WORKSHOP

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APPLICATON OF LOSS ESTIMATION TECHNIQUES IN ENGINEERING & PROPERTY UNDERWRITING

PAKISTAN INSURANCE INSTITUTE

Agenda

- Basic concepts and definition of Loss Estimates
- C.O.P.E Assessment
- MFL Evaluation
- Loss Estimate scenario development
  - Property Damage & Business Interruption (BI)
  - Construction & Engineering Risks
- Loss Estimate Methodology
- Loss Estimate Models – Market practice

Learning Outcome(s)

- Understand basic concepts of loss estimates and its significance
- Understand Loss Estimate definitions (MPL, MFL, EML etc.)
- Learn Loss Estimate methodology used in Engineering & Property underwriting

Basic concepts & definitions of Loss Estimates

The Alphabet Soup of Initials & Definitions

MAS	Maximum Amount Subject
MPL	Maximum Possible Loss
PML	Possible Maximum Loss
EML	Estimated Maximum Loss
MFL	Maximum Foreseeable Loss
MPL	Maximum Probable Loss
LLE	Large Loss Estimate
LLE	Large Loss Event
PML	Probable Maximum Loss
NLE	Normal Loss Expectancy

Basic concepts & definitions of Loss Estimates

Definitions

Numerous definitions in the market

Insurers have their own definitions

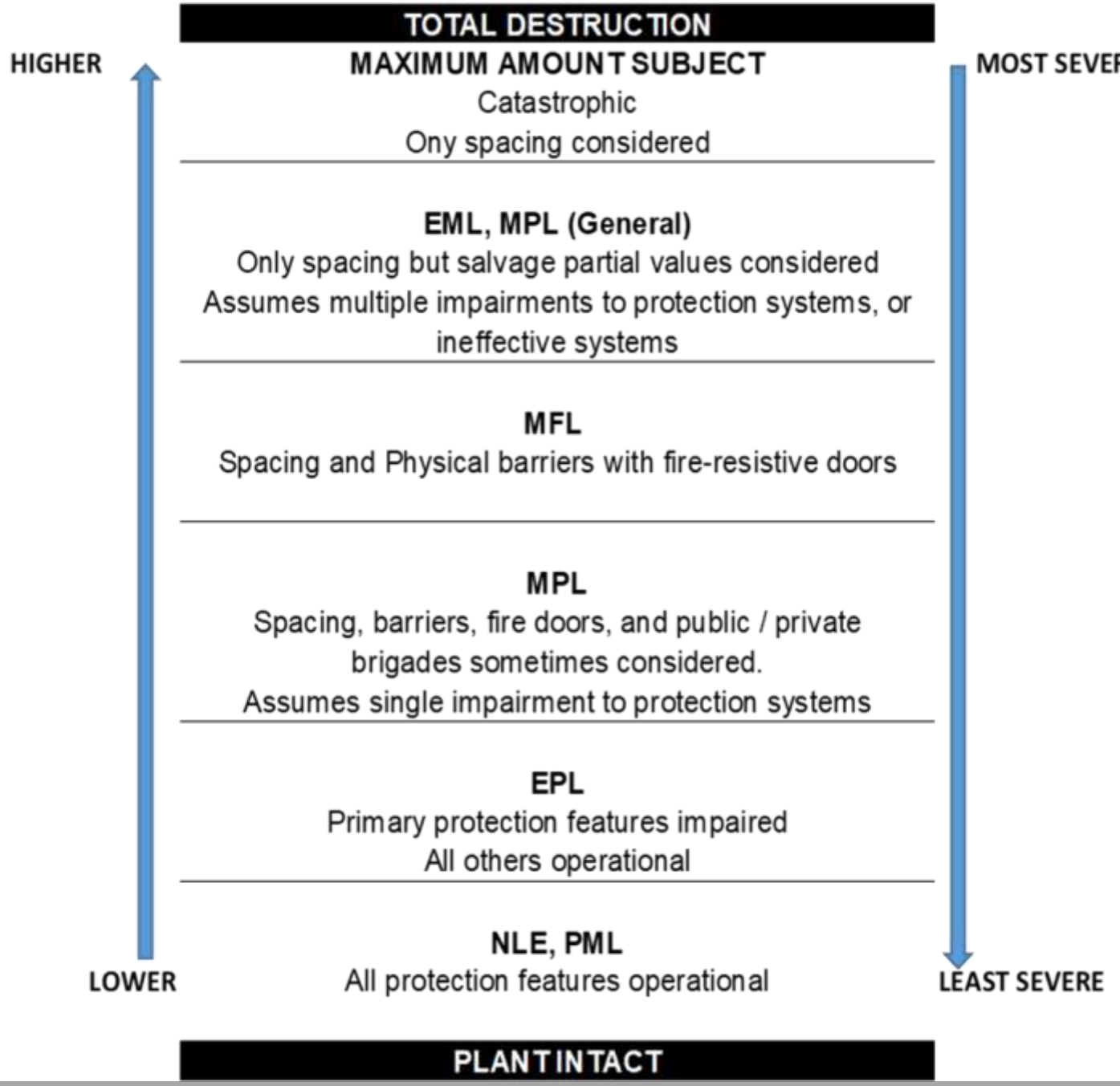
Most common definitions:

- **Probable Maximum Loss (PML)**
- **Estimated Maximum Loss (EML)**
- **Maximum Amount Subject (MAS)**

There No single clear acronym and for every acronym there is a definition and description, which can further be interpreted in different ways …..

