Direct Query: When do we give pressure equalization across valves?

S M Kumar
Process Design Consultant
Top Contributor

I read that (1) SDV bypass or pressure differential is given if the pressure difference is greater than 50% of the flange rating (2) what is differential pressure used as I hear 5 bar is used (3) Will it reduce SDV actuator size (4) Can we provide manual bypass or actuated bypass is a must for pressure equalization (5) any other criteria

Unfollow S M

My response - for your comments

1. Pressure equalization is given for all valves >= 10" ANSI 300# and above. Some go for >=6". I do not know about 50% of flange rating. Usually when the differential pressure is >=2 bar (30 psi). Generally a 2" ball valve + 2" globe valve or 2" ball + RO is provided

2. Why? When you open a valve to pressurize is d/s piping, gas will flow at high velocity. The gas may carry mill scale and dirt that will cut or damage the soft seat of the valve. It will increase leakage or injure the tight shut off (TSO) ability of the valve.

To be considered and approved as a SDV there is a limit on maximum leak across SDVs. If this rate is exceeded then you have to replace the SDV. Allowable leakage rates are specified in API 14B and 14C. You may also like to read <<http://mycommittees.api.org/standards/ecs/sc17/17g/Shared Documents/Reference Codes/MMS Report on Allowable Leak Rates.pdf>>

It is cheaper to replace the RO and 2" ball valve usually used in bypass than the larger main valve. Note: To replace the main valve, you may require a shutdown.

(3) Pressure equalization also helps to reduce the opening torque of large valve and result in smaller actuators in-non safety critical valves. ESDV /XSDVs are sized for full differential pressure even when equalization is provided.

(4) Some companies provide manual bypass (LC/LO) to save money. Good practice is to give automated bypass/ equalization.

(5) Special cases: SDVs in automatic start-up duty as in compressor train inlet. Regardless of size, you need an automated bypass here. The bypass is programmed to open first and then the main valve will open after the pre-set pressure differential is reached. Then by-pass SDV is auto-closed. Whenever a signal is sent to close the main SDV, it is also sent to the bypass SDV to close it, though it remains closed.

If the equipment at downstream of the SDV cannot handle any sudden flow increases such as a glycol contactor or filter coalesce, provide the pressure equalization regardless of size and pressure rating.

Caution: A check valve u/s of compressor outlet SDV may trap pressure even after a trip and blow down. If the pressure differential is measured across the outlet SDV, the SDV may open before the pressure is equalized. A few operators have noticed it and process engineers find it convenient point to mark dP transmitters across the main and bypass SDV. Check PT tap off

In liquid service, pressure will equalize very fast – all you need is a few drops of liquids from upstream to downstream. Usually you do not need pressure equalization for larger valves. You may go for it to reduce actuator size or if the large valve is going to be in throttling mode for a long time to fill a long stretch of pipeline as during start-up. It is less expensive to change the damaged bypass then then the damaged seat of mainline LBV (line break valve).

Comments

Mojtaba Habibi, ANJARIA HITESHKUMAR M. and 3 others like this

28 comments • Jump to most recent comment

Mojtaba

Mojtaba Habibi
Process Engineer at Petroleum Engineering and Development Company (PEDEC)
Top Contributor

Dear Mr.Kumar,

Could you please clarify this part of your explanation?

"Caution: A check valve u/s of compressor outlet SDV may trap pressure even after a trip and blow down. If the pressure differential is measured across the outlet SDV, the SDV may open before the pressure is equalized. A few operators have noticed it and process engineers find it convenient point to mark dP transmitters across the main and bypass SDV. Check PT tap off"

Which check valve do you mean? the one u/s of compressor outlet SDV and d/s of anti surge line take-off point? If so, can we relocate it d/s (but as close as posible) to compressor outlet SDV?

Which points to be cared for PT tap off?

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S M

S M Kumar
Process Design Consultant
Top Contributor

Second thoughts: Though you may equalize the pressure to 2 bar, for design purpose it is not bad idea to have the actuators sized for 5 bar press differential

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S M

S M Kumar
Process Design Consultant
Top Contributor

Mojtaba: the one u/s of compressor outlet SDV and d/s of anti surge line take-off point. Yes, you can relocate it d/s. I have seen a few companies do it on the notion that check valves do not require maintenance. But if check valve needs repair or maintenance, entire production will be lost. If check valve is u/s of SDV, then you can maintain it with a single train shutdown assuming more than 1 train is present.

Compressor outlets are usually provided with a pressure differential transmitter, that senses the pressure upstream and downstream of the outlet SDV. Via a dPI, it allows pressure equalization across the main SDV via its 2" bypass/equalization line and then open the main SDV. The upstream pressure sensing PT or pressure transmitter tapping of this dPI, should be u/s of the check valve before the outlet SDV. If you sketch it or look at a P&ID, it will be clear.

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Mojtaba

Mojtaba Habibi
Process Engineer at Petroleum Engineering and Development Company (PEDEC)
Top Contributor

Dear Mr.Kumar,

1. You have mentioned that:

"A check valve u/s of compressor outlet SDV may trap pressure even after a trip and blow down."

