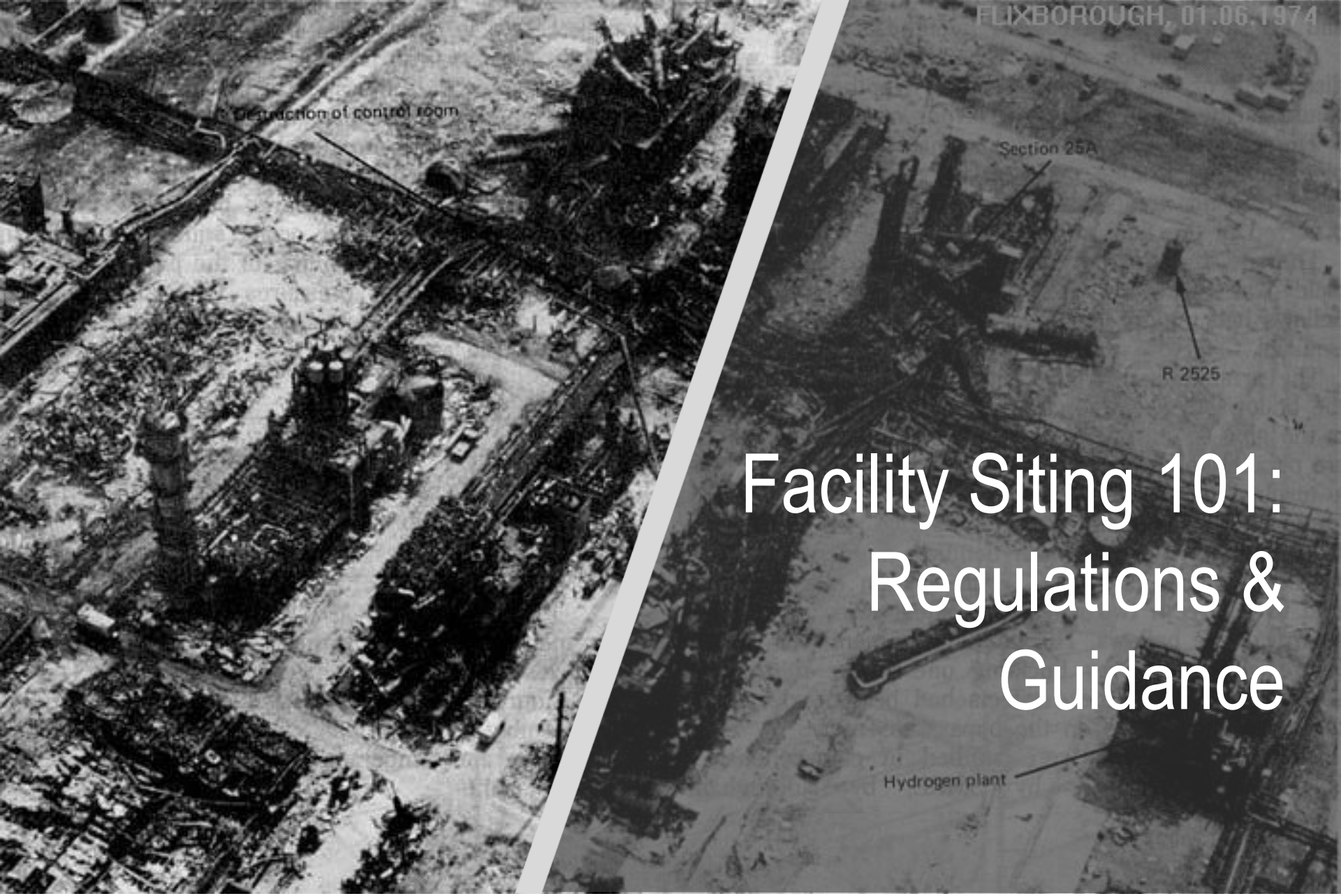
API RP 752 Facility Siting Overview

Gary Fitzgerald
Director
ABS Consulting
San Antonio, TX 78232
210-495-5195

Overview

- Facility Siting 101: Regulations & Guidance
- History
- Approaches to Facility Siting Studies
- Facility Siting Remedial Actions
- Questions



Facility Siting 101: Regulations & Guidance

U.S. Regulations

Occupational Safety and Health Administration (OSHA)

- Process Safety Management (PSM) Regulation lists “facility siting” as one of the elements in a Process Hazards Analysis (PHA) with no guidance on what “facility siting” means.