Basic concepts & definitions of Loss Estimates

Probable Maximum Loss (PML)	Estimated Maximum Loss (EML)	Maximum Amount Subject (MAS)
▪ Mitigated Scenario ▪ Safety & Fire protection system working at the time of loss ▪ Fire, Explosion etc.	▪ Worst Scenario ▪ Rare but highly destructive ▪ Fixed Fire Protection & Safety system not functioning ▪ Fire, VCE, HPVR	▪ Catastrophic Scenario ▪ Total destruction of site ▪ NATCAT, Aircraft Impact etc.



Basic concepts & definitions of Loss Estimates

The definition of EML / MPL :

"The Maximum Probable Loss in respect of Property Damage and Business Interruption where protection and controls do not function correctly due to: None installed / Impaired / Damaged in incident plus the consequence of a fire or explosion occurring in the most vulnerable area of a property."

The definition of MFL:

"The Maximum Foreseeable Loss where severely adverse conditions are present. This includes the consequences of a fire or explosion in the most critical area of the property assuming the loss or failure of all existing private fire protection systems. It also includes the highly unlikely catastrophic incidents such as earthquake, hurricane etc. resulting a total destruction of the assets"

C.O.P.E Assessment

Method of reporting Underwriting Information

- **C**onstruction
- **O**ccupancy & Operations
- **P**rotection – both physical & procedural
- **E**xposures & Hazards

C.O.P.E Assessment

Risk Quality Factors

- Inherent risks – e.g. process conditions
- Location risks – e.g. windstorm, earthquake, flood, political
- Hardware – i.e. equipment design and construction
- Software – i.e. management systems
- Emergency control

MFL Evaluation & Scenario development
Case Example (FM Data Sheet 1-22)

Definition

The maximum foreseeable loss (MFL) is the largest loss to result from an insured event, as calculated from an understanding of the overall hazard and associated business impact.

This event assumes that **active protection systems or safety devices** are **impaired**, with the exception of specifically FM Approved and tested MFL fire doors.

The event can be related to fire, explosion, equipment failure, or other scenarios, with the exception of natural hazards.

The MFL scenario is based on **impaired active protection systems and/or safety devices**, **reliance on passive protection only**, and an understanding of the overall hazard and associated business impact.

Additional unfavorable conditions, such as delayed fire service response, are considered.

MFL Evaluation & Scenario development
Case Example (FM Data Sheet 1-22)

Construction

- Use of fire resistance Equipment, materials, and services whenever they are applicable in the facility
- Construction types and new construction
- MFL Limiting Factor

MFL Evaluation & Scenario development
Case Example (FM Data Sheet 1-22)

Occupancy

Evaluate the effect on business continuity from a maximum foreseeable event (e.g., fire, explosion, equipment breakdown) and develop strategies , including equipment contingency planning as part of a documented business continuity plan, to limit the business interruption to these events.

Strategies may include, but are not limited to, the following:

A. Using fire-resistant construction

B. MFL subdivision using MFL limiting factors to passively protect high-value property or critical processes from the maximum foreseeable event.

C. Providing redundant capacity at a location not subject to the maximum foreseeable event

MFL Evaluation & Scenario development
Case Example (FM Data Sheet 1-22)

Protection

The MFL event assumes that active protection systems are impaired.

Contingency Planning

Review, test and validate the strategies, business continuity plans and equipment contingency plans in place to maintain viability and confirm efficacy.

MFL Evaluation & Scenario development
Case Example (FM Data Sheet 1-22)

An MFL scenario, regardless of the type of event, consists of four major components:

1. The peril (e.g., fire, explosion)
2. The scenario timeline (e.g., fire development, spread. and control)
3. Damage to property / Material Damage
4. Business interruption / Delay-in Startup

Whilst the peril associated with the MFL event is usually easy to determine, the remaining three components can be highly variable and complex.

MFL Evaluation & Scenario development

Case Example (FM Data Sheet 1-22)

Peril

The event can be related to fire, explosion, equipment breakdown with ensuing damage or other scenario, with the exception of natural hazards.

Scenario

The scenario assumes active protection systems or safety devices are impaired, with the exception of specifically FM Approved and tested MFL fire doors.

