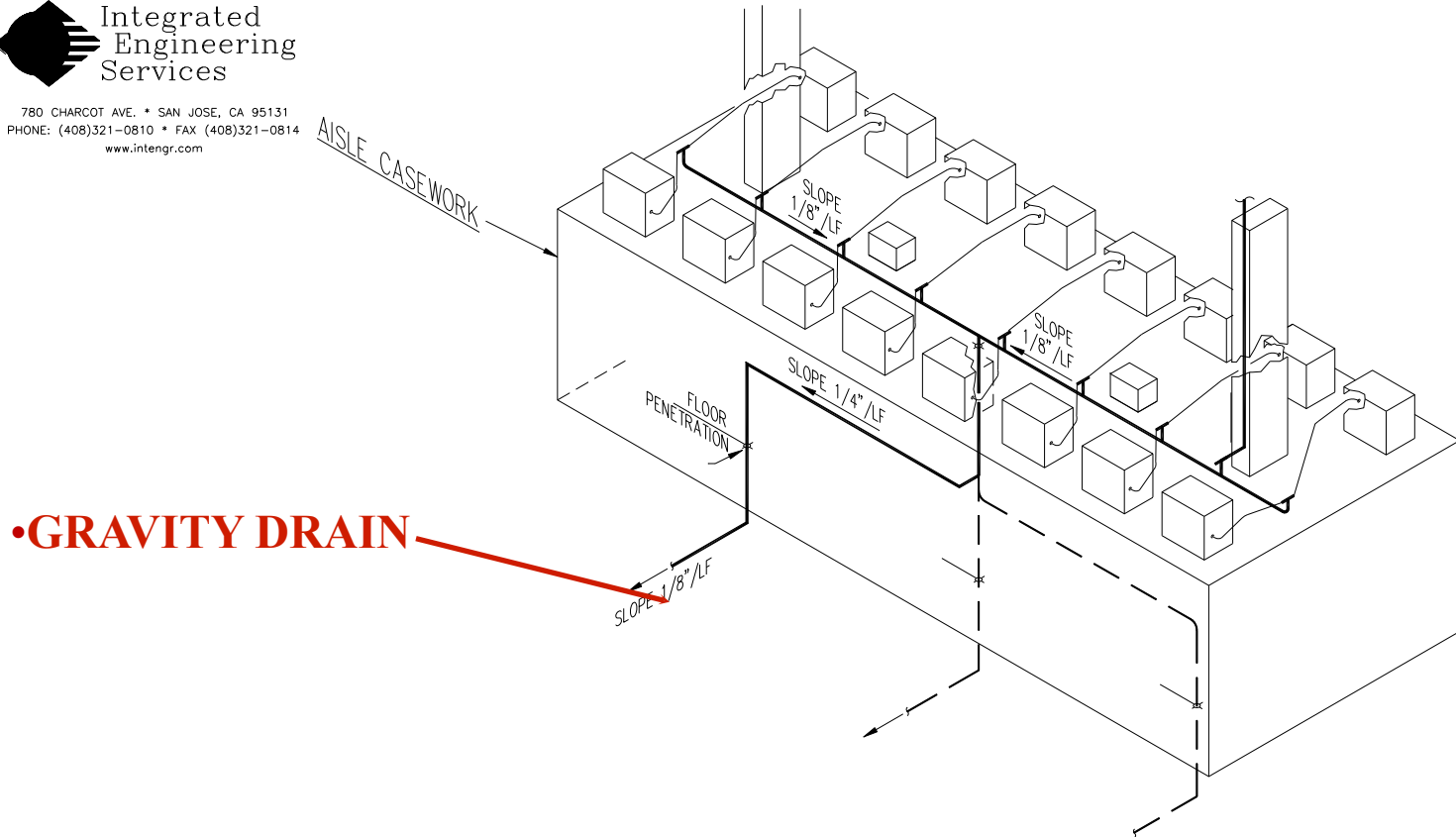
Blast, fire injures three at UC Irvine science lab

IRVINE, Calif. (AP) -- Three people were injured, years of research were lost and as much as \$10 million in damage was inflicted by a fire in the University of California, Irvine's physical science building. The fire erupted Monday afternoon on the second floor of the six-story building, said Orange County Fire Authority spokesman Dennis Shell. Authorities told the Orange County Register the disaster began about 3:45 p.m. as graduate student Cy Fujimoto purified benzene under a hooded ventilation system on a second floor lab...

