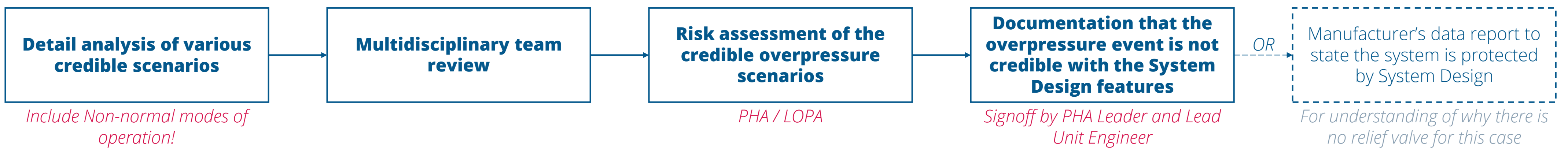


# EXEMPTION FROM FIRE CASE RELIEF VALVE

Applying Code Case 2211-1 (ASME, VIII, UG-140) to Endorse Alternatives to Fire Case Relief Valves

## UG-140(A) REQUIREMENTS FOR SYSTEM DESIGN

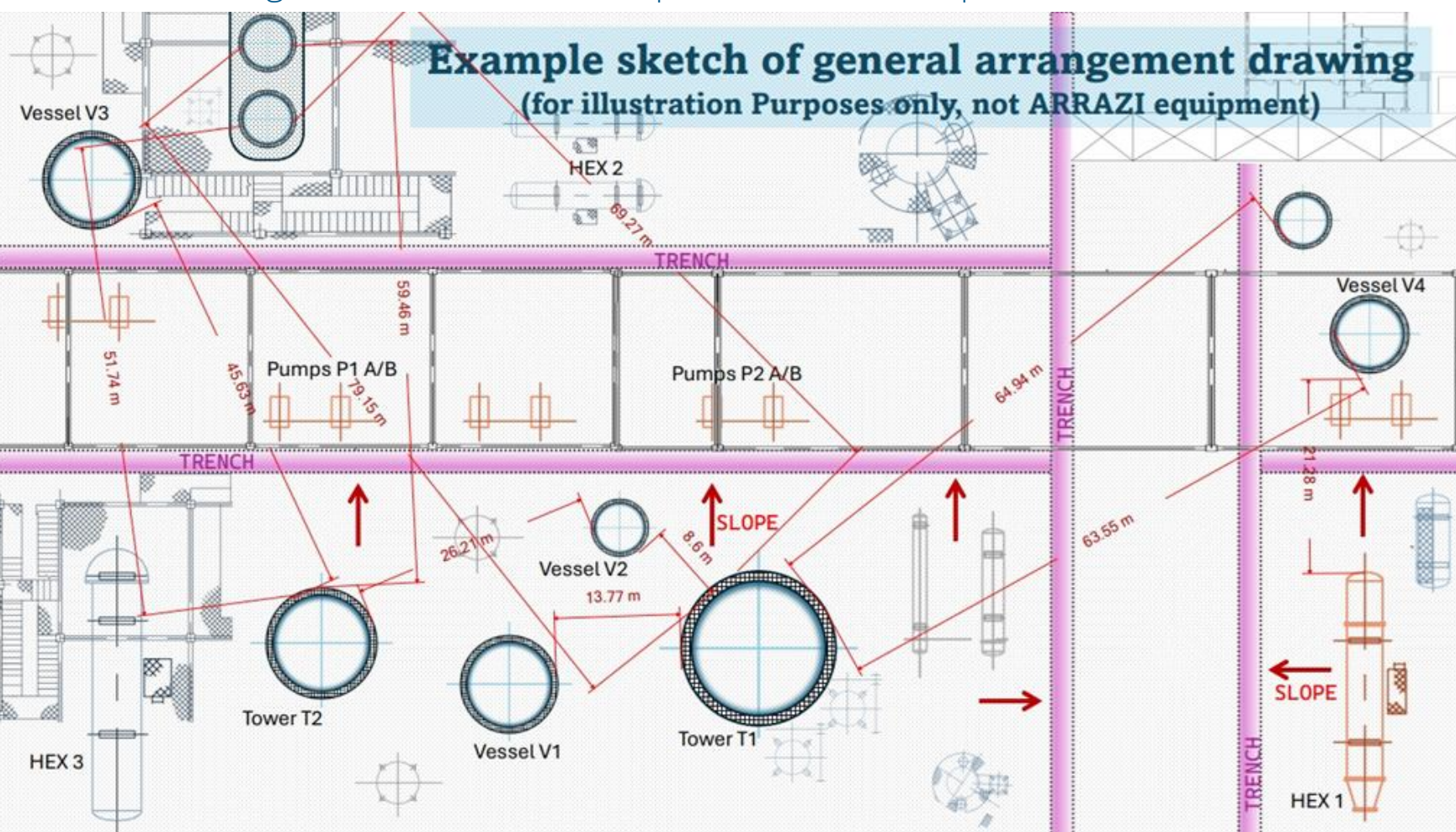


## QUESTIONS CONCERNING VESSELS IDENTIFIED FOR AN EXTERNAL FIRE CASE

1. Is there a PSV available to the vessel when blocked in for maintenance outage? Is it sized for external fire case? – *if both are true, then likely best to leave as is*
2. Is the bottom of the vessel more than 25 ft (7.6 m) above a potential pool of flammable liquid? – *the limit of flame height from API 521*
3. If the vessel is normally empty, will the MAWT be reached before the MAWP? – *then fire case PSV not helpful*
4. Is liquid normally in vessel during a maintenance outage (such as for wash out)? And is there an engineering feature to ensure no liquid in the vessel during a maintenance outage? – *difficult to prove*
5. Are there engineering features, including slope of pad, dike, trench, and/or distance to nearest flammable liquid source, to ensure no flammable pooling under the vessel? – *easy to measure and justify*
6. Are there engineering features to ensure automatic extinguishing of fire under the vessel, including during a maintenance outage? – *difficult to prove statistically to a PFD = 10<sup>-2</sup>*
7. Does the vessels MAWP and MAWT make it inherently safe from external fire when considering the intensity and duration of the fire?

## APPLICATION EXAMPLE

Two staff went to the plant and measured distances between vessels of concern, measured height of vessels above grade/pad, and identified location of trenches. Detailed drawings were reviewed for slope of the concrete pads.



### Summary of alternative System Design considerations for one plant (13 vessels in question)

- 7 have sufficient distance and slope of pad and have a significant trench between the source vessel and target vessel