Property Damage

Total cost of repairing/replacing damaged property, including cleanup; planning; hiring consultants, architects, engineers, etc.; reconstruction; and installation and commissioning of equipment.

The amount of damage to involved property should consider the type of event, as well as the given physical circumstances.

For example, for a single warehouse building storing plastic components in a structure that uses combustible plastic insulation on a steel frame, the MFL event is an uncontrolled fire. In this scenario, 100% loss of building, contents, and stock would be assumed.

MFL Evaluation & Scenario development

Case Example (FM Data Sheet 1-22)

Business Interruption

Restoration Time

Time required to fully restore operations on site is divided into three main phases:

Phase 1:

- Any authority investigations
- Cleanup of contamination and environmental impacts
- Discussions regarding permits, etc.
- Removal of debris

Phase 2:

- Construction, including design and permits, changes in legislation from original buildings, etc.

Phase 3:

- Fit-out, considering lead time of equipment, setup, startup, and quality assurance of process or products, and approval from authorities if needed

MFL Evaluation & Scenario development

Case Example (FM Data Sheet 1-22)

Business Interruption

Interdependencies

Any impact on company production (upstream and downstream of site) until operations are fully restored, and the associated impact thereof.

Mitigation

Consider viable equipment contingency planning, equipment breakdown sparing (including N+1 online sparing) and business continuity planning that can minimize the business interruption impact during the MFL restoration time.

Make-up capacity could be present at other locations within the company, or any third-party contracts that are in place.

MFL Evaluation & Scenario development

Case Example (FM Data Sheet 1-22)

Business Interruption

Extra Expenses

Consider any additional costs that can be expected from an MFL loss event, such as the following:

- Contractual penalties
- Decontamination costs
- Regulatory fines

Loss Estimate - Methodology

Step 1: Information request

- Site layout plan
- Building heights / number of floors
- Occupancy
- Contents and processes (fire / explosion hazards)
- Description of construction (roof, ceilings, exterior and interior walls, insulation materials)
- Fire walls, Fire area separation walls

Loss Estimate - Methodology

Step 2: Subdivision of risks into Fire Areas

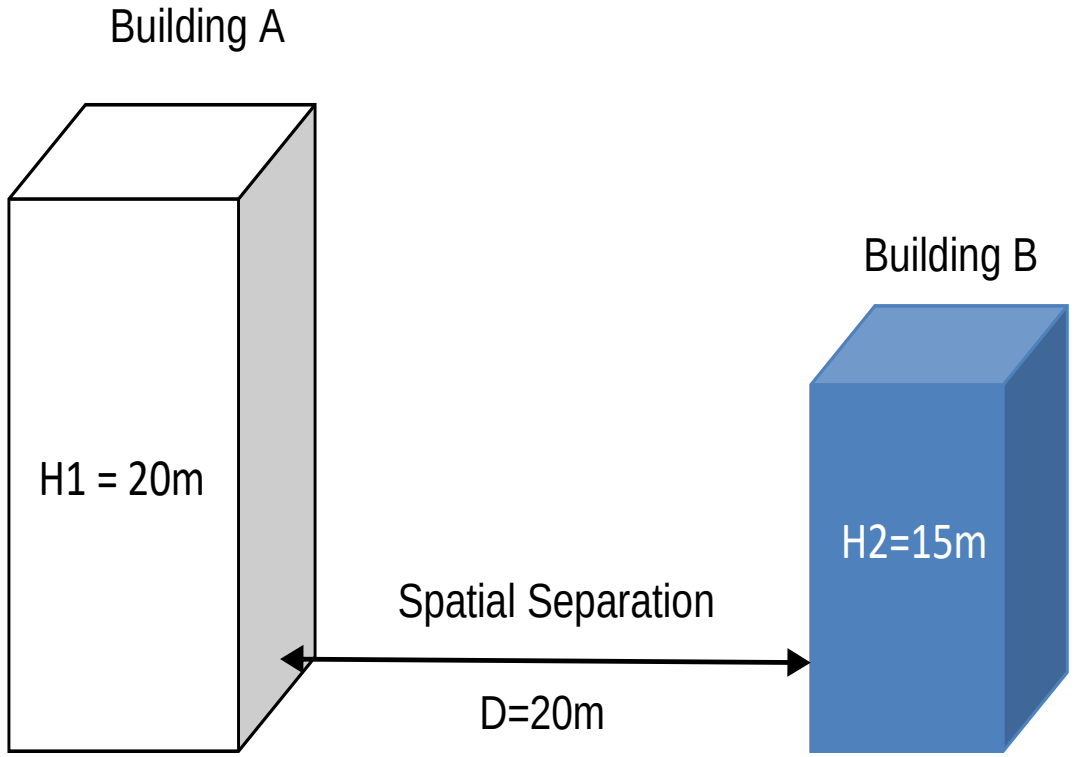
- Buildings
- Installations in the open (e.g. stocks stored in open)
- Inside buildings
- Spatial or Constructional Fire Area separation

A **Fire Area** is formed by one or several buildings or installations in the open which are not separated from each other, but are separated from neighboring buildings or fire areas.

