Biodiesel Production: The Code Official's Perspective

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Special Hazards

Biodiesel Production

The Code Official's Perspective

- Fire Marshals
- Building Officials

Permitting and Occupancy

Fire Marshals & Building Officials

- Building Permit Process
- Certificate of Occupancy

Fire Marshals

- Ongoing/Annual Inspections

Statutory Authority

- 2005 State Building Code
  - Adopts 2003 IBC with CT Amendments
  - Authorized by CGS 29-252
  - Regulations of CT State Agencies 29-252-1d
  - FM approval required (CSBC 105.3.1.2)
- 2005 CT Fire Safety Code
  - Adopts portions of 2003 IFC, NFPA 101, & NFPA 1 with CT Amendments
  - Authorized by CGS 29-292
  - Regulations of CT State Agencies 29-292-1e to 29-292-11e

Statutory Authority

- CT Flammable & Combustible Liquids Code
  - Authorized by CGS 29-320
  - Regulations of CT State Agencies 29-320-1a to 29-320-4a
  - 29-320-3a adopts 11 NFPA Standards
    - Service Stations, Tank Vehicles, Cleaning Tanks, Aerosol Manufacturing, etc.
    - NFPA 30 Flammable & Combustible Liquids Code

National Fire Protection Association

- What is the NFPA?

National Fire Protection Association

"The authority on fire, electrical, and building safety."

"Established in 1896, NFPA serves as the world's leading advocate of fire prevention and is an authoritative source on public safety."

National Fire Protection Association

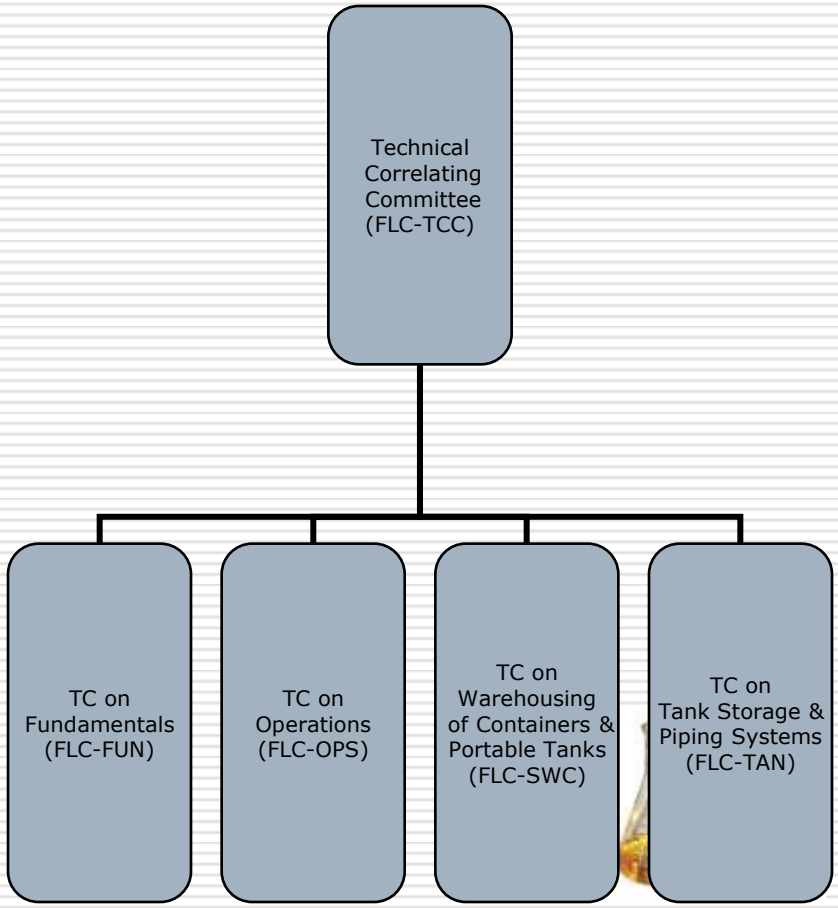
- International nonprofit organization
- Consensus codes and standards, research, training, and education
- More than 81,000 individual members
- More than 80 national trade and professional organizations
- American National Standards Institute (ANSI) accredited code development process

National Fire Protection Association

"NFPA's 300 codes and standards influence every building, process, service, design, and installation in the United States, as well as many of those used in other countries."

