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Why 21% over pressure is considered in fire case PSV sizing scenario

S M Kumar
Process Design Consultant
Top Contributor

My response:
Fire under a vessel is a low probability event - unlike say a blocked discharge or upstream PCV/ LCV failure. So code allows relief valve sizing to be based on 121% pressure. This does not mean the vessel will undergo that pressure. All it allows is to select a smaller relief valve. That is all. If you get a PSV area of A sq.inch for normal case with 10% overpressure, then in fire case you are allowed to buy a smaller PSV of A*1.1/1.21. But you are going to select a standard size PSV. If its area is more than what you calculated, then this bigger than required standard size PSV will pass the required fire flow at a pressure lower than 121%! Got it. No real gain.

Extra 1 As I mentioned in another posting the fire case PSV sizing ignores the higher metal temerature and the resultant decreased ability of the metal wall even to withstand its design pressure. In all probability the vessel will rupture under fire before the PSV lifts. Thst is why we provide blowdown valve to reduce the internal pressure

Extra 2. BDV provision is a common practice in the upstream Oil & Gas units. May not be that common in the downstream refinery and petrochemical plants. There is no universal rule.

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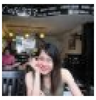

Sue Chin

Sue Chin Lim
Principal Process Engineer at SBM Malaysia Sdn Bhd, CEng PEng MIChemE MIEM

I would like to add that only vessels built to ASME code is allowed with 21% overpressure but not vessels built to PED which is an European code where the allowable overpressure is only 10%. Of course, we seldom see vessels built to PED, that's why it's been like a norm to size the fire relief PSV for 21% overpressure.

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Manoj

Manoj Tiwari
Process Engineer at Ingenious Inc. Process Solutions Pvt. Ltd

Sorry all , but above responses only justifies the code . But why 21% and why not 22, 25 or 26%. How did the code arrived with this figure?.

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Harry

Harry Ma
Sr. Process Engineer at Projex

I believe since ASME allows 10% over 10%, it will become 100X1.1x1.1= 121%.

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Manoj

Manoj Tiwari
Process Engineer at Ingenious Inc. Process Solutions Pvt. Ltd

thanks..Harry Ma

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Ali

Ali Saffari
Senior Process Engineer at PGSOC

thank so much!!!!!!!!!!

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Harry

Harry Ma
Sr. Process Engineer at Projex

One of good point everybody cannot ignore. Thanks!

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Thomas

Thomas Gros
Process Engineer at Citec Engineering

I would say it is not simply the low probability that allows for the higher pressure. It is also the fact that after a fire you would not continue operation without proper inspection, repair or replacement of the potentially damaged equipment.

The choise for exactly 21% is unclear but the figure makes sense. Pressure vessels standard generally limit the allowable stress to roughly yield stress / 1,5 at design pressure. Considering the metal temperature is higher in a fire case you can be quite close to plastic deformation at this 21% higher pressure.

The above statement for PED is not true. The 10% overpressure rule applies for normal operating transients where you will continue operation after the transient. In a fire-case there is no set rule for overpressure in PED but a 20% overpressure would be acceptable.

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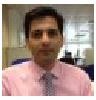

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

Thomas,

I don't know the reason for choosing 21% for fire case either but I have two reasons to relate it to the probability of fire - not the design or mechanical considerations:

1. if I follow your argument, the over-pressure for a non-fire case should have been higher than fire case (21%). The temperature rise in the non-fire cases is usually lower therefore the allowable over-pressure can be higher than 21% - which is not. I guess using allowable stress of yield stress / 1.5 can be because of the hydrotesting operation.

2. I have seen project design code for the pipeline (for instance) where the allowable over-pressure was defined based on the duration/possibility of the over-pressure. I hope a pipeline engineer can remind me about standard/reference.

I don't fully endorse what Harry mentioned above about 10% over 10% but number of likes emphasizes on the fact that "simple is beautiful". And I will use it till I find a better explanation for that.

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Thomas

Thomas Gros
Process Engineer at Citec Engineering

Saeid,

Say the the pressure vessel standards would allow using 90% of tensile stress. Would you still allow 21% overpressure during a fire case? No, because the allowable stress has to be related to the design margins used in the pressure vessel design.

1. No that is not true. You are correct in the sense that that the lower temperature would allow for a higher pressure before actual damage to the pressure vessel occurs. But as 10% overpressure scenario is allowed quite often without inspection, repair or replacement of the pressure vessel you have to maintain a higher margin to yield/tensile stress for this case. In a fire case you can allow a lower margin as you would not continue operation after this. Similarly in the pressure

testing scenario a much lower margin is allowed as you perform this only once during controlled circumstances with (preferably) cold water.

2. Typical example of this would be pressure vessel design in nuclear plants, see for example ASME BPVC III NB, NC and ND. Here the allowable stress is related to the probability of the load case. But also here it is related to the intended action after the load case. You would not expect to continue operating a potentially damaged vessel/piping system.

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