Loss Estimate - Methodology

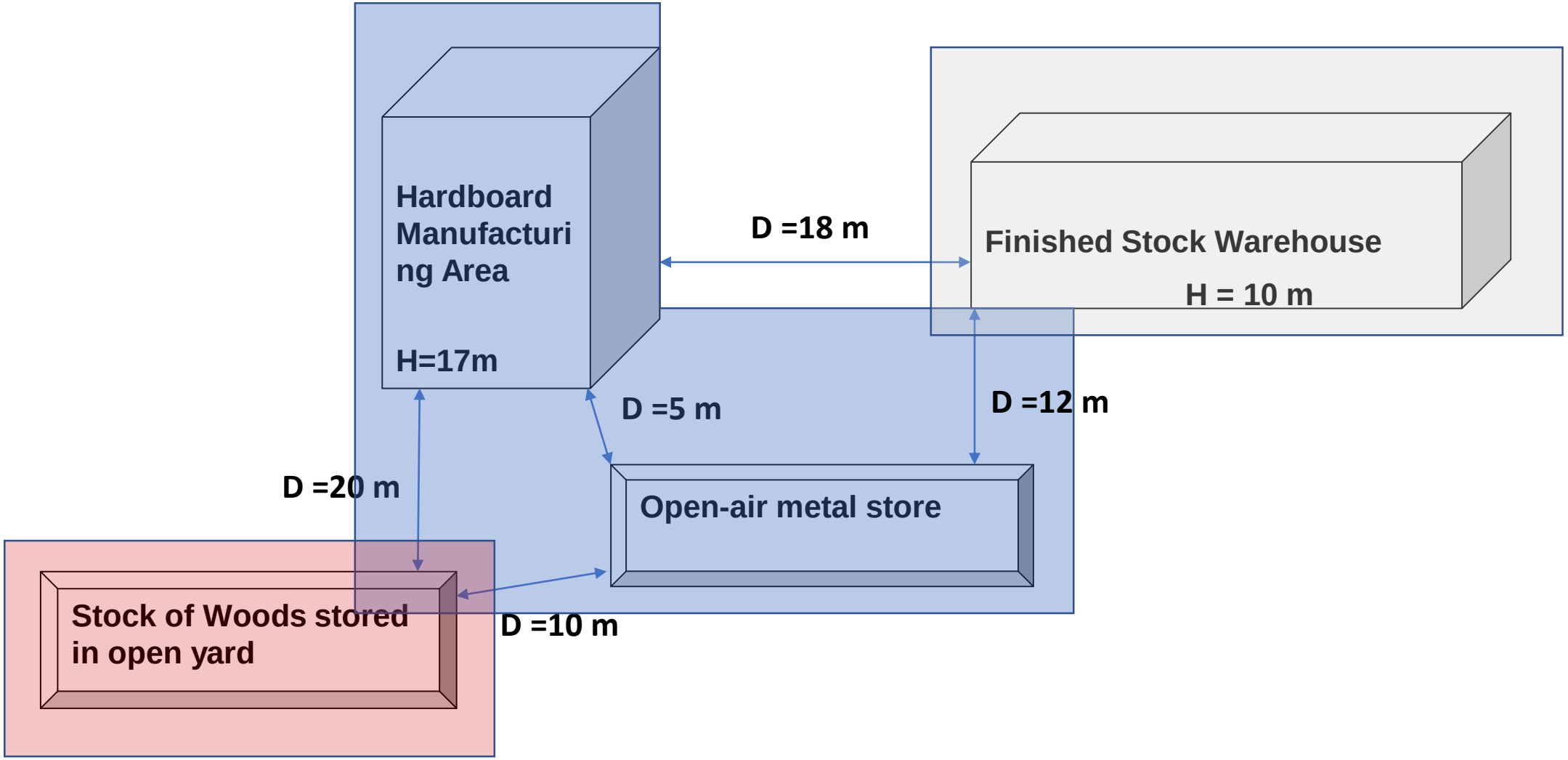
Fire Area Separation

FIGURE-1 Spatial Separation



Loss Estimate - Methodology

Fire Area Separation Exercise

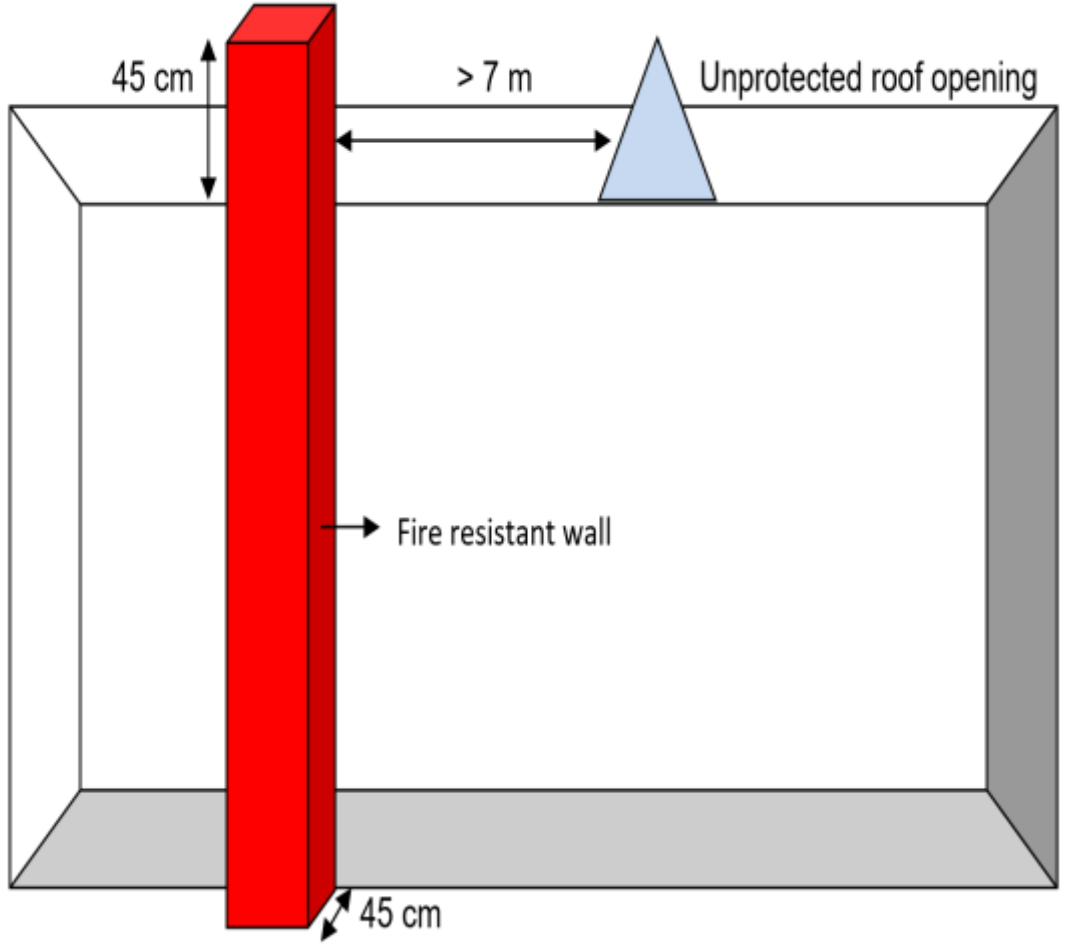


Loss Estimate - Methodology

Fire Area Separation

Structural Fire Area Separation

- Passive fire protection
- Vertical / Horizontal Fire-resistant areas
- Example: Fire Wall / Perfect party wall



Loss Estimate - Methodology

Fire Damage Area Size

Main factors

- Degree of hazard
- Adequacy of Fire protection (in Fire Area)
- Adequacy of Manual firefighting (at site)

Loss Estimate - Methodology

Step 3: Distribution of Values

- Building
- Machinery / Plant
- Stocks
- Annual sales or Revenue (for Business Interruption)

Loss Estimate - Methodology

Step 4: Comparison of different loss scenarios

Property Damage (PD)	Machinery Breakdown (MBD)	Business Interruption (BI)
• Fire • Vapor Cloud Explosion(VCE) • Tank fire • Vessel Disintegration • Natural Perils	• Rotating Machineries • Generators • Boilers	• Process units • Key machinery • Utilities • Customers • Suppliers • Natural Perils

Loss Estimate - Methodology

Step 5: Loss Estimate Calculations

For both PD + BI Loss estimates:

- Largest PD / MBD Loss + its corresponding BI Loss

OR

- Largest BI Loss + its initiating PD / MBD Loss

Loss Estimate - Methodology

Loss Estimate Calculation - Example

	EML (USD Million)	Comment
Property Damage (PD)	130	Catastrophic methane release resulting in a VCE event in the Ammonia unit
Machinery Breakdown (MB)	18	Based on estimate for loss of a gas turbine/HRSG. Loss of Synthesis Gas Compressor is expected to have a machinery breakdown value of USD 12 million.
Business Interruption		
- PD	120	A 24 month rebuild of the Ammonia unit following the VCE event described above
- MB	45	A nine month interruption following the Machinery Breakdown event described above
- Suppliers Extension	10	Failure of natural gas supply from Sui gas field for 3 months
- Customer Extension	-	No exposure

Combined EML PD+BI = USD 250 Million

Loss Estimate - Methodology

Summary

- Provide a definition, not just 3 letters …
- Provide a scenario, stating where the fire starts, how it propagates and why it stops. Include assumptions …
- Provide information regarding business interruption, contingency business interruption and dependencies …
- Provide split of values insured per area and per class …
- Provide loss estimate both in monetary terms and % of TSI