NFPA 30
Flammable & Combustible Liquids Code

- Consensus standard
- 4 Technical Committees & Correlating Committee
- Representatives from various interests
- No single interest can exceed 1/3 of the code committee
- Currently about 35 members on FLC-FUN



NFPA 30
Flammable & Combustible Liquids Code

- **M** **Manufacturer**
- **U** User
- I/M Installer/Maintainer
- L Labor
- R/T Applied Research/Testing Laboratory
- **E** Enforcing Authority
- **I** **Insurance**
- C Consumer (not User)
- **SE** **Special Expert** (not included above)

NFPA 30
Flammable & Combustible Liquids Code

- *From 1913 to 1957, Suggested Ordinance for the Storage, Handling and Use of Flammable Liquids*
- Changed to code format in 1957
- Revised on a 3 year cycle
- NFPA 30 – 2008 is the current edition
- NFPA 30 – 2011 is in the earliest stages of development

NFPA 30
Flammable & Combustible Liquids Code

Adopted Code in CT is the 1996 edition

NFPA 30 – 1996

- Flammable and Combustible Liquids Code
  - Chapters
    1. General Provisions
    2. Tank Storage
    3. Piping
    4. Portable Containers
    5. Operations

NFPA 30 – 1996

- **1-1 Scope**
  - **1-1.1** This code shall apply to the ***storage***, ***handling***, and ***use*** of flammable and combustible liquids, including waste liquids, as herein defined and classified.
  - Exceptions
    - certain special classes of liquids with unique hazards
    - liquids covered by NFPA 395
    - transportation governed by US DOT
    - fuel oil tanks connected with oil burning equipment

NFPA 30 – 1996

- **1-2 Purpose**. The purpose of this code shall be to provide ***reasonable requirements*** for the safe storage and handling of flammable and combustible liquids.

NFPA 30 - 1996

- **1-3 Applicability**. Chapters 2 and 3 shall apply to bulk storage of liquids in tanks and similar vessels. Chapter 4 shall apply to storage of liquids in containers and portable tanks in storage and in warehouses. Chapter 5 shall apply to handling of liquids in manufacturing and related operations and processes.

NFPA 30 - 1996

1-6 Definitions

- **Refinery.** A plant in which flammable or combustible liquids are produced on a commercial scale from crude petroleum, natural gasoline, or ***other hydrocarbon sources***.

NFPA 30 - 1996

1-6 Definitions

- **Storage Tank Building.** A ***roofed structure*** that contains storage tanks and that limits the dissipation of heat or the dispersion of flammable vapors or restricts fire-fighting access and control and that is installed in accordance with the requirements of Section 2-5.

NFPA 30 - 1996

1-6 Definitions

- **Storage Tank.** Any vessel having a liquid capacity that exceeds 60 gal. (227 L), is intended for fixed installation, and is ***not used for processing***.

NFPA 30 - 1996

1-6 Definitions

- **Process or Processing.** An integrated sequence of operations. The sequence can be inclusive of both physical and chemical operations, unless the term is modified to restrict it to one or the other. The sequence can involve, but is not limited to, ***preparation***, ***separation***, ***purification***, or ***change in state***, ***energy content***, or ***composition***.

