



Center for Enterprise Risk Management



INDUSTRIAL SAFETY AND RISK ASSESSMENT WORKSHOP

PART 2: LOSS ESTIMATION TECHNIQUES

November 16, 2018

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Agenda

- Definition (PML / MPL / EML etc.)
- Methodology
- Loss Scenarios & Calculations
- Loss Estimate Models

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

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**

Definitions

Probable Maximum Loss (PML)

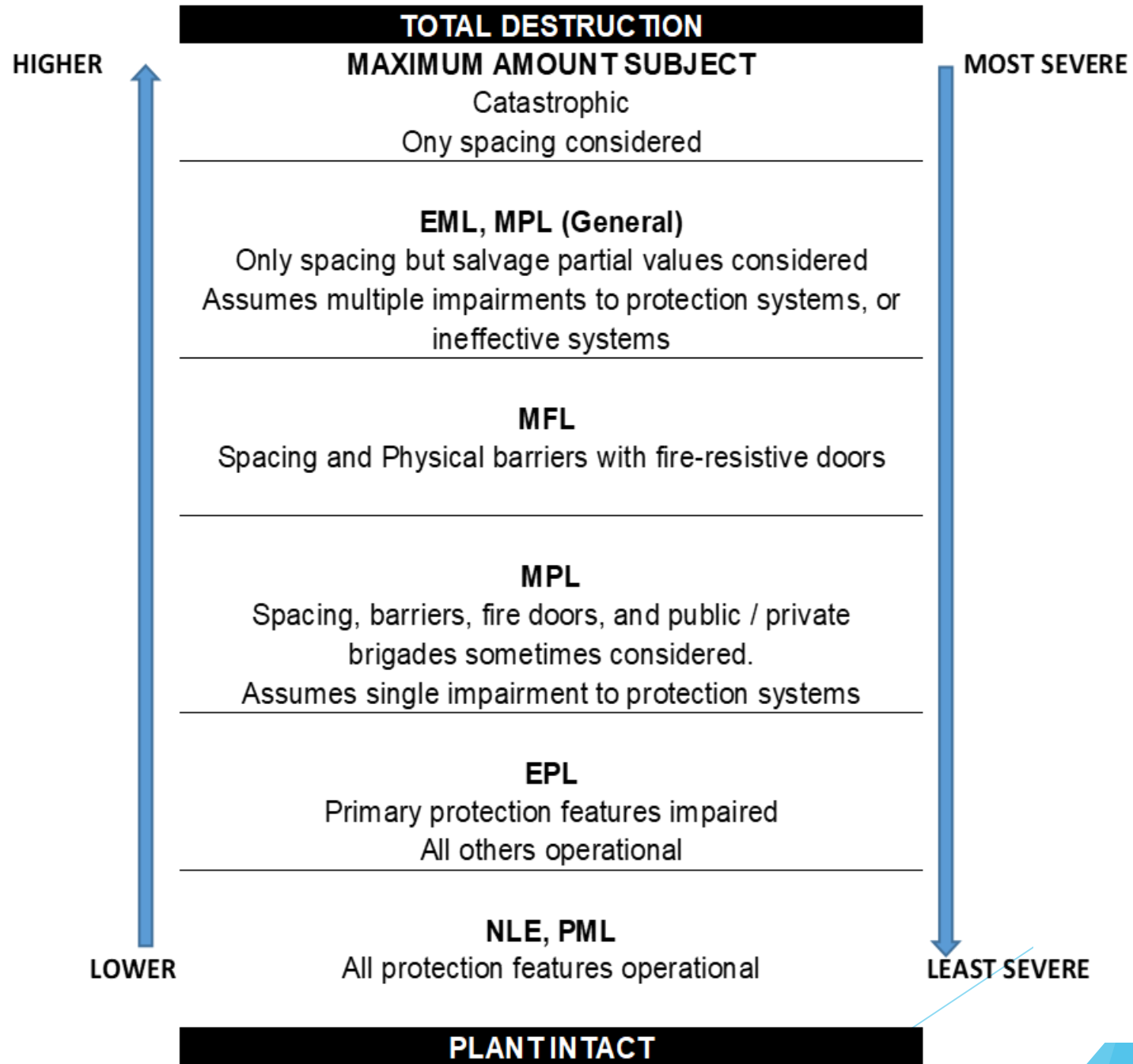
- Mitigated Scenario
- Safety & Fire protection system working at the time of loss
- Fire, Explosion etc.