Loss Estimate Models – Market Practice

BLAST Model

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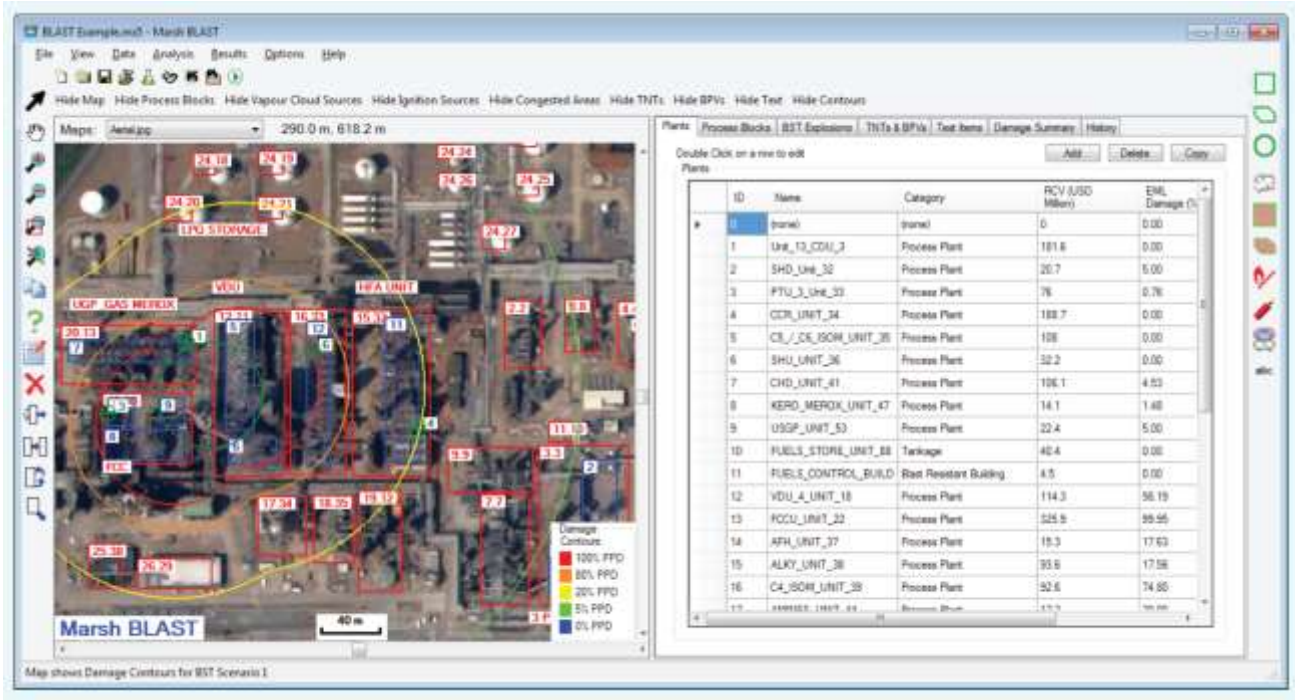


Ex Tool V5

Swiss Re

Loss Estimate Models – Market Practice

- Model insurance losses associated with VCE
- For Onshore Energy Risks
- Approaches:
  - TNT-based model
  - Congestion-based Explosion model
- Consider Blast and Explosion effects