Gravity Drain System



780 CHARCOT AVE. • SAN JOSE, CA 95131
PHONE: (408)321-0810 • FAX (408)321-0814
www.intengr.com



— TYPICAL AISLE SOLVENT WASTE ISOMETRIC
— NTS

Additional Regulatory Concerns

- Fire Sprinklers in Hoods
- Fire Sprinklers in Ducts.
- Cold Room Storage
- Biohazards

Fume Hood Sprinklers

- NFPA 45-Laboratory fume hoods where flammable materials are dispensed shall be protected by an automatic fire-extinguishing system.
- NFPA 1 – Extinguishing Systems for Laboratory Fume Hoods and Spray Booths. 60.4.10.1.3

MSDS
Safety Data Sheet



FLAMMABLE



Flammable Concerns

- Provide sufficient ventilation to maintain concentration $< 25\%$ LEL
- Limit volume of solvent to maintain concentration $< 25\%$ LEL

Flammable Concentration

- Example: 4' Fume Hood with 18" Sash Height
 - Area: 2.5' X 4' = 10 sq.ft.
 - Exhaust Rate: 1.5' X 4' X 100 fpm = 600 cfm

Solvent	Evaporation Rate (g/min)	Min. Exhaust (cfm)	Max. Volume (ml)
Acetone	260	544	NL
Diethyl Ether	508	1140	489
Isopropyl Alcohol	46	120	NL

Pharmacies [CA]

- A pharmacy shall have a designated area for preparation of sterile products which is ventilated in a manner so as not to interfere with laminar air flow
- Bio-hood required for preparing parenteral cytotoxic agents
 - Class II, Type A or B laminar hood
 - Bag in – Bag out filter
 - Plenums must be negative pressure and leak tight

ASME BPE

- Bio-Process Engineering (BPE)
 - The ASME BPE Standard establishes criteria for design, materials, construction, inspection, and testing of vessels, piping, and related accessories such as pumps, valves, and fittings for use in the biopharmaceutical industry, including:
 - Sterility and cleanability
 - Dimensions and tolerances
 - Surface finish requirements, and
 - Seals
 - Safety applies to L Occupancies
 - Safety

ASME A112.20.1 (2004)

- Qualification of installers for high-purity piping systems.
- ASME BPE

Maximum Allowable Quantities

Flammable Liquids

Material Classification			Table 60.2.2.1 Maximum Allowable Quantity of Hazardous Materials per Control Area ^a							
Physical Hazards			Stored ^b			Use-Closed ^b			Use-Open ^b	
Material	Class	High Hazard Protection Level	Solid	Liquid	Gas	Solid	Liquid	Gas	Solid	Liquid
			Lbs. (Cu.Ft.)	Gal. (Lbs.)	Cu.Ft.	Lbs. (Cu.Ft.)	Gal. (Lbs.)	Cu.Ft.	Lbs. (Cu.Ft.)	Gal. (Lbs.)
Flammable Liquid ^c	I-A	2 or 3		30 ^{e,f}			30 ^{e,f}			10 ^f
	I-B & I-C	2 or 3		120 ^{e,f}			120 ^{e,f}			30 ^{e,f}
	Combination (I-A, I-B, I-C)	2 or 3		120 ^{e,f,1}			120 ^{e,f,1}			30 ^{f,1}

CFC:
Has Separate
Line Items

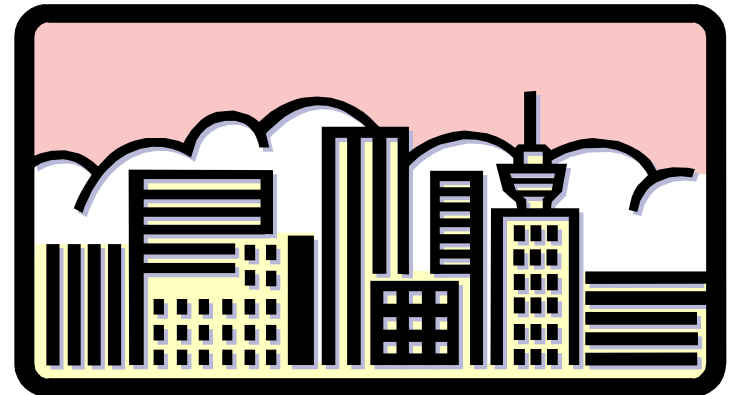
CFC = 60 Gal.