Estimated Maximum Loss (EML)

- Worst Scenario
- Rare but highly destructive
- Fixed Fire Protection & Safety system **not functioning**
- Fire, VCE, HPVR

Maximum Amount Subject (MAS)

- Catastrophic Scenario
- Total destruction of site
- NATCAT, Aircraft Impact etc.



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

Methodology

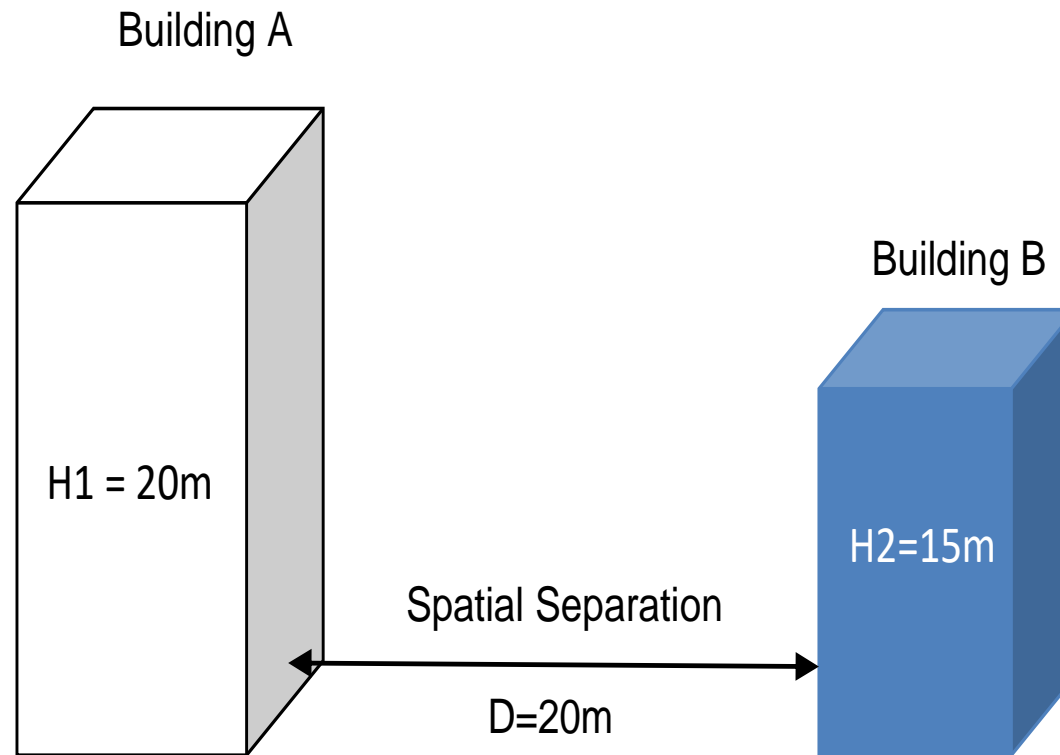
Step 2: Subdivision of risks into Fire Areas