- 2 have relief valves between the process isolation valves that need a fire case relief valve datasheet; the relief valves appear to be large enough for the fire case
- 3 need a dike to preclude accumulation under the target vessel and the target vessel does not contain flammable liquid
- 1 needs deeper evaluation

Exemption from need for Fire Case PSV per UG-140 (Case Case 2211-1)	
Plant / Area:	Plant III
FC Item Number:	2 (PHA Recommendation 25)
Vessel Number:	V-3502
Vessel Name:	Refining Column RG Reboiler Condensate Drum
Vessel Content:	Reformed gas and chemical process water
PSV (if applicable):	N/A
Is the Vessel exempt from Need for FC PSV:	Yes
Explanation of decision on exemption:	Vessel is 14 M from the edge of T-3501 which contains crude methanol (CMA) in the column bottom. There is no trench between V-3502 and T-3501, but the grade slopes upward at 1:40 pitch towards V-3502. Further note that V-3502 is outside of the 2500 sq ft area (>8.6 m radius) and outside of the 5000 sq ft area (> 12 m) from the centerline of T-3501, meeting one of the exclusions allowed in SES: S03-E01, Rev05. This SES references API Std 521 but 4.6.7.2 of API Std 521 does not appear to be an exclusion from requiring a fire case relief valve, but instead states that in such designs, there is no increase in the flare load of a relief header due to external fire (so API Std 521 4.6.7.2 does not explicitly remove the requirement for a fire case relief valve for the vessel for protection during a shutdown & blocked-in condition). Nevertheless, the team and responsible engineers concur that the distance is sufficient given the volume of liquid from T-3501 and the opposing slope.
Recommended action to be exempt:	Not applicable
Supporting recommendation to maintain exemption:	
Concurrence on Exemption	
Responsible Area Engineer	Signature: [Signature]
	Name: [Name]
	Title: Engineer, Process; Process Engineering
	ID #: [ID]
Date	10/20/2024
PHA Team Leader	Signature: [Signature]
	Name: William Bridges
	Title: PHA Leader, Plant III; President of PII
	Company: Process Improvement Institute, Inc.
Date	October 7, 2024

