

## 04.25 – EML/PML ASSESSMENT METHODOLOGY AND LOSS SCENARIOS

The objective of a PML or EML assessment is not merely to provide a percentage of the Sum Insured, but to develop a technically justified loss scenario describing:

- Where and how the loss originates;
- How the loss propagates;
- Which protection systems are expected to operate;
- Why the loss is ultimately contained; and
- The resulting Property Damage (PD) and Business Interruption (BI) exposures.

A robust EML/PML assessment should therefore be based on a structured engineering analysis rather than on arbitrary percentages.

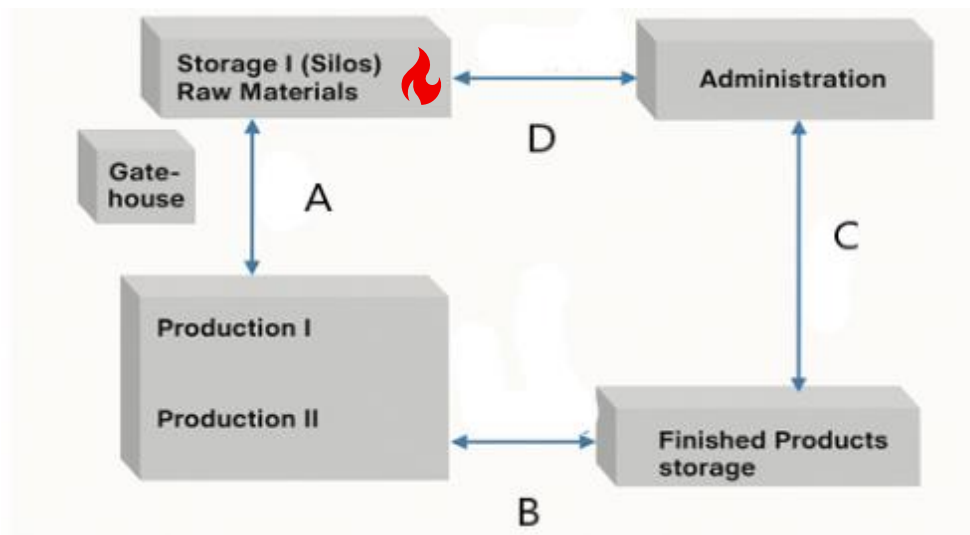
### STEP 1: DEVELOP A SITE LAYOUT AND EXPOSURE MAP

The assessment begins with the preparation of a detailed site plan identifying:

- Building locations and separation distances;
- Construction characteristics (walls, roofs and structural elements);
- Fire walls and other fire compartmentation features;
- Percentage of openings in external walls;
- Building dimensions and heights;
- Occupancy type and hazard classification;
- Total Insurable Value (TIV) allocated to each building or area.

The purpose of this exercise is to identify the principal concentrations of value and to evaluate the potential for fire or explosion to spread from one area to another.

Example:



|                    |     |
|--------------------|-----|
| Distance A (feet)  | 70  |
| Distance B (feet)  | 80  |
| Distance C (feet.) | 100 |
| Distance D (feet)  | 80  |

| Sector                       | Sum Insured (USD) | Severity exposure |
|------------------------------|-------------------|-------------------|
| Production I - Production II | 12,000,000        | moderate          |
| Storage I (silos)            | 3,000,000         | moderate          |
| Storage Finished Products    | 4,000,000         | severe            |
| Other (Administration)       | 1,000,000         | light             |
| TOTAL MD                     | 20,000,000        |                   |
| BI                           | 20,000,000        |                   |

| Percentage of openings in external walls | Width North face | Width East face | Width South face | Width west face |
|------------------------------------------|------------------|-----------------|------------------|-----------------|
| Production I - Production II             | 20%              | 20%             | 20%              | 20%             |
| Storage I (silos)                        | 10%              | 10%             | 10%              | 10%             |
| Storage Finished Products                | 10%              | 10%             | 10%              | 10%             |
| Other (Administration)                   | 10%              | 50%             | 50%              | 50%             |
| TOTAL                                    | 40               | 10              | 40               | 10              |

| Dimension of Buildings (feet) | Height | Width North face | Width East face | Width South face | Width west face |
|-------------------------------|--------|------------------|-----------------|------------------|-----------------|
| Production I - Production II  | 20     | 240              | 150             | 240              | 150             |
| Storage I (silos)             | 50     | 150              | 30              | 150              | 30              |
| Storage Finished Products     | 15     | 150              | 75              | 150              | 75              |
| Other (Administration)        | 15     | 50               | 50              | 50               | 50              |