CFC = 60 Gal.

CFC = 15 gal.

Chapter 5

- General Height and Area Limitations
 - The height and area for buildings shall not exceed the limits in Table 503.
 - Limits based on:
 - Type of Construction
 - Occupancy



Chapter 10 IBC - Means of Egress

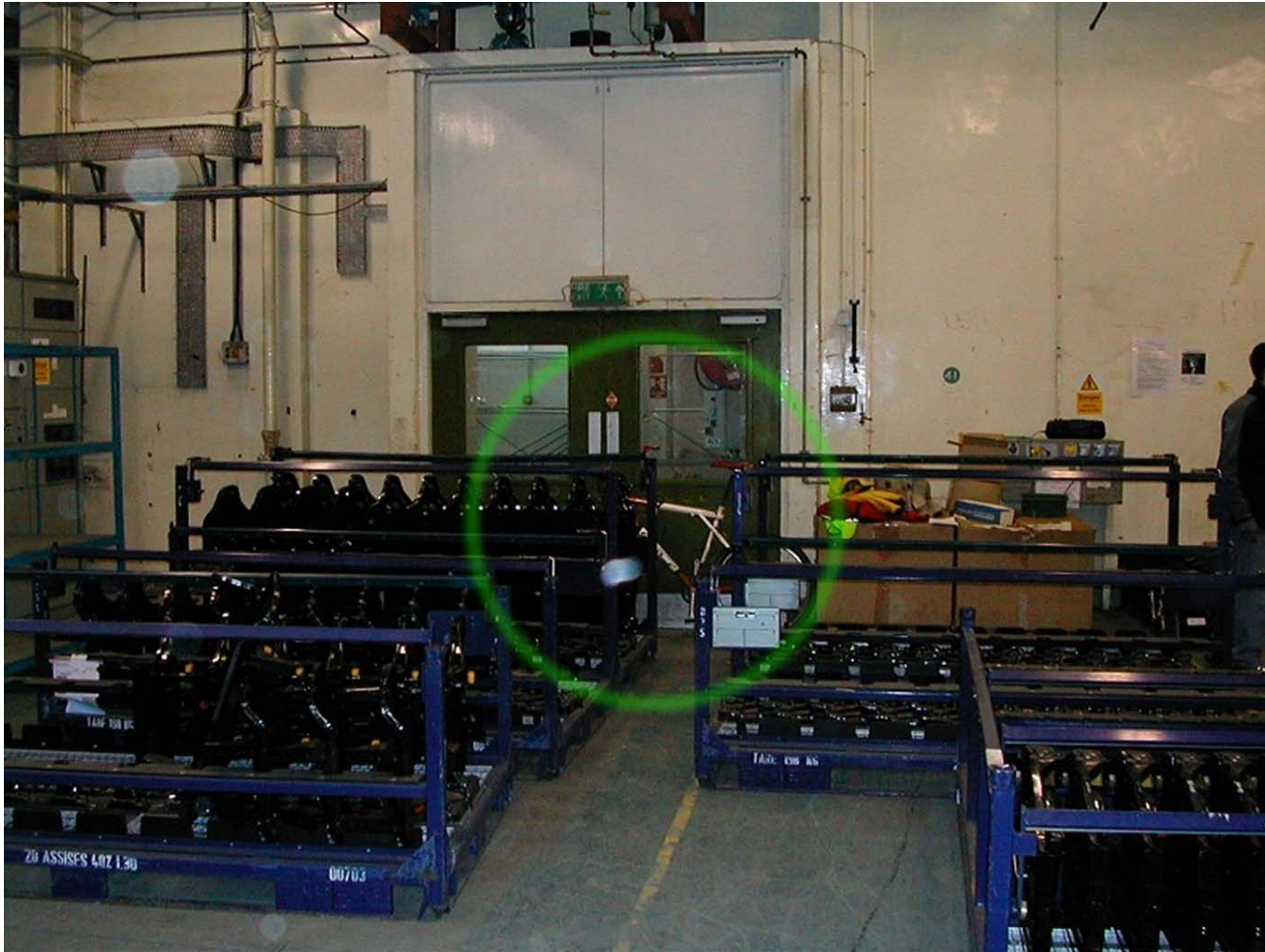


Means of Egress (MOE)