Environmental Protection Agency (EPA)

- Risk Management Program (RMP) lists “stationary source siting” as one of the elements in a PHA with little guidance on meaning.

The initial intent was to keep people from being hurt by the building they are working in but it has also extended to include proper building location that ensures a safe evacuation can be made or building is safe to shelter in place.

Guidance Documents

Without any regulatory guidance, the American Petroleum Institute (API) generated its own Recommended Practices (RPs):

- API RP 752 – Permanent Building Siting (2009)
- API RP 753 – Portable Building Siting (2007)
- API RP 756 – Tent Siting (2014)

Hazards to include are:

- Explosion, fire and toxic exposure from PSM covered processes
- Many companies extend this to all processes.

Who Needs to Perform Facility Siting Studies?

All indications I have are that OSHA expects all PSM-covered processes to have a facility siting study

- Consequence studies are expected
- Must be revalidated every 5 years or as conditions change (process or building changes)

Companies with non-PSM covered processes are adopting facility siting practices to address recognized hazards

Approaches to Facility Siting Studies

Facility Siting Approaches

An evaluation of consequences is required using one of three methods.

1. Spacing Tables

- Tables of distance from a hazard allowed only for fire hazards. (CCPS is one example.)
- Pass or fail criteria.
  - Failure requires additional study or moving people.

2. Consequence-Based Study

- Maximum Credible Events (MCEs) postulated and evaluated.
- All results greater than criteria must be resolved.

Facility Siting Approaches

3. Risk-Based Study

- Rigorous risk calculation to include numerical frequencies and consequences, typically called a Quantitative Risk Assessment (QRA).
  - Risk greater than tolerance must be remediated.
- Qualitative evaluations of either frequency or consequence are not allowed, other than for prioritizing corrective actions in a consequence-based study.

Maximum Credible Events (MCEs)

Used in Consequence-Based Studies:

"A hypothetical explosion, fire, or toxic material release event that has the potential maximum consequence to the occupants of the building under consideration from among the major scenarios evaluated. The major scenarios are realistic and have a reasonable probability of occurrence considering the chemicals, inventories, equipment and piping design, operating conditions, fuel reactivity, process unit geometry, industry incident history, and other factors. Each building may have its own set of MCEs for potential explosion, fire, or toxic material release impacts."

Occupied Buildings for Analysis

If personnel are assigned to a building, the building must be included

- No man-hours limit specified in RP.
- Exception is enclosed process buildings where only essential personnel operating the process are located.
- Examples provided in the RP.

Intermittently occupied buildings may be excluded (definition of intermittent is up to owner/operator)

Occupied Buildings for Analysis (Cont.)

Every building must be designated either as an Emergency Shelter or to be evacuated in a fire or toxic emergency and evaluated for such.

Analysis must be performed for both existing buildings and new construction.

All occupied buildings onsite must be included.

Periodic inspections must be performed to ensure unoccupied buildings have not become occupied.

Exclusions

Non-essential personnel:

- Cannot be located in enclosed process buildings.

Brittle construction:

- Use is not prohibited, but must have documentation to show why it was chosen over other methods and have an analysis proving satisfactory response to predicted hazards.
- Given the little change in explosion loads needed to change the damage prediction from minor to severe, you will need to ensure your predicted loads are far from that needed to exceed your criteria to adequately defend using brittle construction.
- Not much reinforcement and little expense is needed to give brittle construction ductility.