If this is the case, and blowdown valve is located u/s of the check valve then I expect there should be another depressuring valve (either manual or if needed automatic) considered between check valve and outlet SDV to depressurize this pipe section after a shutdown. Once this pipe section is depressurized, the pressure equalizing can be done. To me this is un-usual to depressurize the train and leave this pipe section pressurized and then re-start the compressor.

2. And about this part of your comments:

"Mojtaba: the one u/s of compressor outlet SDV and d/s of anti surge line take-off point. Yes, you can relocate it d/s. I have seen a few companies do it on the notion that check valves do not require maintenance. But if check valve needs repair or maintenance, entire production will be lost. If check valve is u/s of SDV, then you can maintain it with a single train shutdown assuming more than 1 train is present."

Very good point but how often we may need maintenance for check valve in comparison with other components of the compressor station such as inlet or outlet SDV, other manual valves and etc?

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S M

S M Kumar
Process Design Consultant
Top Contributor

1. We are talking about a small piece of pipe between check valve and outlet SDV. If you believe that you require another depressuring valve (either manual or if needed automatic), you may do it in your plants.

2. Again go by your experience.

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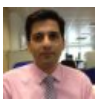

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

I wish the discussion had continued with the same subject rather than the location of check valve :O). Anyway, I am writing about the first 5 questions:

(1) Not all SDVs / manual valves with high differential pressure need pressurization bypass. In order to identify these valves, you need to talk to completion group to see: What is the sequence for normal start up and shutdown operations? What are the possible modes of operation when on side will be pressurized while the other side is depressurized.

For each section of plant, you have to identify which valve will be used to pressurize the system. Is it inlet or outlet isolation valve which will be sued to pressurize a particular section? For example, sometime a major part of the plant can be pressurized from discharge side (pipeline already in operation).

How big this section can be? What is the extent that can be pressurized in one go? For example, is it entire separation train and gas compression train at the same time or first separation train (slug catcher, first and second stage separators) will be commissioned and compression train will pressurized when separation train is operating properly?

Among these valves which have been were identified, the valves 6”and larger AND with differential pressure in excess of 15 bar may require pressurization bypass.

So pressurization bypass is not required when:

• Valve is larger than 6” but the differential pressure is less than 15bar. This is because lower differential pressure may not create significant shock wave travelling through the pipe at sonic speed.

• The differential pressure is higher than 15bar but the valves size is 4” and less. This is because controlled opening (cracking a valve open) is easier with a small valve than with a big valve and there is no major difference between 4” main valve and 2” bypass valve.

• The valve is larger than 6” with differential pressure in excess of 15 bar, but there is a control valve downstream which can be opened gradually after opening the valve.

• The system contains only liquid.

(2) 5bar is the differential pressure across pressurization connection at which logic permits operator to open the main SDV. In other words, it is assumed that opening the main valve at differential pressure of 5.0 bar can not cause damage to the downstream vessel internals, flanged connections, bellows etc.

(3) As far as I know, the actuator of the SDV equipped with pressurization bypass is sized for 5.0 bar differential pressure. Check with an instrument engineer.

(4) If the isolation valve is SDV in SOUR service, the pressurization bypass should be SDV with DP indicator and automatic logic (which permits the main valve to be opened by operator). Otherwise, it can be manual pressurization bypass valve.

If the isolation valve is manual valve, the pressurization bypass should be manual valve + DP indicator with high dif. pressure alarm to warn operator not to open the main valve.

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Nooshin Harandi likes this

Mojtaba

Mojtaba Habibi
Process Engineer at Petroleum Engineering and Development Company (PEDEC)
Top Contributor

Dear Saeid,

Could you please introduce your reference for 6" size & 15 bar differential pressure? Also for 5 bar differential pressure as the basis of permit for opening of the main valve and sizing of SDV actuator?

I am asking this question because this is common issue and most of the time during P&ID review meeting or Hazop study meeting, Clinet/End User request for provision of pressure equalizing line.

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

It is the design practice of an oil production company (Client basically). But the point is that this is Client- A criteria which may not be acceptable to Client-B.

It is very strange if the Client asks for something without providing you with specific project document/specification to explain the background, where it is required, what the details are, etc.

If the Client does not have any criteria, then whatever is proposed by you should be acceptable as far as it makes sense.

There is no other way out.

Delete • December 13, 2012

Sampath

Sampath Kumar R
Upstream Process Engineer at Technip

Dear All,
Interesting discussion. Valuable points on pressure equilization lines.

One point I would like to say here is that regrading the location of check valve at comrpessor discharge.
Check valve and SDV can have flange to flange connection which will eliminate the trapped inventory b/w check valve and SDV.

Saied: I presume the pressure equilisation discussion comes to an end and hence started this topic:O).

Kind Regards

Sampath Kumar R

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S M

S M Kumar
Process Design Consultant
Top Contributor

Sampath: I know that process engineers like to show NRV and SDV flange to flange. But operators are not happy with it - either due to the trapped pressure that can shoot off mill scale or the check valve flapper intruding into SDV space - my Recall Memory is not working. I have seen in a few projects, client asking the process engineers show some piping between NRV and SDV.