## STEP 2: DEFINE FIRE AREAS

The site should be divided into distinct Fire Areas, representing those portions of the risk that could reasonably be affected by a single fire event.

A Fire Area may comprise:

- One or more buildings adequately separated from adjacent structures;
- Outdoor storage areas;
- Process installations in the open;
- Compartments created by fire-resistant walls or other recognised fire separations.

The definition of Fire Areas is one of the most important stages of the analysis, as it establishes the maximum extent of damage that may reasonably result from a single incident.

## STEP 3: ASSESSMENT OF FIRE SPREAD

For most industrial risks, fire represents the principal driver of both PML and EML values. When evaluating the potential for fire to spread between buildings, particular consideration should be given to:

- Separation distances;
- Building height and geometry;
- Combustible loading;
- Percentage of wall openings;
- Wind exposure;
- Fire-resistant construction features.

The propagation analysis may be supported by methodologies contained within **NFPA 80A, "Recommended Practice for Protection of Buildings from Exterior Fire Exposures"**

Under this methodology, a guide number is determined according to:

- Hazard severity (light, moderate or severe);
- Building geometry;
- Percentage of wall openings; and
- Fire exposure characteristics.

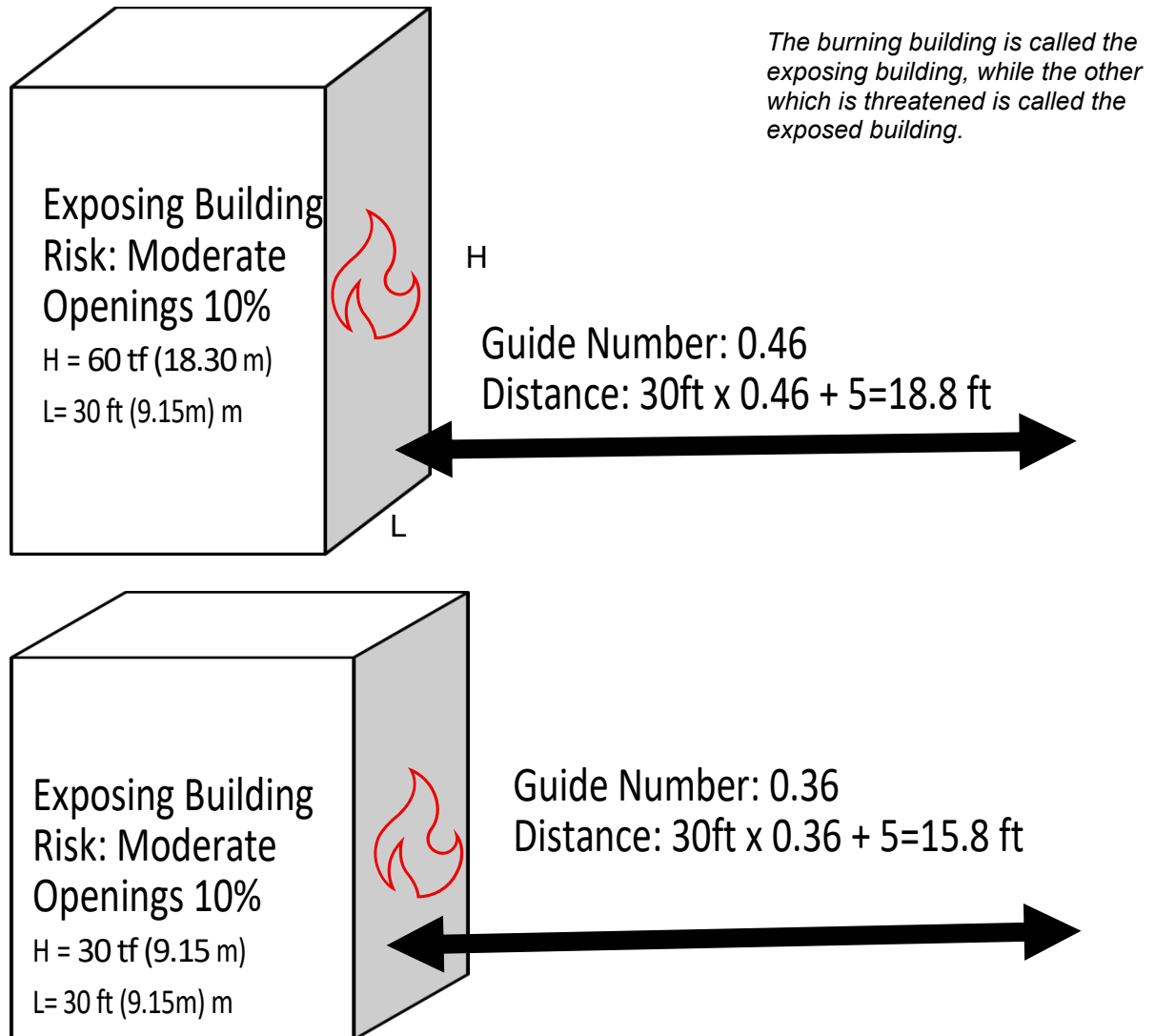
This guide number is then used to determine the minimum separation distance required to prevent fire spread between adjacent structures.

