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the realistic relief capacity of PSV installed downstream a wellhead choke valve

Bahareh Mahdavian
Looking for new challenges

The determining the realistic relief capacity of PSV installed downstream a wellhead choke valve is very important. We are using 2 different below scenarios for PSV sizing which are very different in result and the size of PSV.
1-Based on the choke internal failure and according to well P-Q profile (maximum production).this scenario give us a smaller PSV.
2-Based on the choke failure in fully open position (which is a function of max SIWHP, the PSV relief pressure and selected CV of choke valve).Since our client use a typical choke valve with a big CV so the PSV relief capacity is very huge and the size based on this scenario is far bigger than the first scenario.
I am wondering if anybody can share his/her experience in this area or knows which scenario cab be better option to size a PSV for brownfiled platform.

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Mojtaba

Mojtaba Shadmanrad
Lead Process Engineer at NGLTech Sdn Bhd

Bahareh, check the choke valve fail position first. Is it fail to open/close or last position?
If there is possibility of fully open choke valve failure, then you have to take the 2nd approach into account.

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Leila

Leila Hassanzadeh
Oil & Gas Process Engineer

Bahareh, Usually PSV downstream of choke valve is sized based on block outlet scenario . As Choke sizing criteria will take into consideration the future production profile so they are designed with big CV, but they are design with a mechanical stop to limit discharge flow rate in case of any failure. Mechanical stop should be provided with choke maximum opening to be equivalent with well design capacity.

regards,

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Learn Syan

Learn Syan Lee
Process Design Engineer

Bahareh,

Agreed with Leila. While performing wellhead choke valve sizing, one can specify mechanical stopper to limit the opening of choke and hence limiting the fail-open flow rate through choke as the sizing basis of its downstream PSV on the flowline (typically limited to flowline capacity). One may want to consider WHFP as choke valve upstream pressure instead of WHSIP since this would be a more realistic sizing case (well flowing conditions through choke to PSV) rather than WHSIP, which will occur during well shut in condition (no flow).

In brownfield modification, one can also ask from client for well sustainable flow against PSV set pressure (i.e. well P-Q profile as mentioned in query), which could be the more realistic sizing flow

rate.

Regards,
Syan

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Leila

Leila Hassanzadeh
Oil & Gas Process Engineer

Usually PSV down stream of choke valve is used to reduce design pressure of facilities down stream of choke valve so set point of PSV can't be WHSIP.

regards,

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Arun

Arun kumar
Senior Process Engineer at Saipem

Bahareh,
The PSV`s capacity is calculated for each case using HEM-method. The capacity is dependent on relieving pressure, temperature and composition. Check for the Procedure in API 14 C which very clearly states the procedure where a PSV should be provided in wellheads and other details.

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Saeid Rahimi Mofrad
Senior Specialty Process Engineer at Fluor

I propose the following set of conditions for calculation:

Upstream pressure: maximum WHFP (well head flowing pressure)
Downstream pressure: relief valve set pressure (one may consider relieving pressure)
Flow rate: reservoir engineers should calculate the maximum well deliverability with above differential pressure across a fully open choke valve. The maximum production flow can be limited by well hydraulic not the choke valve capacity.

And keep in mind that Relief valve flow rate = well production rate under above mentioned conditions minus normal production rate

In other words, the difference between wide open choke valve flow and normal (heat and material balance) flow should be dedicated to the relief valve.

By the way, if you are using a reduced valve Cv due to mechanical limiter, check with your Client if they give any credit to mechanical limiter. Many companies don't consider the mechanical limiter as a reliable device to limit the relief valve capacity. They may be removed during the plant life!

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Bahareh Mahdavian likes this

Amir

Amir Mofidi
Sr. Process Engineer at Wintershall

I would like to stress out two following issues with respect to the two mentioned methodologies;

- The first methodology will result in under sized PSV. Because the well PQ curve is only applicable when the well flow is established and in principle there is a smooth gas flow production from the well. PQ curve for this specific purpose is not considered as a realistic case, since a so called "well storage effect" is not taken in to account. For the first moments after choke valve opening, we can't use PQ curve to determine the flowrate which passes through the chock valve at PSV set pressure.

- The second method will definitely lead to an over sized PSV, due to the larger dp over the choke valve (SIWHP - PSV set pressure).

The most realistic relief flowrate will be achieved by conducting a dynamic study in which all of the following items are incorporated;

- Characteristics of the well (quadratic PQ relationship or any other type as advised by reservoir engineers)

- Choke valve CV and characteristics (it should be noted that choke valve shall be equal percentage type in order to limit the relief flowrate at the first moments of opening)

- Choke valve opening time (The relief flowrate can also be limited by longer choke valve openings,

i.e. the longer the choke valve opening, the less flowrate through choke valve and thereby the less relief flowrate)

- Choke downstream inventory volume (the volume between choke valve and blockage point)

I have performed this study and the relief flowrate was somewhere between relief flowrate achieved from method #1 and method #2.

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S M Kumar, Bahareh Mahdavian and 2 others like this

Deepak

Deepak Kumar

Senior Process Engineer at DPS (Bristol) Ltd

I agree with Amir, since a flow assurance study is required to understand the pressure profiles across the choke valve.

This will even make more sense in case you have subsea choke valve as well.

Though in absense flow assurance study, it will be better to size the Choke valve based on more conservative approach (higher PSV orifice).

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Bahareh Mahdavian likes this

S M

S M Kumar

Process Design Consultant

I agree with Amir. While d/s pressure is PSV relieving pressure, upstream pressure has to be figured out by good analysis. WHSIP may not be right. It could be WHFP in the initial seconds but may fall of under steady state conditions if the flow is >> normal designated flow on which WHFP is taken.

As pointed out by Leila, the system is usually fully rated to the block valve d/s of choke valve and the PSV is provided to protect the lower rated downstream piping based on blocked outlet scenario. If it is so, Saied's suggestion to deduct normal flow should be reviewed. The inventory holding capacity of the d/s piping to the first valve that can be closed or blocked will determine the rate of pressure raise and time taken to go up from normal operating pressure to PSV relieving pressure; and the pressure decline u/s choke valve from WHFP to a lower value when the PSV lifts.

A good dynamic study starting from the reservoir will help get the correct answer or figure out the right response. I have seen engineers opting for HIPPS without a dynsim analysis - not realising in the time taken to trigger PAHH and close the ESDVs the pressure build-up could exceed the pipe rating. The d/s piping inventory or holding capacity is usually low and in liquid-filled lines the pressure build-up is rather steep. Fully rating could be right solution in such systems - until the last ESDV valve before the pipeline or manifold with bigger inventory and reduced rate of pressure build-up

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Padmanabha

Padmanabha NC

Lead / Senior Process & Flow Assurance Engineer at PT. Meindo Elang Indah

Hi ,

preferred choke valve to be in last position due to control (PCS) failure and choke valve to be in fail close if instrument gas failure.....and design the downstream PSV for blocked outlet case for full single well capacity defined in production profile.

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