NFPA 30 - 1996

- **1-6 Definitions**
  - **Atmospheric Tank.** A storage tank that has been designed to operate at pressures from atmospheric through 1.0 psig measured at the top of the tank.
  - **Low-Pressure Tank.** A storage tank that has been designed to withstand an internal pressure above 1.0 psig but not more than 15 psig measured at the top of the tank.
  - **Pressure Vessel.** Any fired or unfired vessel within the scope of the applicable section of the ASME *Boiler and Pressure Vessel Code*.

NFPA 30 - 1996

- **1-6 Definitions**
  - **Stable Liquid.** Any liquid not defined as unstable.
  - **Unstable Liquid.** A liquid that, in the pure state or as commercially produced or transported, will vigorously polymerize, decompose, undergo condensation reaction, or become self-reactive under conditions of shock, pressure, or temperature.

NFPA 30 - 1996

- **1-6 Definitions**
  - **Protection for Exposures.** Fire protection for structures on property adjacent to liquid storage. Fire protection for such structures shall be acceptable when ***located either within the jurisdiction of any public fire department*** or adjacent to plants having private fire brigades capable of providing cooling water streams on structures on property adjacent to liquid storage.

NFPA 30 - 1996

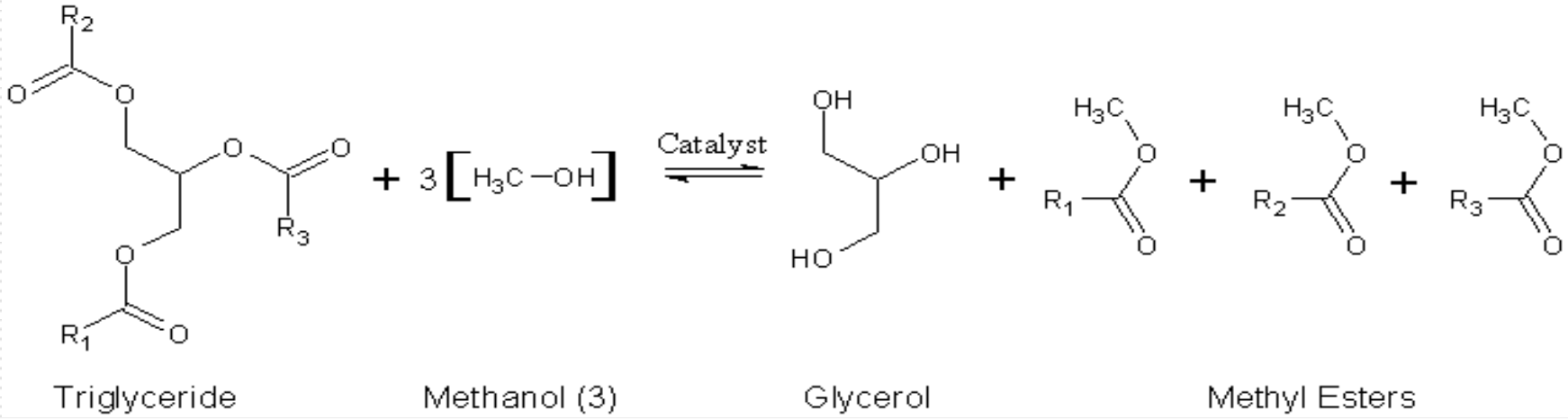
- 1-7.3.1 Flammable Liquid
  - **Class I**
    - Flash Point < 100 F
    - Vapor Pressure <= 40psia @ 100 F
    - **Class 1A**
      - Flash Point < 73 F & Boiling Point < 100 F
    - **Class 1B**
      - Flash Point < 73 F & Boiling Point => 100 F
    - **Class 1C**
      - 73 F <= Flash Point < 100 F

NFPA 30 - 1996

- 1-7.3.2 Combustible Liquid
  - **Class II**
    - 100 F < Flash Point <= 140 F
  - **Class IIIA**
    - 140 F <= Flash Point < 200 F
  - **Class IIIB**
    - Flash Point > 200 F

Applying NFPA 30

Ask the right questions!