As a consequence, taller buildings generally require greater separation distances than lower structures presenting the same occupancy and fire load.

Buildings connected by Enclosed conveyors; Pipe racks; Utility bridges; Cable trays or Electrical services should not automatically be regarded as independent Fire Areas, unless adequate fire-stopping

arrangements are provided, these connections may permit fire propagation between otherwise separated facilities.

Similarly, cable penetrations through fire walls should be appropriately sealed to maintain the integrity of the fire compartment boundary.



If a building is connected to another through a conveyor, it should be considered part of the same fire area. Conveyors can transmit fire from one site to another unless they are equipped with a locking system—such as dampers that automatically close upon fire detection.



## STEP 4 – ESTABLISH CREDIBLE SCENARIOS

Once Fire Areas have been defined, a series of credible loss scenarios should be developed, for fire hazards, the analysis should consider:

- Occupancy hazard classification;
- Combustibility of construction materials;
- Fire load and process characteristics;
- Reliability of fire detection systems;
- Expected performance of fixed fire protection systems;
- Availability of emergency response resources;
- Accessibility for firefighting operations.

Typical Assumptions

### PML Scenario

- Fire detection and suppression systems operate substantially as designed;
- Emergency response is timely and effective;
- Fire spread is limited to part of the Fire Area.

### EML Scenario

- Critical protection systems fail, are impaired or are overwhelmed;
- Firefighting efforts are delayed or ineffective;
- Fire spreads throughout the entire Fire Area and potentially to adjoining areas.

Where relevant, additional scenarios may be required to address:

- Vapour Cloud Explosions (VCE);
- Dust explosions;
- Natural catastrophe perils;
- Machinery breakdown and ensuing fire;
- Utility failures causing prolonged shutdowns.

## STEP 5: QUANTIFY PROPERTY DAMAGE AND BUSINESS INTERRUPTION

### Property Damage Assessment

The estimated physical loss should consider:

- Buildings;
- Machinery and equipment;
- Stock and raw materials;

- Ancillary structures;
- Debris removal costs;
- Escalation and inflation allowances.

The loss estimate should reflect the proportion of each asset expected to be damaged under the defined scenario.