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

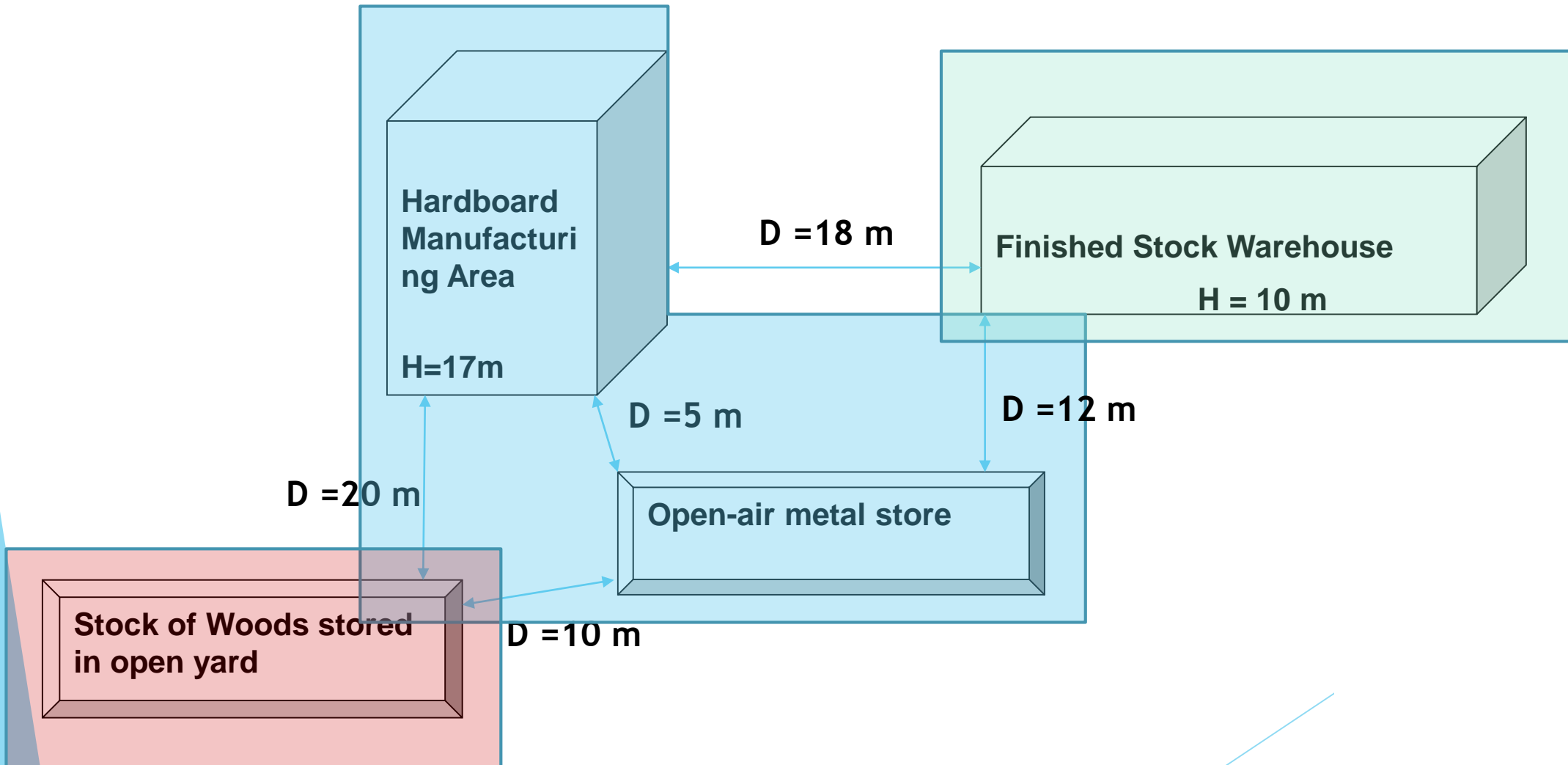
A **Fire Area** is formed by one or several buildings or installations in the open which are not separated from each other, but are separated from neighboring buildings or fire areas.