Facility Specific Data

- Exactly what will the facility do?
  - Storing/distributing Biodiesel products?
  - Refining raw feed stock into Biodiesel?
    - Feed Stock & Alcohol ➔ B100
  - Blending Biodiesel with petrodiesel?
    - B100 & petrodiesel ➔ B20, B5, B2
    - fuel additives
      - anti-gel / pour-point depressants; may contain toluene
      - anti-contaminants; biocides & fungicides
      - stabilizers / antioxidants; may contain phenols

Facility Specific Data

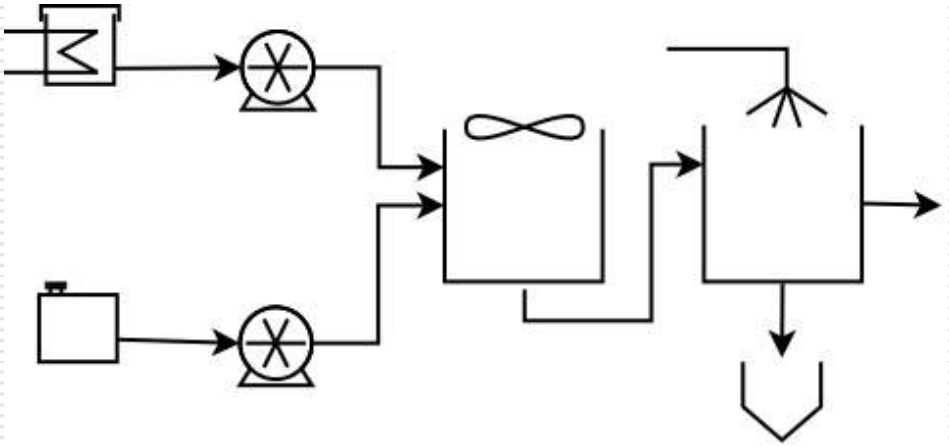
- Exactly what will the facility do?
  - Dispensing Biodiesel fuels?
    - public service stations
    - fleet service stations
  - Using Biodiesel on the premises?
    - building heating
    - feed stock heating
    - farm equipment fueling

Facility Specific Data

- Construction Documents
  - Provide Detailed Physical Layout
    - plot plan
      - property lines
      - other important buildings
      - public ways
    - show every tank & process vessel
      - contents, capacities, purpose
    - determine required separations

Facility Specific Data

- Construction Documents
  - Provide Schematic Piping Plan
    - identify tanks and process vessels
    - identify valves and related appurtenances
    - identify product flow through entire system



Facility Specific Data

- Construction Documents
  - Provide MSDS for each chemical
    - determine hazard classes
      - Flammable Class IA, IB, IC
      - Combustible Class II, IIIA, IIIB
  - Provide Quantities for each chemical
    - Cumulative by classification
  - Determine occupancy group in IBC
    - Group F or S
    - Group H → IBC Chapter 4, Section 414

Material Safety Data Sheet

BIODIESEL INDUSTRIES INC.

MATERIAL SAFETY DATA SHEET

SECTION 1 – PRODUCT IDENTIFICATION

Common Name: Biodiesel
Chemical Name: Fatty Acid Methyl Ester
Formula: C14-C24 Methyl Esters
Chemical Family: CAS No. 67784-80-9

SECTION 2 – INGREDIENTS AND HAZARDOUS CLASSIFICATION

Typical Composition:

	OSHA PEL	ACGIHTLV	Percent
Alkyl C14-C24 Methyl Esters	none	none	99

This product contains no hazardous materials.
SARA Title III, Section 313: Not Listed

SECTION 3 – PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point: >400° F
Vapor Pressure (mm Hg): <5 mm Hg @ 72° F
Evaporation Rate: less than .005 versus (Butyl Acetate = 1)
Solubility in Water: insoluble
Appearance and Odor: light to dark yellow clear liquid / light musty odor