Criteria

Criteria should be established before the analysis.

For spacing tables, it is distance criteria pass/fail.

For consequence study, it is typically:

1. Allowable building damage for explosions
2. Thermal flux for fires
3. Toxic concentration for toxic releases
   - Vulnerability is often used in lieu of fire and toxic criteria above to account for length of exposure

For risk study, it is typically a comparison of criteria to:

1. Aggregate risk
2. Maximum individual risk
   - Must consider both individual and aggregate risk

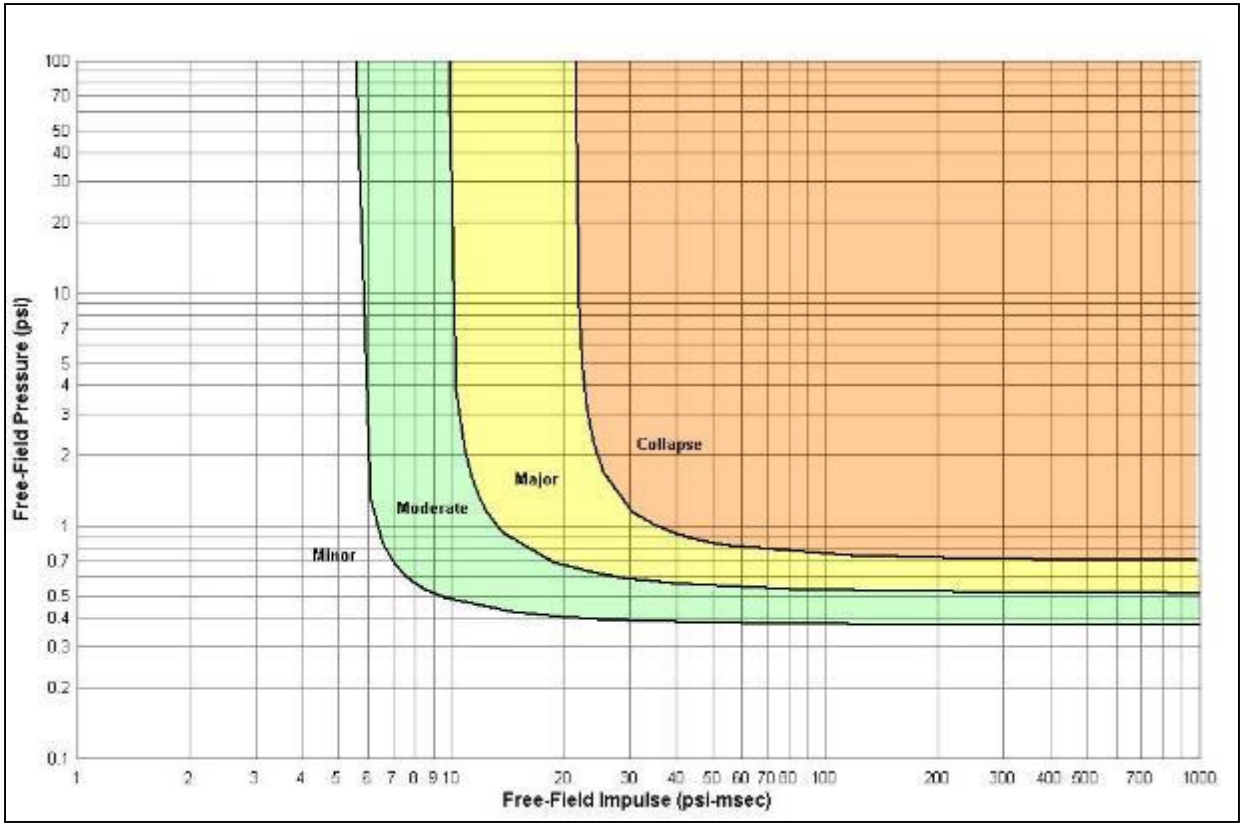
Hazards Analysis Methods

Methods can vary from simple to detailed.