Fire Area Separation

FIGURE-1 Spatial Separation



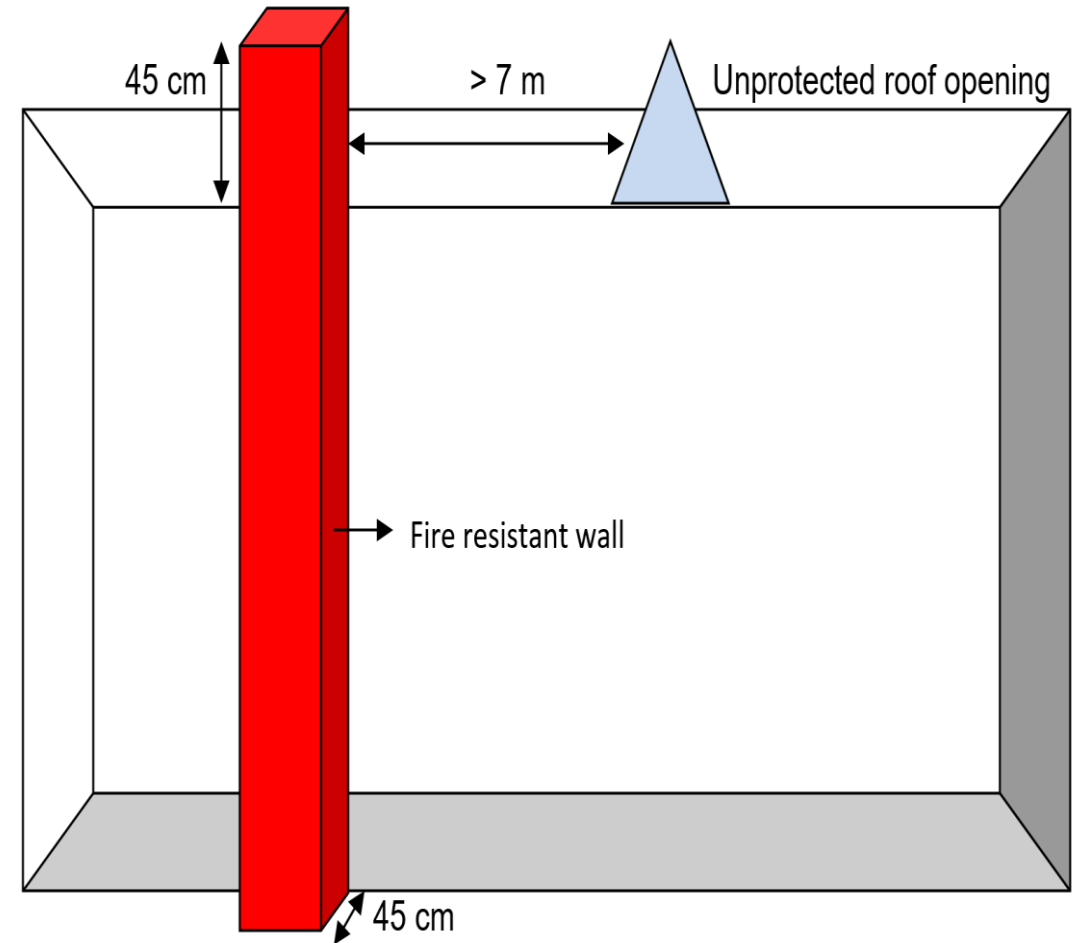
Fire Area Separation Exercise



Fire Area Separation

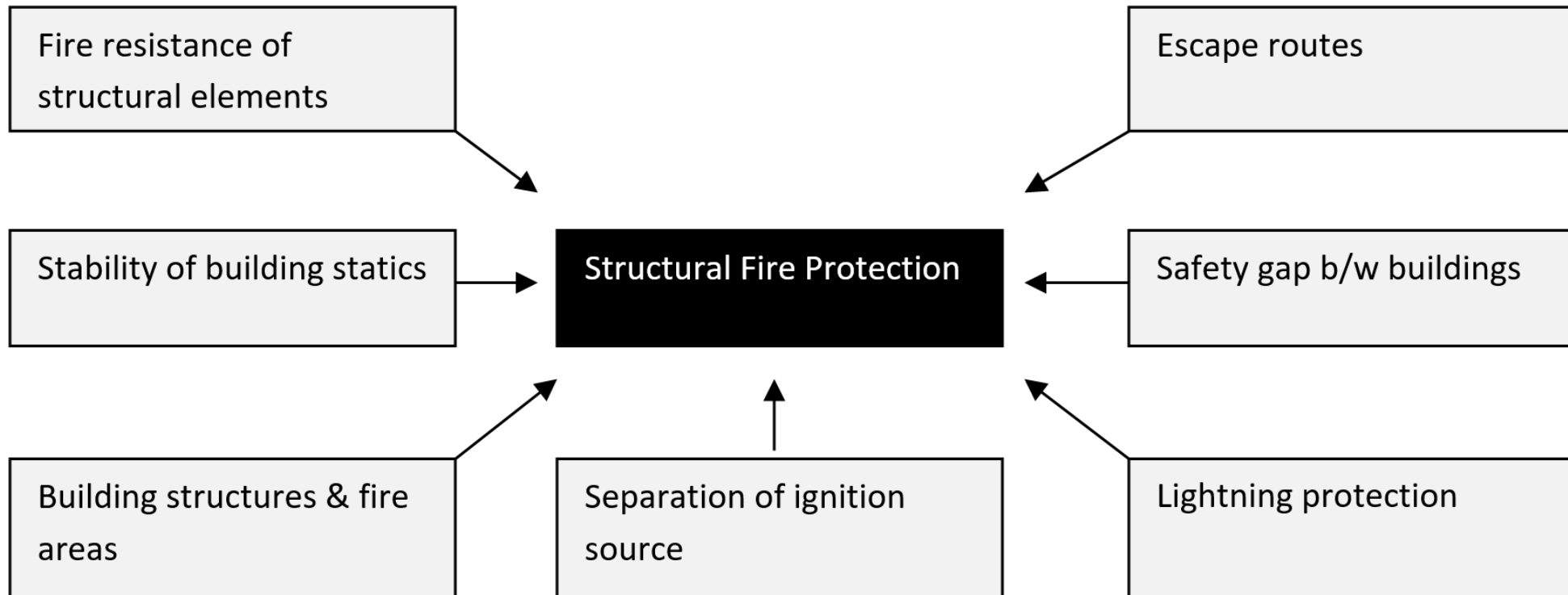
Structural Fire Area Separation

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



Fire Area Separation

Structural Fire Area Separation



Fire Damage Area Size

Main factors

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

Methodology

Step 3: Distribution of Values

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

Methodology

Step 4: Comparison of different loss scenarios

Property Damage (PD)