### **Business Interruption Assessment**

Business Interruption (BI) often exceeds Property Damage losses and should therefore receive equal attention.

The analysis typically considers:

- Critical production dependencies;
- Repair and replacement periods;
- Long-lead equipment;
- Availability of alternative suppliers;
- Outsourcing opportunities;
- Temporary production arrangements;
- Loss of gross profit;
- Contractual penalties and loss of market share.

Particular attention should be paid to bottleneck assets capable of generating disproportionate BI losses.

### **Combined Property Damage and Business Interruption Assessment**

The final EML and PML should reflect the most severe realistic combination of:

- Property Damage (PD);
- Machinery Breakdown Damage (MBD), where applicable; and
- Business Interruption (BI).

Our recommendation is to consider the greater of:

- The scenario producing the highest Property Damage loss plus its associated Business Interruption loss; or
- The scenario producing the highest Business Interruption loss plus the initiating Property Damage loss.

The resulting EML and PML should be expressed both

- As a monetary value (USD); and
- As a percentage of the Total Insurable Value (TIV).

Example:

|                              | EML        | PML        | Comment                                                                                                                                                                                |
|------------------------------|------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Property Damage</b>       | 15,000,000 | 5,000,000  | <i>Base on fire at Paint storage (storage I building).<br/> EML: Total damage to building storage I and production.<br/> PML: The fire does not spread to the production building.</i> |
| Debris Removal               | 600,000    | 200,000    |                                                                                                                                                                                        |
| Inflation (3%)               | 450,000    | 150,000    |                                                                                                                                                                                        |
| Total                        | 16,050,000 | 5,350,000  |                                                                                                                                                                                        |
| <b>Business Interruption</b> | 15,000,000 | 8,000,000  | <i>EML: 12 month rebuild of Production Building.<br/> PML: 6 month reparation. leasing of a replacement warehouse</i>                                                                  |
| Inflation                    | 750,000    | 400,000    |                                                                                                                                                                                        |
| Total                        | 15,750,000 | 8,400,000  |                                                                                                                                                                                        |
| <b>Combined PD+BI (\$)</b>   | 31,800,000 | 13,750,000 |                                                                                                                                                                                        |
| <b>Combined PD+BI (%)</b>    | 68%        | 30%        | <i>As % of TIV</i>                                                                                                                                                                     |

## SPECIAL CONSIDERATIONS FOR HIGH-RISE BUILDINGS

For high-rise structures, facade construction becomes a critical factor in EML and PML estimation.

Where combustible cladding or curtain wall systems are present, historical loss experience has demonstrated the potential for rapid vertical fire spread and near-total losses.

The Grenfell Tower fire in London (2017) highlighted how external combustible facade systems can permit fire propagation over multiple floors in a very short period, bypassing conventional compartmentation assumptions.

Firefighters usually estimate that the fire generated in residential occupations takes a minimum of 30 minutes to go from one level to another, but in this case the fire spread to several upper floors in the same period of time.

The start of the fire was reported at 1:00 am on the 4th floor and by 3:45 the flames had reached the 23rd floor.



Even where combustible façades are not present, severe fires have occasionally resulted in structural damage sufficiently extensive to require complete demolition of the building, as illustrated by the Windsor Building fire in Madrid.

For high-rise buildings exceeding approximately 15 storeys, particularly where firefighting access is restricted and evacuation complexities are significant, consideration should be given to EML values approaching a total loss scenario unless robust mitigating factors can be demonstrated.

## KEY DELIVERABLES OF AN EML/PML ASSESSMENT

A professional EML/PML study should always include:

- Clear definitions of EML and PML (Not just 3 letters...)
- A detailed loss scenario and its assumptions (Provide a scenario, stating where the fire starts, how it propagates and why it stops. Include assumptions ...)
- Property Damage estimates;
- Business Interruption estimates;
- Allocation of insured values by Fire Area;
- A breakdown of loss estimates by asset category;
- Results expressed in both currency and percentage terms; and
- A transparent explanation of the engineering judgement supporting the conclusions.