1. Simple, Dispersion Not Required:
   - Can assume a process unit is filled with flammable vapors and all buildings are impacted by toxic release
2. Moderate, Open-Field Dispersion:
   - Gives added ability to predict the size of a flammable cloud where a unit may not be filled, potential ingestion in building or preventing a safe evacuation or toxic exposure
3. Detailed, Computational Fluid Dynamics (CFD):
   - May be desired to remove many assumptions made by simpler methods (actual process dispersion, homogeneous vapor cloud, uniform congestion)

Pressure-Impulse Diagrams

Lines of constant damage representing an infinite combination of pressure and impulse pairs that produce the same damage.



Building Explosion Analysis Methods

All explosion structural response evaluations must include both pressure and impulse predictions in one of two approaches.

1.The simple method is using a known building response for a building of similar construction.

- If a pressure is used without an impulse, that pressure must be the pressure asymptote to account for large impulses (such as using 0.6 psi only to evaluate trailer damage).

2.The detailed method is a response specific to the building being evaluated and involves generating a P-I diagrams for building structural components.

- Damage levels on a P-I diagram may be equated to occupant vulnerability for risk calculations.

Building Fire Analysis Methods

Look-up tables such as those by the Center for Chemical Process Safety (CCPS)

- Other tables must document their basis and applicability

Flame length and radiant heat predictions typically performed by consequence models

- Radiant heat versus distance provides a basis for performing evacuation vulnerability calculations assuming a retreating speed

Building Toxic Analysis Methods

Can assume all buildings are affected and not perform dispersion modeling.

- How can you show personnel are safe to shelter or evacuate with Personal Protective Equipment (PPE) without dispersion modeling?
  - One exception is to use emergency escape respirators that do not have assigned protection factors

Dispersion modeling is typically performed

- Provides concentration versus distance and time
- Allows vulnerability calculations and PPE effectiveness evaluations

Facility Siting Remedial Actions

Emergency Shelters

Only published guidance is applicable to electrically classified buildings or refining HF Alkylation Control Rooms.

Each company must establish acceptance criteria for emergency shelters considering expected event durations.

Buildings designated as emergency shelters for toxic hazards should consider potential explosion damage that may precede the toxic release, and ensure they function as needed following the explosion.