- Fire
- Vapor Cloud Explosion(VCE)
- Tank fire
- Vessel Disintegration
- Natural Perils

Machinery Breakdown (MBD)

- Rotating Machineries
- Generators
- Boilers

Business Interruption (BI)

- Process units
- Key machinery
- Utilities
- Customers
- Suppliers
- Natural Perils

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 Calculation - Example

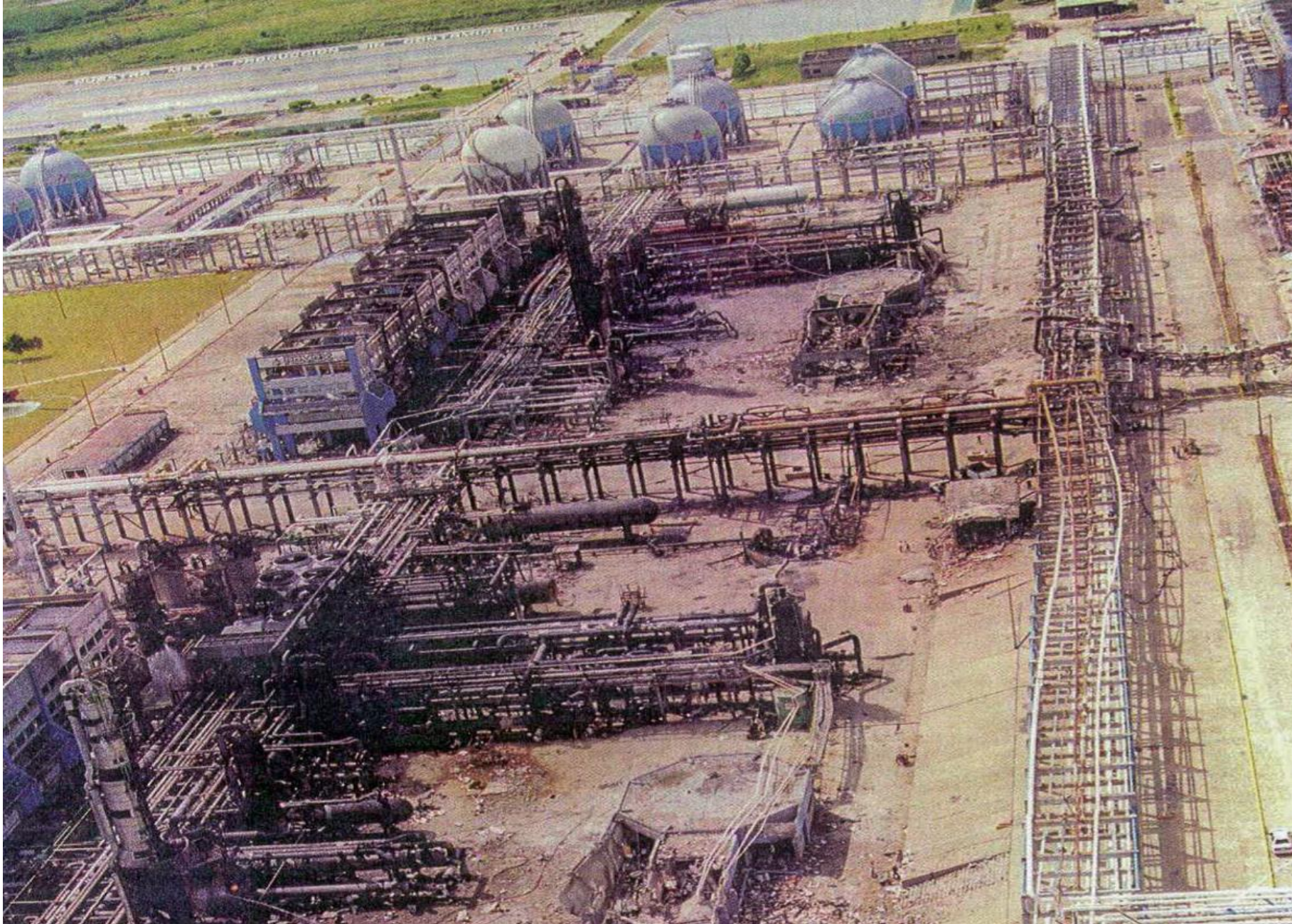
	EML (USD Million)	Comment
Property Damage (PD)	130	Catastrophic methane release resulting in a VCE event in the Ammonia unit
Machinery Breakdown (MB)	18	Based on estimate for loss of a gas turbine/HRSG. Loss of Synthesis Gas Compressor is expected to have a machinery breakdown value of USD 12 million.
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