ACCUMULATION OF HYDROCARBON VAPOUR WITH IN CONGESTED STRUCTURE

Loss Estimate Models – Market Practice

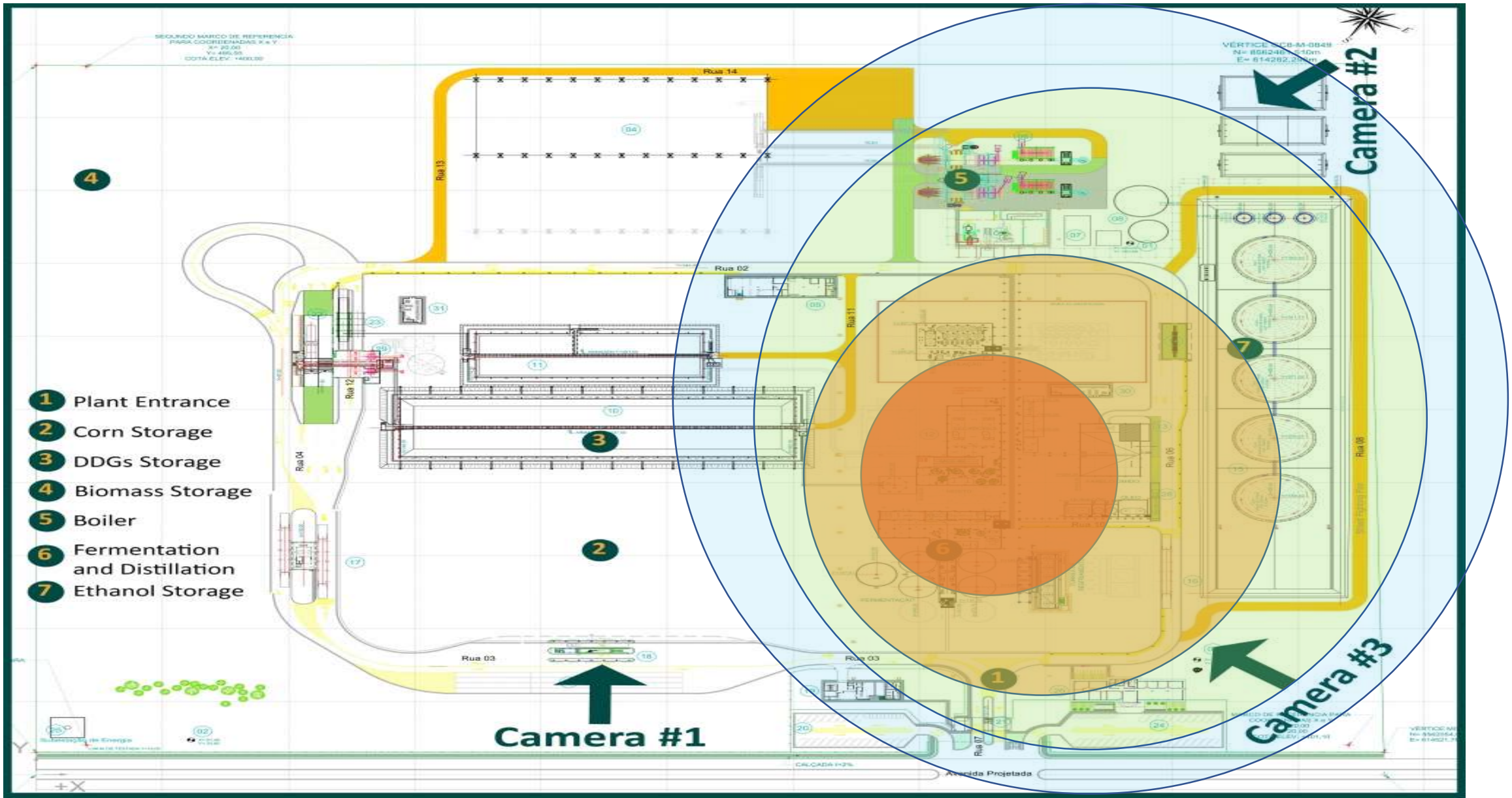
Congestion-based Explosion Model

Congestion

Confinement

Fuel Reactivity

Loss Estimate Models – Market Practice



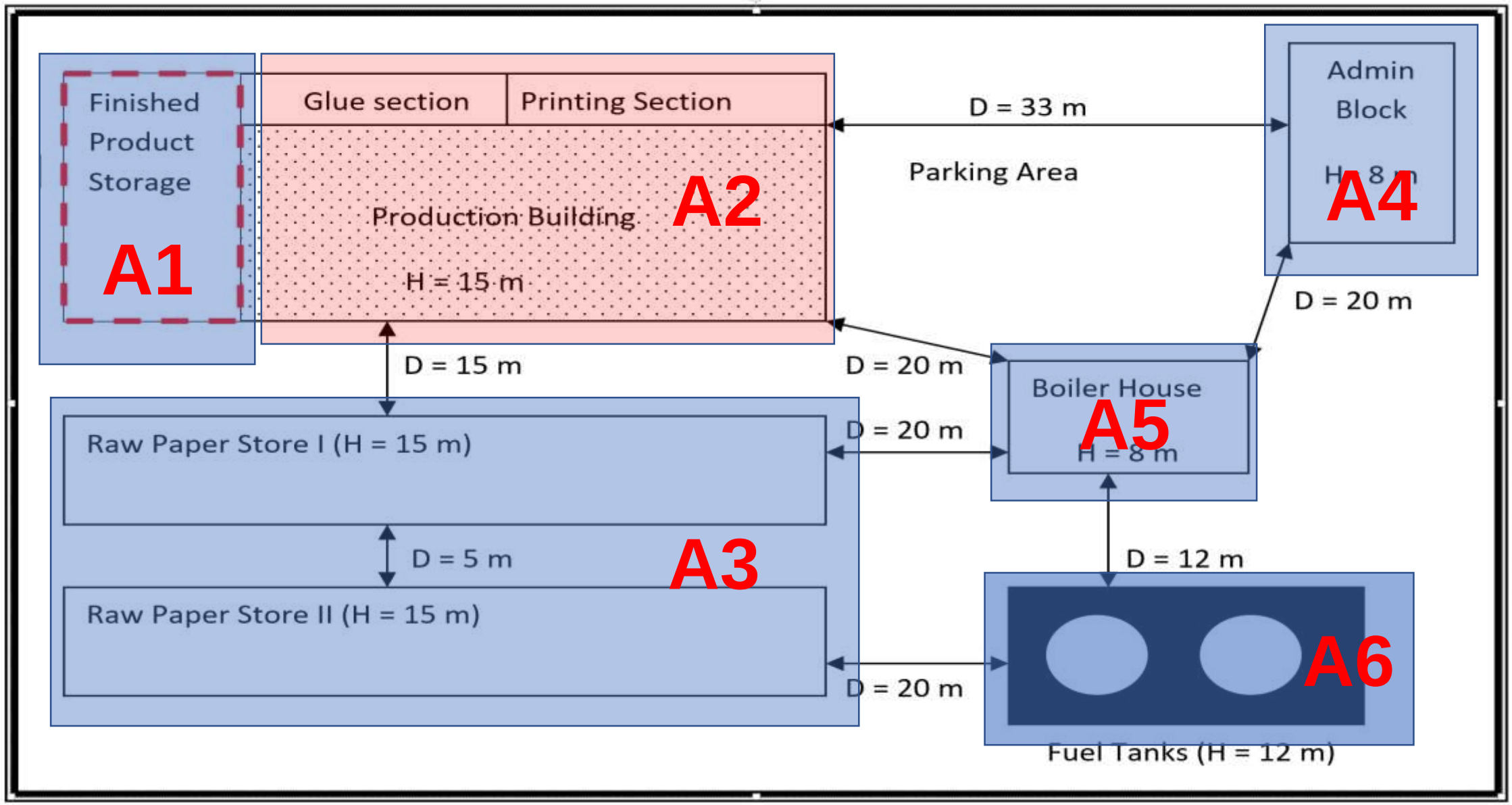
Loss Estimate Models – Market Practice

Loss Estimates Significance

- Estimates the monetary outcome of a loss scenario at a certain risk
- Increase insurers underwriting capacity
- Shows more realistic the risk taken by the insurers
- Increase premium income

Even though the Loss Estimate is taken as basis for the underwriting decision, normally the sum insured remains the actual limit of liability

Loss Estimate Exercise


Finished
Product
Storage
A1
Glue section
Printing Section
Production Building
H = 15 m
A2
D = 33 m
Parking Area
Admin
Block
H = 8 m
A4
D = 20 m
D = 15 m
D = 20 m
Boiler House
H = 8 m
A5
D = 20 m
Raw Paper Store I (H = 15 m)
D = 5 m
Raw Paper Store II (H = 15 m)
A3
D = 12 m
D = 20 m
A6
Fuel Tanks (H = 12 m)

	FIRE AREA	SUM INSURED (in PKR)	MPL
A1	**Finished Product Storage**	**15 M**	
	- Building	5 M	
	- Plant & Machinery	-	
	- Stock	10 M	
A2	**Production building, Glue & Printing sections**	**50 M**	