- Every building, or portion of a building thereof, shall be provided with a means of egress.
- The means of egress shall be:
 - Continuous
 - Unobstructed
 - Undiminished



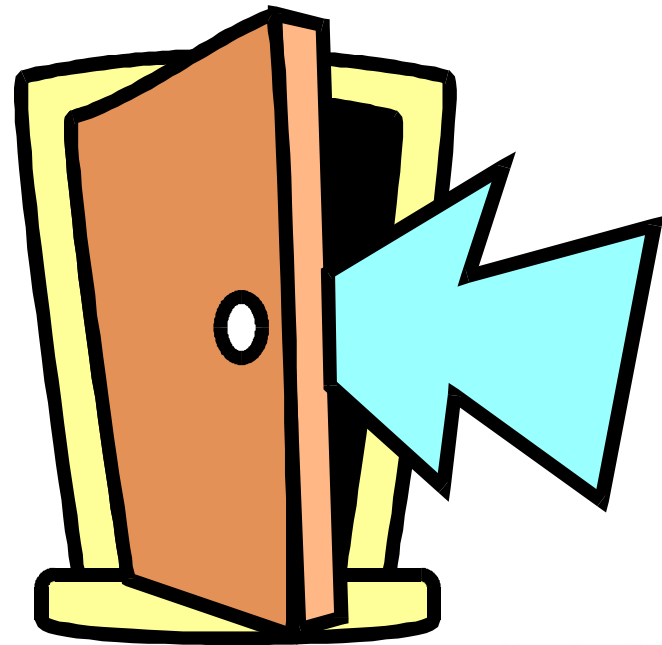
Obstructions



Section 1003 General MOE

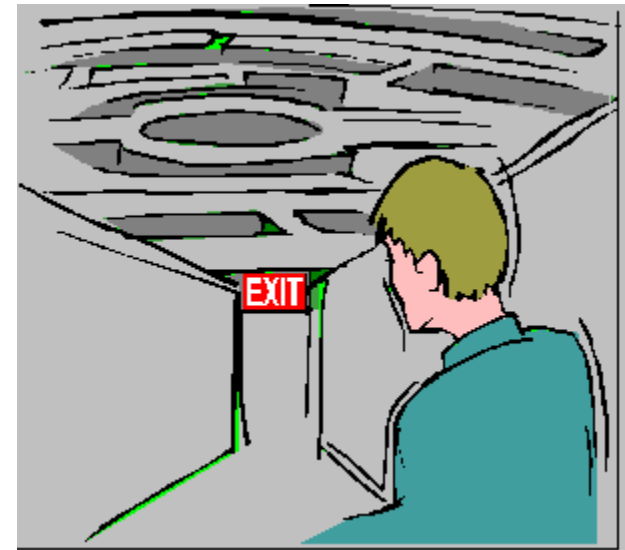
- The means of egress system consists of three separate and distinct elements:

- Exit access
- Exit
- Exit discharge



Exit Access

- That portion of a MOE system that leads from any occupied portion of a building or structure to an exit.
- Exit Access includes:
 - Rooms
 - Aisles & Hallways
 - Corridors



Exit

- That portion of the MOE system that provides a protected path of egress between the **exit access** and the **exit discharge**.
- **Exits** include:
 - Exterior **exit** doors at ground level
 - Other elements separated by fire-rated construction and openings:
 - **Exit Enclosures and Exit Passageways**
 - **Exit Stairs & Exit Ramps**
 - **Horizontal Exits**

Laboratory Control Area??



Laboratory Incidents

- Recently, it was discovered that a perchloric acid fume hood was heavily contaminated with potentially explosive perchloric acid salts.



Laboratory Incidents

- Recently, a steel lecture bottle located within a hood in a laboratory ruptured with explosive force. The explosion occurred at night and no one was present in the laboratory at the time of the incident. There was, however, significant damage to the lab hood



Laboratory Incidents

- At the University of X in the hazardous waste facility, a 55 gallon drum containing 30 gallons of mixed organic solvents exploded, launching upward into the ceiling. A significant fire ensued. Luckily no one was hurt. The mixed organic solvents in the drum had been consolidated from solvent waste containers from laboratories throughout the campus.