Methodology

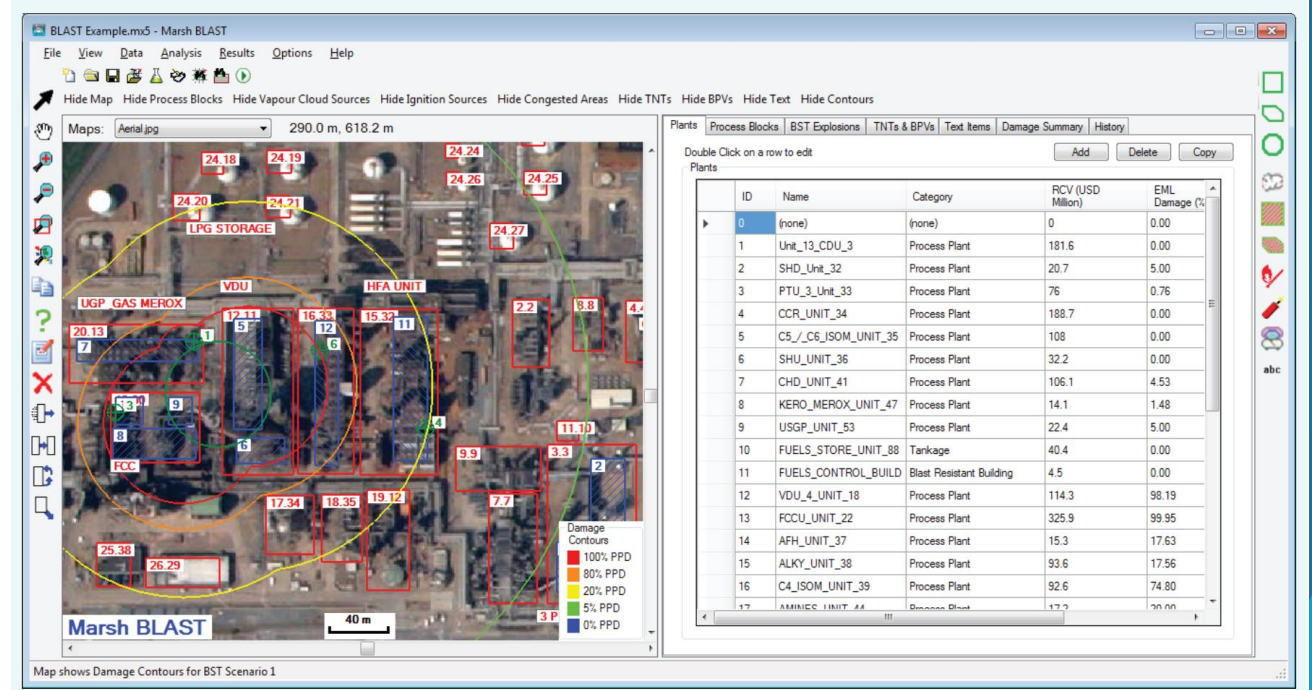
Summary

- 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 Estimation Models

BLAST Model

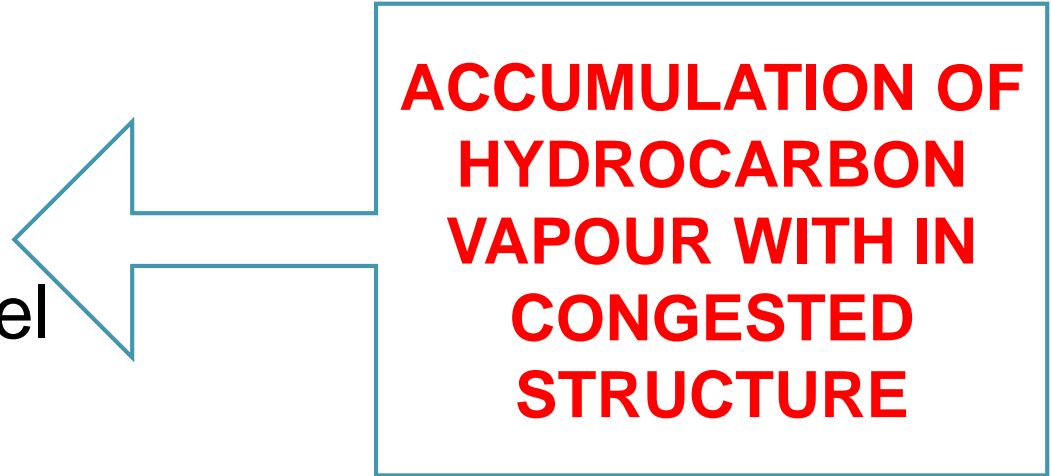


Ex Tool V4



Loss Estimation Models