	- Building	20 M	
	- Plant & Machinery	25 M	
	- Stock	5 M	
A3	**Raw Paper Stores I & II**	**10 M**	
	- Building	4 M	
	- Plant & Machinery	-	
	- Stock	6 M	
A4	**Admin Block**	**5 M**	
	- Building	5 M	
	- Plant & Machinery	-	
	- Stocks	-	

	FIRE AREA	SUM INSURED (In PKR)	MPL
A5	**Boiler House**	**10 M**	
	- Building	3 M	
	- Plant & Machinery	7 M	
	- Stock	-	
A6	**Fuel Storage Area**	**10 M**	
	- Building	-	
	- Plant & Machinery	4 M	
	- Stock	6 M	
	Total Sum Insured (TSI)	**100 M**	

	FIRE AREA	SUM INSURED (in PKR)	MPL
A1	**Finished Product Storage**	**15 M**	**15%**
	- Building	5 M	
	- Plant & Machinery	-	
	- Stock	10 M	
A2	**Production building, Glue & Printing sections**	**50 M**	**50%**
	- Building	20 M	
	- Plant & Machinery	25 M	
	- Stock	5 M	
A3	**Raw Paper Stores I & II**	**10 M**	**10%**
	- Building	4 M	
	- Plant & Machinery	-	
	- Stock	6 M	
A4	**Admin Block**	**5 M**	**5%**
	- Building	5 M	
	- Plant & Machinery	-	
	- Stocks	-	

	FIRE AREA	SUM INSURED (In PKR)	MPL
A5	**Boiler House**	**10 M**	**10%**
	- Building	3 M	
	- Plant & Machinery	7 M	
	- Stock	-	
A6	**Fuel Storage Area**	**10 M**	**10%**
	- Building	-	
	- Plant & Machinery	4 M	
	- Stock	6 M	
	Total Sum Insured (TSI)	**100 M**	

Thank You !