Laboratory Incidents

- A corrosive storage cabinet under a chemical hood in a University undergraduate laboratory was the site of an early morning explosion. Luckily, no one was standing in front of the hood when the explosion occurred.



Laboratory Incidents

BLAST, FIRE INJURES THREE AT UC IRVINE SCIENCE LAB

IRVINE, Calif. (AP) -- Three people were injured, years of research were lost and as much as \$10 million in damage was inflicted by a fire in the University of California, Irvine's physical science building. The fire erupted Monday afternoon on the second floor of the six-story building, said an Orange County Fire Authority spokesman. Authorities told the Orange County Register the disaster began about 3:45 p.m. as a graduate student purified benzene under a hooded ventilation system on a second floor lab...

Laboratory Fires

- A fire occurred when a flask containing an organic solvent cracked and leaked onto a stir plate causing ignition. The fire was extinguished by a sprinkler within the fume hood. Without the sprinkler the incident would have propagated outside the hood and caused significant damage to the laboratory...



Laboratory Fires



Laboratory Fires



Laboratory Fires



Laboratory Fires

1/11/02 – University of California at Santa Cruz

A three-alarm fire Friday on the fourth floor of Sinsheimer Laboratories injured no one but gutted two large research labs, damaged other areas of the building, and closed several other buildings in the Science Hill area of campus...



Practical Difficulties – L Occupancy

- Maximum allowable quantity, e.g. “exempt amount” prorated per floor.
 - Class 1B Flammable Liquids above 3rd floor limited to:
 - 7 ½ Gallons in use per control area¹
 - 30 Gallons total per control area²
 - Practically limits PI’s to 2 to 4 per control area³
 - Maximum 2 control areas

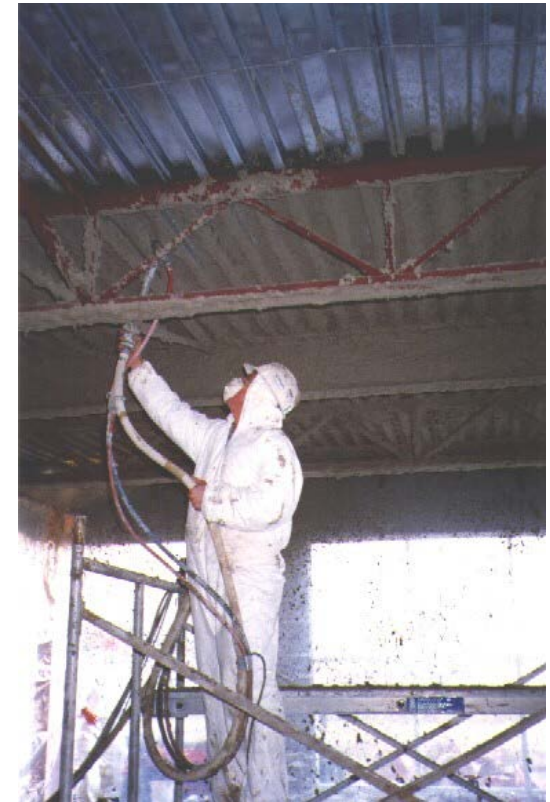
¹ Sprinklered building, open use

² Sprinklered building, may be doubled when stored in fire-rated cabinet.

³ Based on average of 8 gallons flammable liquids per PI.

Practical Difficulties

- Requires 2-hour fire resistant floor rating.
- Exception:
 - 3 stories or less in height, and
 - Full automatic fire protection system, and
 - Type IIA, IIIA, VA, e.g. 1-hour Construction
- 2-hour fire resistant construction must extend to supporting structural elements to grade