SECTION 4 - FIRE AND EXPLOSION HAZARD DATA

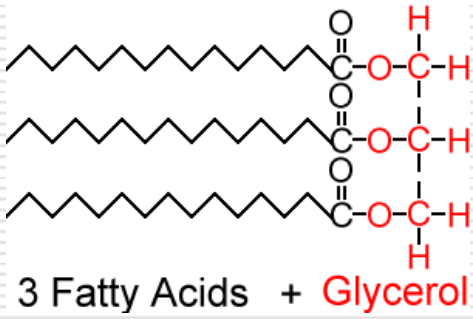
Flash Point (method used): 321° F PMCC
Flammable Limits: N/A
HMIS Rating: Health: 0 Fire: 1 Reactivity: 0
Extinguishing Media: Use water spray, dry chemical, foam or carbon dioxide.
Special Fire Fighting Procedures: Treat as oil fire.
Unusual Fire and Explosion hazards: Rags soaked with any solvent present a fire hazard and should be stored in an approved UL listed covered container.

– Page 1 of 2 –

- Source for Hazard Data
- Material Classification
  - Flash Point
  - Boiling Point
  - Stable or Unstable
- NFPA 704
  - Health
  - Flammability
  - Reactivity

Common Chemicals

- "Feed Stock"
  - Raw materials that will be processed into Biodiesel
    - most often vegetable oil, raw or recycled, but a wide variety of sources may be used
  - Stable, usually Class IIIB
  - "triglyceride"



Common Chemicals

- Methanol
  - Commonly known as "Wood Alcohol"; CH_3OH
  - Stable, Class 1B Flammable
  - Toxic (Poison B)
  - NFPA 704 1-3-0
  - Main ingredient in "Dry Gas" for automobiles

- Other alcohols may also be used
  - ethanol; "grain alcohol"; C_2H_5OH
  - propanol; C_3H_7OH
  - butanol; C_4H_9OH

Common Chemicals

- Sodium Hydroxide
  - commonly know as "Lye"; NaOH
  - alkaline catalyst
  - "Corrosive" (Caustic)
  - NFPA 704 3-0-1
- Potassium Hydroxide
  - also known as "Potash Lye"; KOH
  - alkaline catalyst
  - "Corrosive" (Caustic)
  - NFPA 704 3-0-1
- Sodium Methoxide
  - $Na(CH_3O)$
  - alkaline catalyst
  - "Corrosive" (Caustic)
  - NFPA 704 3-4-3

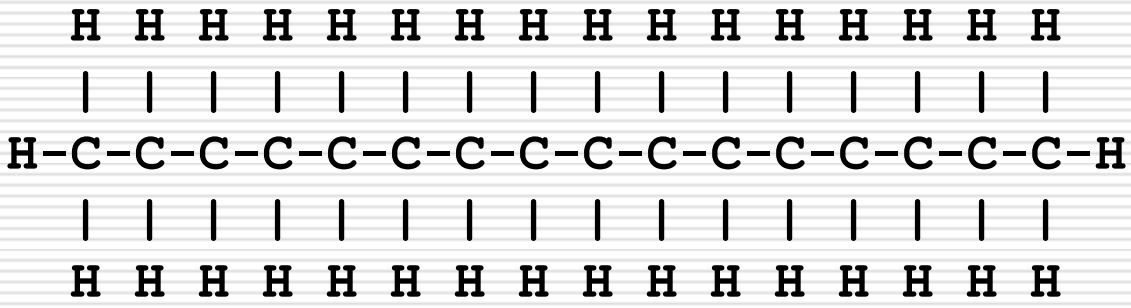
Common Chemicals

- "Methoxide"
  - Often misused in Biodiesel production literature.
  - Most often properly refers to a "metal hydroxide solution in methanol"
  - NaOH or KOH dissolved in methanol → OH^-
  - Stable, Class IB flammable
- Sodium Methoxide / Sodium Methylate
  - $Na(CH_3O) \rightarrow CH_3O^-$
  - Highly toxic, flammable, & reactive