- 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 Estimation Models

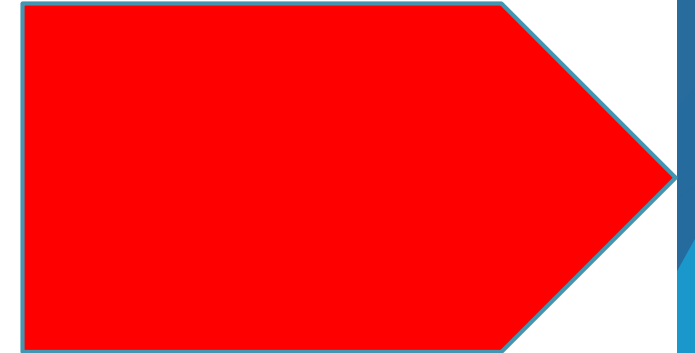
Congestion-based Explosion Model



Congestion

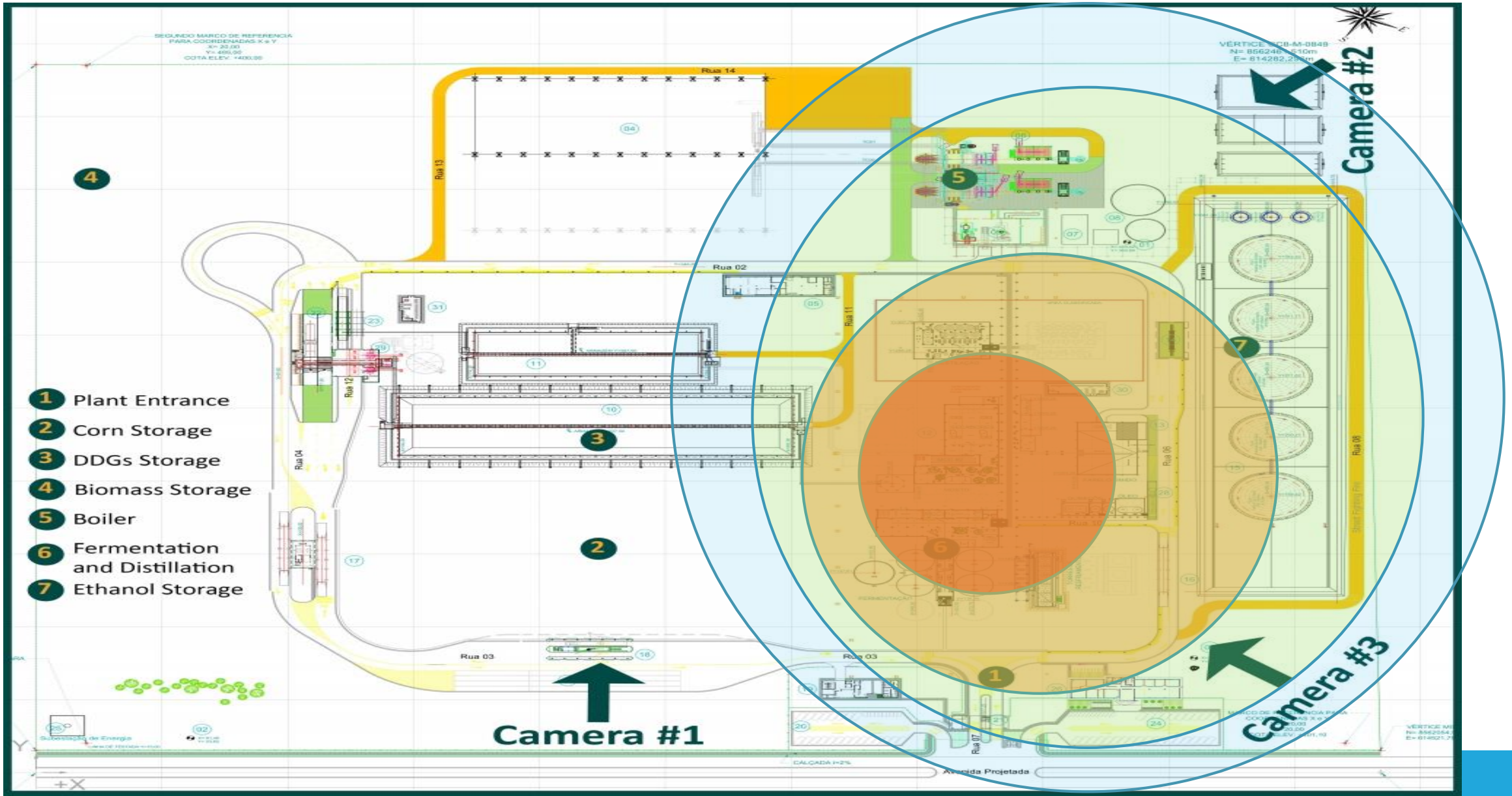


Confinement



Fuel Reactivity

Loss Estimation Models