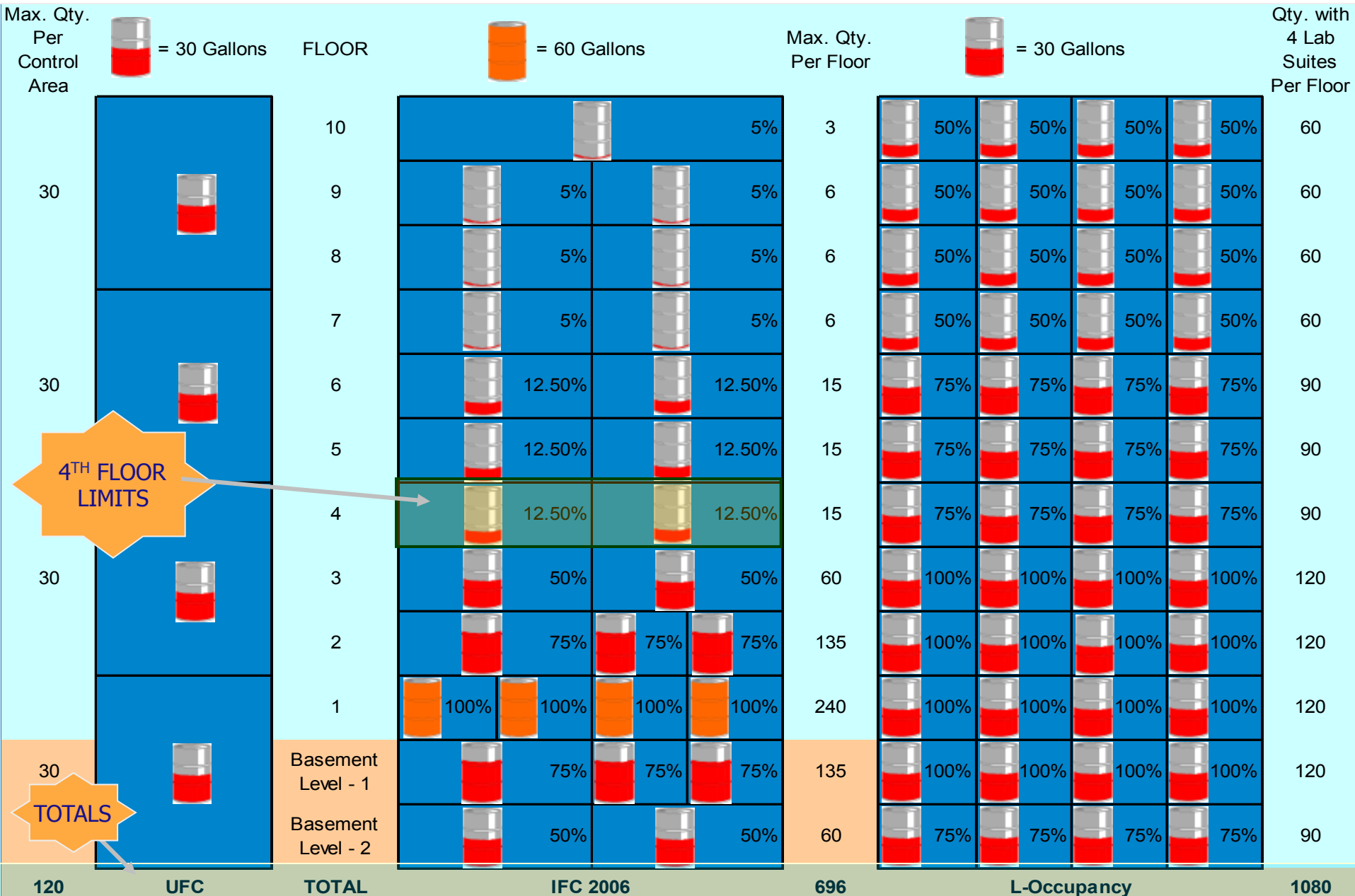
L-Occupancy –Jan.1 2009



L-Occupancy

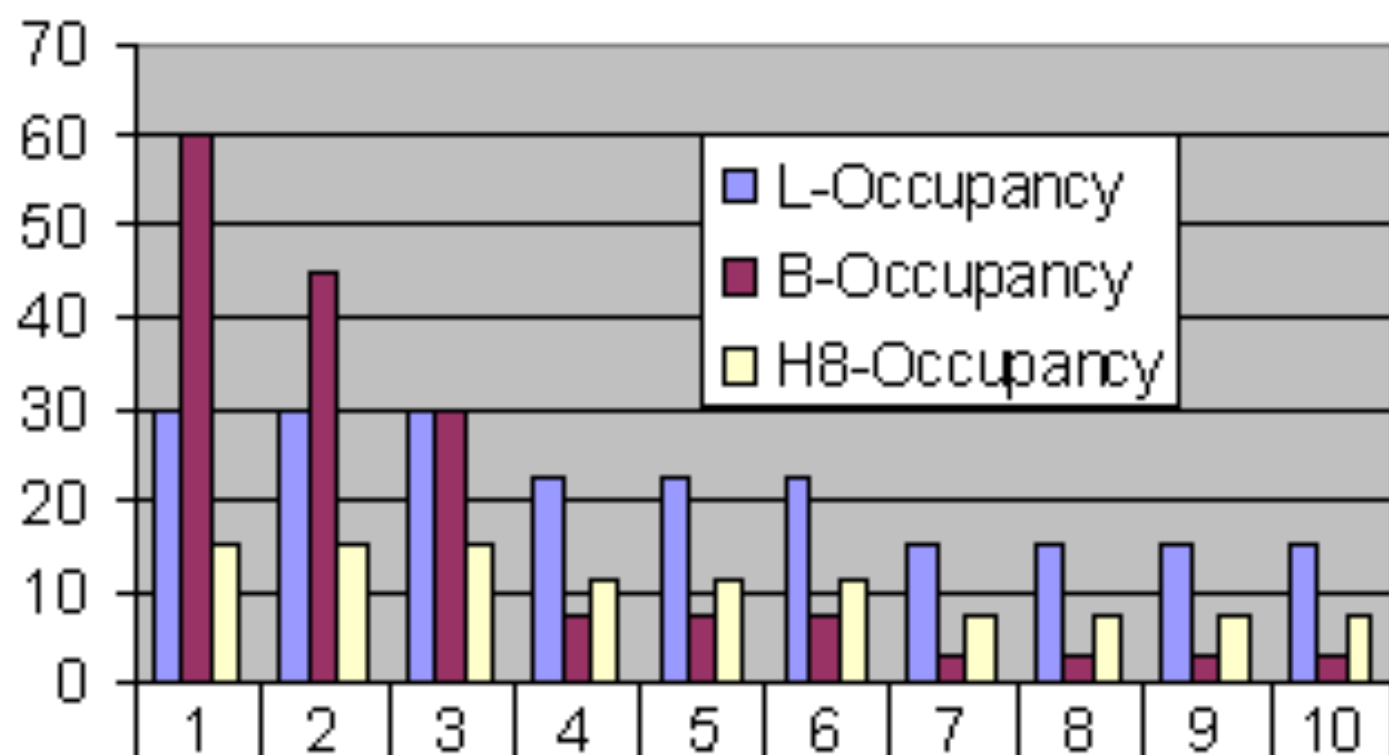
- Substitutes “Laboratory Suite” for Control Area Concept
 - Laboratory suite may encompass ancillary support areas, including offices, storage areas, etc.
 - Requires only 1 hour vertical and horizontal separations.

FL-1B Use Open



MAXIMUM ALLOWABLE QUANTITY

FL-1B OPEN-USE (GAL)



STORY

L-Occupancy	30	30	30	23	23	23	15	15	15	15
B-Occupancy	60	45	30	7.5	7.5	7.5	3	3	3	3
H8-Occupancy	15	15	15	11	11	11	7.5	7.5	7.5	7.5

L-Occupancy

- Original SFM version submitted to BSC limited the scope to “post secondary institutions”
- Based on input the SFM revised wording to omit reference to “post secondary institutions”.
- However, CBC Section 111 applies only to facilities regulated by SFM

L-Occupancy

- Egress:
 - Changes would require 2 exits or exit access doors for areas > 500 sq.ft.
 - Travel Distance limited to 200 ft. and within Lab Suite 100 ft.
- Construction:
 - Provide any construction type commensurate with the type of building being constructed.

L-Occupancy

- Maximum allowable quantities:
 - Proposed changes would reference CBC tables
- Story Sub-Division
 - Proposed changes would require 2-hour fire resistance barrier 5th floor and above.

L-Occupancy

- Lab Suite Boundary
 - Proposed changes would permit lab suites to span floors
- Clarify
 - Emergency power requirements
 - Ventilation requirements
 - “Liquid Tight” floors
 - Lab suite separations

Conclusion

- Get involved with your local AHJ
- Get Involved with Code Development
- The greatest barrier to learning the truth is to be convinced you already know it.