Common Chemicals

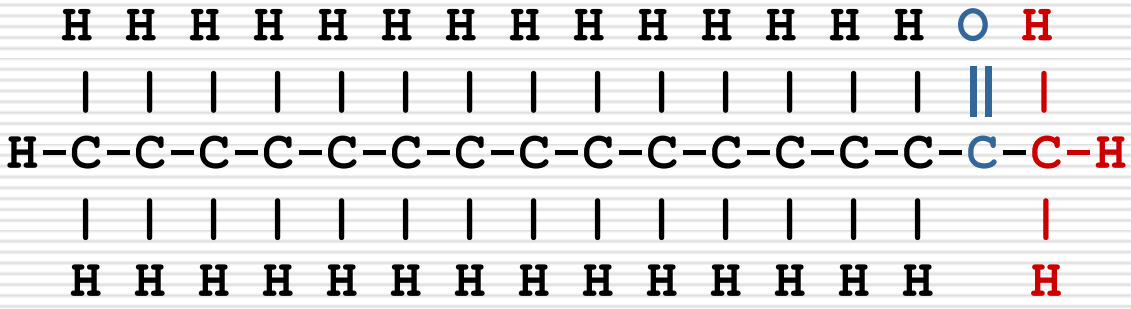
- "Biodiesel"
  - Fatty Acid Methyl Ester (FAME); Alkyl C_{14} – C_{24} methyl esters
    - "cetane" in petrodiesel is $C_{16}H_{34}$
  - Stable, Class IIIB Combustible
  - Non-toxic, environmentally friendly

Petrodiesel vs Fatty Acid Methyl Ester



$C_{16}H_{34}$

Cetane



$C_{14}H_{29}COCH_3$

F.A.M.E.

Common Chemicals

- Glycerin/glycerol
  - Stable, Class IIIB Combustible
  - $HOCH_2CH(OH)CH_2OH$
  - used in soap making
  - sugar alcohol used in foods and beverages
  - also used to make nitroglycerin

Tank Storage

- Constructed to recognized standards
  - Appropriate standard for type and use
    - Atmospheric Tanks
    - Low-Pressure Tanks
    - Pressure Vessels
      - "not to exceed the design pressure"
  - Approved by a CT PE if altered
    - conforms to sound engineering practices

Tank Storage

- Outside Aboveground Tanks
  - Far enough from property lines, public ways, and important buildings
  - Look up in Tables
    - Type & Size of Tank
    - Stable versus Unstable Liquids
    - Relief Venting Pressures
    - Protection of Exposures

Tank Storage

- Normal tank venting to account for day to day changes in pressure
- Emergency tank venting to prevent catastrophic tank failure during a fire exposure or other thermal insult
  - reduce possibility of BLEVE

Tank Storage

- Storage Tank Buildings
  - *Buildings with Storage Tanks in Them*
  - Class IIIB tanks only are exempt
  - Far enough from property lines, public ways, and important buildings
  - Construction Integrity for 2 Hours
  - Ventilation (accumulation of vapors)

Tank Storage

- Drainage to minimize fire exposure
- Flammable tanks vent outdoors
- Tank openings properly secured
- Electrical equipment / ignition sources
- Support, Foundations, & Anchorage
- Overfill prevention
- Leakage detection for U/G tanks

Piping Systems

- Includes all devices for mixing, separating, distributing, metering, controlling flow, secondary containment of liquids and associated vapors, etc.
- "suitable for the expected working pressures and stresses"
  - Conformance with ANSI B31 acceptable
  - Engineered alternatives

Piping Systems

- Piping, valve, and fitting materials
  - manufacturer's recommendations
  - cannot be combustible or easily damaged by fire / heat
  - no plastic pipe above ground
  - acceptable pipe joining methods
  - pipe protected against physical damage
  - all piping protected against external corrosion