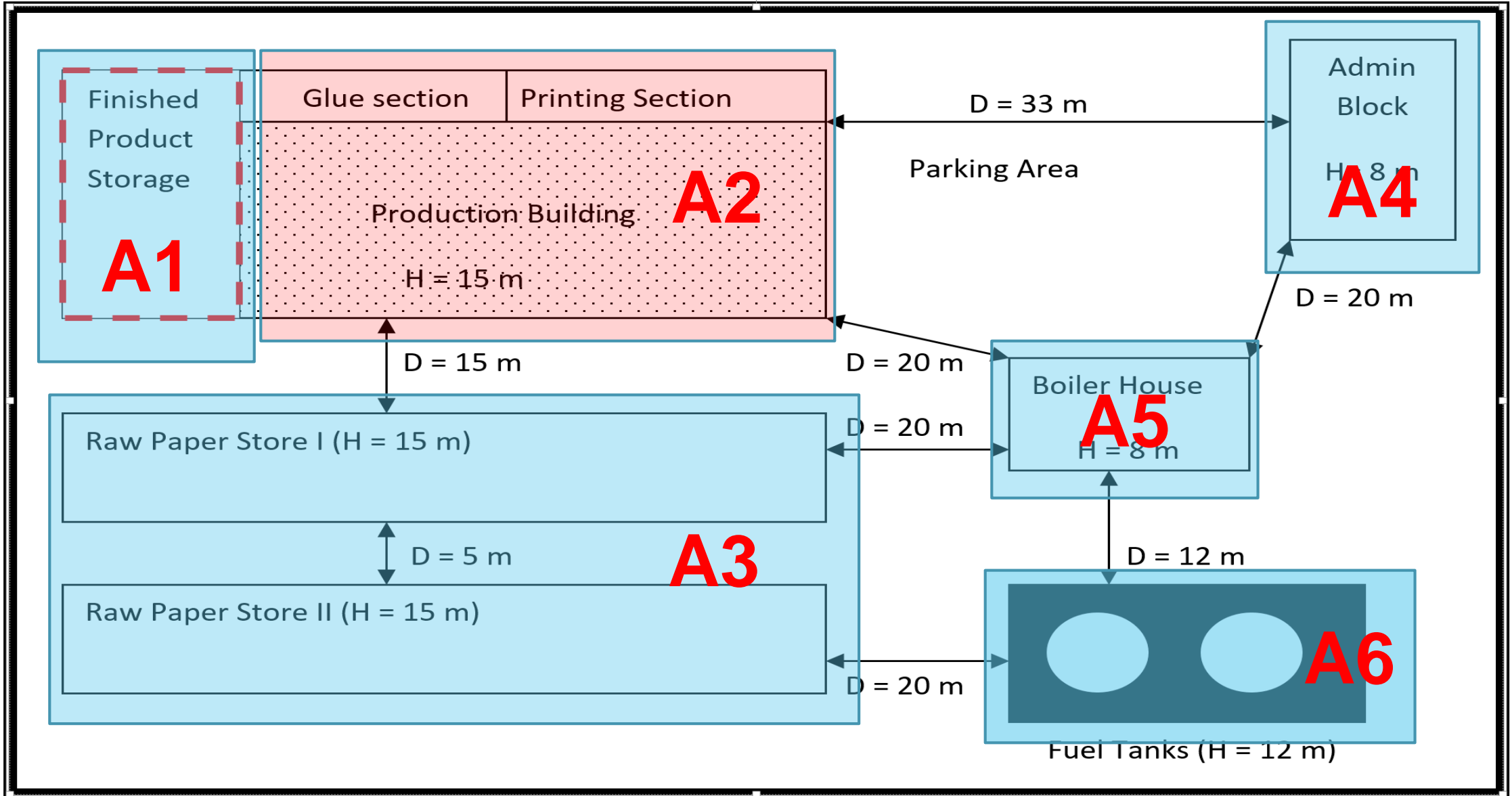


Loss Estimates Significance

- 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



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	



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