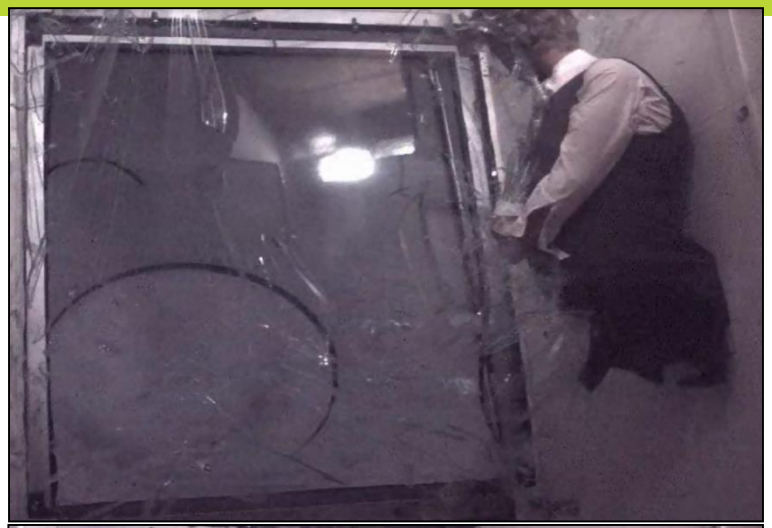
Remediation Plan

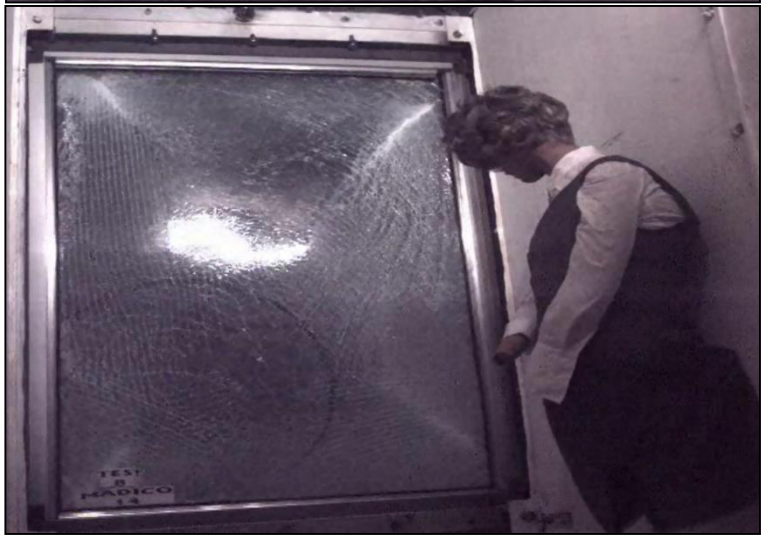
All buildings exceeding criteria is required to be listed on a remediation plan.

- Remediation plan must have a schedule for implementation.
- Remediation plan must be monitored and updated periodically.
- Interim risk reduction measures need to be considered while long-term solutions are being implemented. OSHA has issued a citation for lack of interim risk reduction measures.

Interim Risk Reduction Measures

- Non-structural hazards
- Occupancy levels
- Meeting locations
- Emergency response training and drills
- Preventing inadvertent occupancy





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Management of Change (MOC)

Facility Siting must be monitored in a MOC program that considers the following impacts to facility siting:

- Occupancy changes (personnel relocated or added)
- New portable building siting or relocation
- New building construction or addition
- Process changes

Documentation

Personnel must be qualified for the level of analysis performed.

Criteria, methodology and results must be documented.

Remedial action plan must be documented.

Other Guidance

Portable Building Siting (API RP 753)