Piping Systems

- "a sufficient number of valves"
  - conforms to sound engineering practices
  - schematic plan showing entire process
    - show all tanks, process vessels, valves, pressure relief valves, check valves, etc.
    - isolate tanks, process vessels, pumps, etc.
    - protection against backflow
    - protection against siphoning
- Pressure testing required

Containers & Portable Tanks

- Drums / containers <= 60 gallons
- Portable tanks <= 660 gallons
- Design, construction and capacity of:
  - containers
  - storage cabinets
- Allowable quantities & storage heights
- Outdoor storage

Processing

- Liquid processing vessels and equipment location
- Far enough from property lines, public ways, and important buildings
  - engineering evaluation
  - sound fire protection & process engineering practices

Processing

- Processing buildings or structures shall be of fire resistive or noncombustible construction
- Combustible construction is permitted with automatic fire sprinklers
  - equivalent protection approved by AHJ

Processing

- Ventilation for liquids above flash points
- Emergency drainage for liquids and fire protection water
- Electrical equipment / ignition sources
- Vapor collection systems
- Protection against overfills
- Emergency system shutdown

Operational Issues

- Control Of Ignition Sources
  - Open flames
  - Smoking
  - Static electricity
  - Stray currents

Operational Issues

- Loading and Unloading
  - Specific operational issues
    - Bonding
    - Grounding
  - "Switch Loading" requirements
    - loading tanker with a different liquid
  - Annex contains section on loading and unloading tank vehicles

Operational Issues

- Management of Fire Hazards
  - Management methodology used to identify, evaluate, and control the hazards in processing and handling of Flammable & Combustible liquids
  - Extent of fire protection and control determined by means of an engineering evaluation of sound fire protection & process engineering principals

Operational Issues

- Management of Fire Hazards
  - Written Emergency action plan
    - Procedures for fires and emergencies
    - Appointment and training of personnel
    - Maintenance of fire protection equipment
    - Shutdown/isolation of equipment to reduce the release of liquids
    - Alternative measures for the safety of occupants

Operational Issues

- Fire Protection & Fire Suppression
  - Portable Fire Control Equipment
    - listed portable fire extinguishers
    - NFPA 13 hose connections from sprinkler systems
    - NFPA 14 systems (standpipe and hose)

Operational Issues

- Fire Protection & Fire Suppression
  - Fixed Fire Control Equipment
    - reliable water supplies
    - fire hydrants
    - automatic fire sprinklers, water spray systems, deluge systems, fire resistive materials or a combination of these
  - systems maintained in accordance with NFPA standards

Operational Issues

- Detection and Alarm
  - Approved means shall be provided for prompt notification of fire or emergency within the plant and fire department

Operational Issues

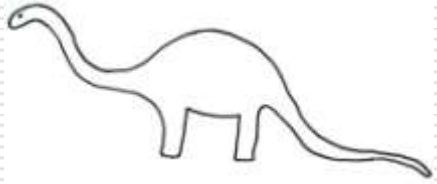
- Emergency Planning and Training
  - training in use of fire protection equipment
    - annual refresher
  - planning coordinated with local responders
  - safe shutdown of operations
  - written plan readily available
  - posted prominently if premises unattended

One Piece of the Energy Puzzle

Remember,

Petroleum is a "bio-fuel," too…

It just takes a lot longer to make.



Questions?

Your Local Fire Marshal & Building Official

State Fire Marshal
860-685-8380
State Building Inspector
860-685-8310
CT Department of Public Safety
ct.gov/dps
860-685-8190

CT Department of Environmental Protection
ct.gov/dep
860-424-3000

Questions?

An outline of this program is available by request from:

Inspector Robert Upson
c/o Southington Fire Department
Fire Prevention Bureau
upsonr@southington.org
860-621-3202 x 140