Vessel Number	Content	A. Does Vessel have PSV already when isolated	B. If Yes, is the PSV sized for FC?	C. Is the bottom of vessel more than 7.6 m above a potential pool of flammable	G. Is there an engineering feature to ensure no flammable liquid pooling under vessel during TAM? (Such as distance to HC liquid source more than 8.6 m)	Recommended Resolution
V-3101	Gas, water maybe during TAM	No	NA	0.91 M	31 M from V-3403	Trench
V-3502	Gas, or CP	No	NA	0.71 M	8.18 M from T-3501 (CHA type in column bottom)	slope uphill from T3501
V-3509	Gas, or CP	No	NA	0.81 M	7.11 M from T-3501 (CHA type in column bottom)	slope uphill from T3501
V-3221	Gas, or CP	No	NA	0.58 M	52 M from T-3501 (CHA type in column bottom)	Trench
E-3222	Gas and water	No	NA	4 M	51 M from T-3501 (CHA type in column bottom)	Trench
V-3203	Gas, or CP	No	NA	0.84 M	62 M from T-3501 (CHA type in column bottom)	Trench
V-3204	Gas, or CP	No	NA	0.74 M	29 M from V-3403	Trench
V-3402	CMA approx.	No	NA	1.93 M	6.1 M from V-3403	27 cm high raised footer/base, with a full metal skirt, with some openings beginning at 18 cm largest opening at 25 cm diameter (for locking in)
V-3504	Higher alcohol	No	NA	3.6 M	6.5 M from T-3501 (CHA type in column bottom)	slope uphill from T3501
R-3101	Gas, and never water	No	NA	2 M	58 M from T-3501 (CHA type in column bottom)	Trench
R-3102 A/B	Gas, and never water	No	NA	2 M	63 M from T-3501 (CHA type in column bottom)	Trench
V-3202	Gas, water maybe during TAM	Yes	Possible based on sizing	0.84 M	27 M from T-3501 (CHA type in column bottom)	Trench
V-3650	Gas, water maybe during TAM	Yes	Possible based on sizing	1.09 M	33 M from T-3503	Trench

### EXEMPTIONS NOT ALLOWED BY TEAM

Is liquid normally in vessel during a maintenance outage (such as for wash out) – **And** - Is there an engineering feature to ensure no liquid in the vessel during a maintenance outage?

**Vessel is gas phase only and there is no credible reason to have liquid (including wash water/condensate) within vessel during a shut down when the vessel is isolated**

This is the most difficult to validate to a Probability < 0.01 as the justification is all human error prevention

For the project shown here, the team decided NOT to use this alternative

Are there engineering features to ensure automatic extinguishing of fire under the vessel, including during a maintenance outage?

This is expensive to design and difficult to validate to a Probability < 0.01 as the justification

For the project shown here, the team decided NOT to use this alternative

## CLOSING

Code Case 2211-1 incorporated in UG-140 (a) can be used for evaluating Safety Design options as an alternative for an External Fire Case relief valve for a pressure vessel; in addition to using an SIF (of SIL 2 or greater) to eliminate one or more other relief scenarios, UG-140(b)

Though the rules for applying the Safety Design as an alternative to a fire case relief valve are straightforward, the assessment takes several hours of team effort per scenario, once the team is acquainted with the approach

**Inherent safe design of pressure vessels can replace the need and requirement for a fire case relief valve**