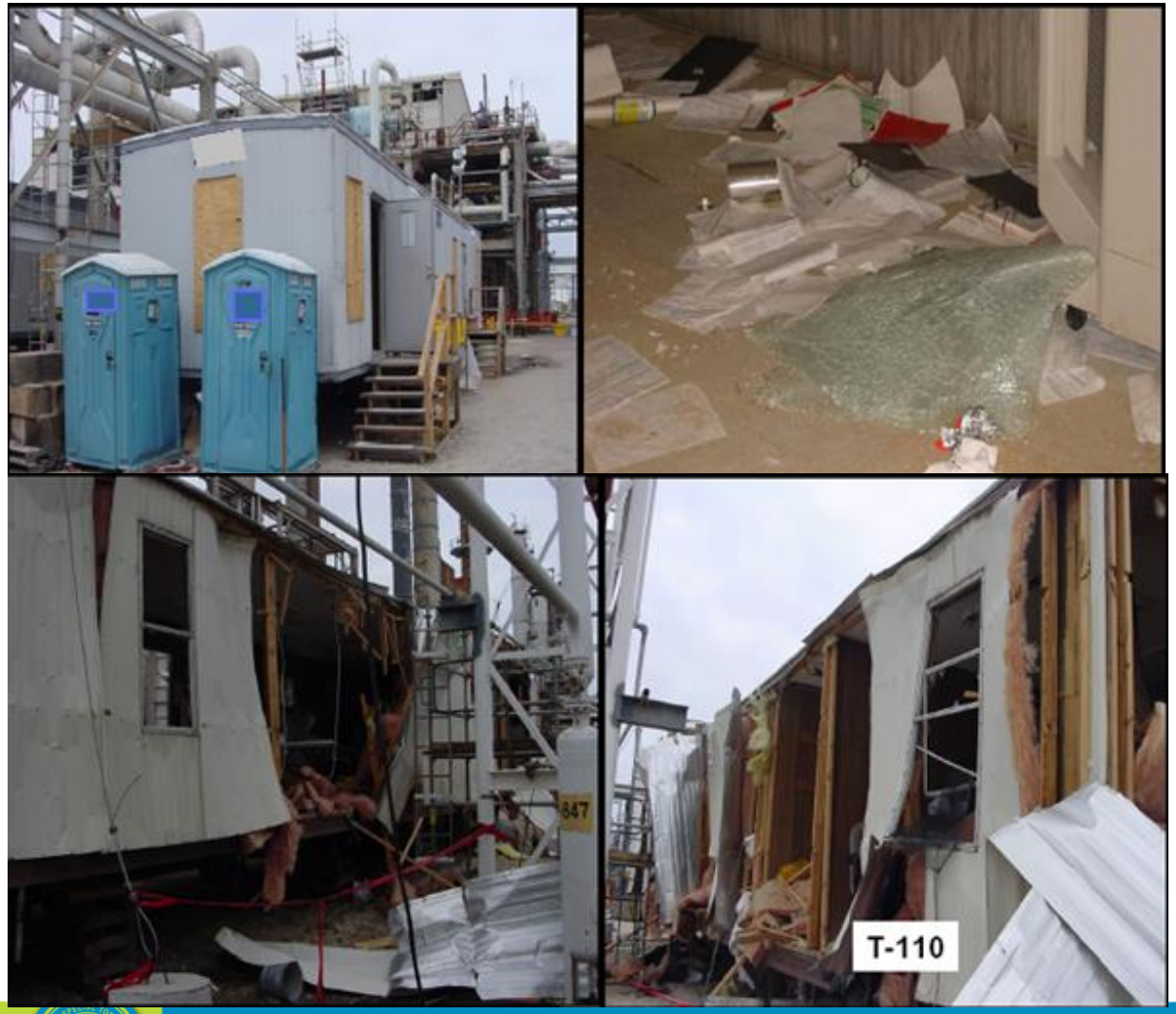
Portable Building Siting is similar to permanent building siting, except for the use of Zone 1 as an exclusion area for trailers and non-essential personnel (in any portable building).

0.6 / 0.9 psi pressures are a means to determine acceptable building damage, because they assume a large impulse (long duration pressure wave) but other means are allowed such a Pressure-Impulse diagrams to account for shorter duration blast waves.

Light Wood Trailer Damage

0.6 psi:

0.9 psi:



Tent Siting (API RP 756)

Portable Building Siting is the similar to permanent building siting, except for the use of Zone 1 as an exclusion area for non-essential personnel (in any tent).

Provides pressure and impulse limits for different types of tent construction or a detailed analysis of the tent explosion response can be performed.

More References

API University Course for API RP 752/753 & 756, taught by ABS Consulting

"Guidelines for Evaluating the Characteristics of Vapor Cloud Explosions, Pressure Vessel Burs, BLEVE and Flash Fire Hazards," CCPS of the AIChE, 2010

- A “how-to” guide on performing hazard calculations

“Design of Blast Resistant Buildings in Petrochemical Facilities,” Published by American Society of Civil Engineers, 2010.

- A guide for evaluating building damage and designing new buildings

DO NOT USE (or use with caution):

"Fire & Explosion Index Hazard Classification Guide," Dow Chemical Company

- Explosion predictions no longer in widespread use by industry (nor Dow) and not allowed in new RP 752 (does not predict blast loads)

Thank You

ABS Consulting
RISK CONSULTING DIVISION

Gary Fitzgerald
Director
ABS Consulting
San Antonio, TX 78232
210-495-5195
gfitzgerald@absconsulting.com