Emergency Depressurisation: 690 kPa or 50% in 15 Minutes?

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Overview

Objectives:
• To consider emergency depressurisation of process plant and reduced risk of failures due to fire.
• To review generic depressurisation criteria.
• To describe a scenario specific approach.

Content:
• Requirement for depressurisation.
• Commonly applied criteria.
• “Specific Calculations”.
• Benefits of Specific Calculations over Generic Criteria.
Emergency Depressurisation: Why?

Reduction in harm:
- People; Environment; Plant
- Immediate Harm; Escalation

Vessel Wall Strength, decreases with increasing temperature

Load on Vessel Wall – increases with temperature
Emergency Depressurisation: How?

HOW:

EDP System:

- Actuated valves; Collection/header pipework; Flare or vent
- Design Standards: typically API 521

![Diagram showing Vessel Wall Strength and Stress over time, with a point of Rupture.]
EDP: How fast?

- Vessel Wall Strength
- Vessel Wall Stress
- Failure
Depressurisation Rate Constraints

Rapid depressurisation is generally good however:

• Equipment and piping low temperature constraints.

• Equipment protection – compressor seals.

• Flare/Vent Capacity on an existing plant.

• Flare/Vent size and weight on a new plant.
How fast?

API 521:

• Depressurise to 50 % of Design Pressure in 15 minutes

• Or 690 kPa in 15 minutes

• Or perform more specific calculations
EDP: How fast?

API 521:

Depressurise to 50% of design pressure in 15 minutes

- Pool fire exposure – not jet fire
- Carbon steel vessel
- Wall thickness approximately 25.4mm,

690 kPa in 15 minutes

- “Vessel leak or failure case”
- “Commonly applied for both fire and leak scenarios”

- Or perform more specific calculations
Specific Calculations

What do we do with the answer?

• What is the organisation’s tolerance of risk?

• What’s the nature of the fire threat, pool or jet, size and duration?

• What governs the depressurisation rate?

• How does vessel rupture under fire attack contribute to overall risk?
Fire Risk Assessment

- Fire type
- Fire size
- Fire duration
- Fire frequency
Fire Sources

Fire sources are determined from:

• Installation description: 3D models, P&IDs, equipment layouts
• Fire and Explosion Risk Assessment, QRA
Specific Calculations

Take cognisance of:
• Vessel, material, size, orientation,
• Vessel contents, composition, conditions,
• Contiguous pipework, etc.
• Fire type, size and duration
• Where does the fire contact the vessel
• Pressure relief fitted to the vessel
• Blowdown
Specific Calculation Results

Vessel Wall Strength

Vessel Wall Stress

TIME

STRESS
Governing Inventory

1. SOURCE VESSEL

2. TARGET VESSEL

Emergency Depressurisation Valves

To Flare
Target Vessel Fails

Jet flame length versus time

Target vessel fire endurance

Source vessel to target vessel separation
Target Vessel Survival – 1

Increase Source Vessel EDP rate to reduce fire threat to Target Vessel
Increase Target Vessel EDP rate to increase Target Vessel endurance in fire.
Optimisation
On a real plant;

- Optimisation may involve adjustment of depressurisation rates across a number of vessels.

- It may involve reducing the depressurisation rates of some vessels to accommodate increasing the rates on others.

- Where multiple vessels are involved a number of iterations may be required to determine the best result.

- Optimisation is unlikely to be achieved by applying generic rules.
Other Mitigation

If depressurisation rates cannot be adjusted to give tolerable failure times, other measures are available:

Plant Configuration
- Separation
- Orientation
- Screening

Passive Fire Protection
- Wet applied systems
- Precast systems or boxes

Active Fire Protection
- Deluge
- Fire response team
Conclusions

There are benefits of using specific calculations to determine emergency depressurisation rates rather than applying generic rules;

• Gives better understanding of the fire risk to process vessels, and the contribution of this hazard to overall risk.

• Allows optimisation of risk reduction on an existing facility.

• Allows optimisation of depressurisation system design on a new facility.
Thank You