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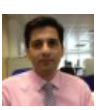

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

I think the correct arrangement for compressor discharge SDV when there is another compression train in service is:

SDV => Check Valve => Manual Isolation Valve (either DBB or SBB)

Check valve can be flange to flange with manual isolation valve.

The reasons are:

• Entire isolated section between SDVs can be depressurized.

• If system is depressurized due to an emergency condition, the trapped volume between SDV and manual valve wont matter as the major system volume has been already made safe after depressuring.

If system is depressurized for maintenance, the trapped volume between SDV and manual isolation valve can be depressurized by temporary opening SDV at the end of depressuring to get ride of the trapped pressure.

• Check valve will be maintainable without shutdown as there is isolation valve downstream. It is a good practice to move check valve to the upstream of last isolation valve when the line is connected to a header collecting/distributing a process fluid from/ between different producers/consumers. A typical example is produced water collection header from separators, desaltres , other PW producers in multiple trains, when check valve failure and maintenance canaffect the whole plant availability.

• Most importantly, the shutdown valve can be tested when the other train(s) is (are) in service, this is especially important during commissioning when gas trains are put in service in phases.

Delete • December 14, 2012

Mojtaba

Mojtaba Habibi
Process Engineer at Petroleum Engineering and Development Company (PEDEC)
Top Contributor

Dear Saeid,

1. How about of having this configuration:

Anti surge line take-off point => Check valve (as close as possible to anti surge line take-off point) => piping section => BDV => ESDV => Manual Isolation Valve (either DBB or SBB)

I think this configuration presents all of the benefits you described. Another point is that for some of the cases the piping section volume and stored energy is great and the ESDV and DBB may be located at farther location because of layout or safety requirement (for example fire zone ESDV). Then this piping section can cause back flow towards compressor casing and also suction side via anti surge line upon a trip. If check valve is located d/s of ESDV there may be concern of back flow originated from this piping section.

But I fully agree with you that by this configuration the drawback is that piping section between check valve and ESDV remains pressurized. I think best solution is to locate compressor stage depressuring valve between check valve and ESDV.

2. You mentioned that:
"If system is depressurized for maintenance, the trapped volume between SDV and manual isolation valve can be depressurized by temporary opening SDV at the end of depressuring to get ride of the trapped pressure. "

Could you please explain more if there is check valve between SDV and manual isolation valve, how to depressurize this piping section by opening of the SDV?

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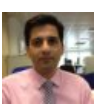

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

1. I think you are talking about different check valve (may be the one close to the compressor discharge nozzle). The one I am writing about (and Kumar's comment was about that) is at the compressor discharge KOD outlet line to the main gas outlet header to prevent back flow from the outlet header to the compressor train.

2. Check valve can be flange to flange with manual isolation valve as explained before.

Delete • December 14, 2012

S M

S M Kumar
Process Design Consultant
Top Contributor

Part 1
Saeid: What you suggest is unusual in my experience. I was going to write “based on 100 over units” and realized that what you are suggesting must have been familiar to you based on your experience.

As I Hazop over different parts of the world, I do realize that different approaches exist – the way our food habits or clothing have evolved.

Based on my exposure:
(1) SDV top work or actuator is usually partial stroke tested when the train is in service; and fully tested to close if the train is on standby. SDV valve is as good as any valve. As we discuss in

Hazop, you don't add another valve to test or maintain a valve, even if its a SDV. Even if you add "n" valves, the "n+1" or the last valve also needs maintenance with equal probability. This is never ending.

(2) I am used to check valve + SDV flange to flange in most of the cases or check valve + piece of pipe + SDV in a few cases demanded by clients. Where DBB is required you add a bleed and manual valve d/s of SDV.

The arrangement you suggest for DBB – 3 valves in series (SDV + 2 manual valves) is unusual for me and I saw it only last week in a P&ID sent by another forum member. And it had a check valve or rather orphan check valve at the d/s header joining point

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S M

S M Kumar
Process Design Consultant
Top Contributor

Part 2
Location of check valve: Earlier days, check valves used to be within the domain of the equipment; domain defined as the outlet SDV, say of produced water line from Production Separator to common header. [Note: Based on safety considerations, the SDV in recent years is located u/s, close to vessel nozzle and the domain limit valve is a manual valve.]

Now I see in a few P&IDs, check valve is moved close to the common header with an addition of another valve, as if this alone will prevent backflow. At times a single check valve or an orphan check valve alone is provided near the common header without a manual valve.

If you sketch, you will realize that it does not matter where the check valve is, like an off switch, in a series circuit – 1 cm from the common header or 10 m away, there will not be any bulk back flow as long as the check valve holds – the pressure d/s of check valve remains the same as d/s header – no delta p, no flow.

As I hazop, I learn about 70% of the operators consider check valve failure is unlikely and it requires no maintenance. Some justify the single orphan check valve near the header protecting them from attempting to repair u/s valves. You will see this in practice reflected with check valve in drain lines – when one is supposed to be drain only after venting source pressure to near atmosphere.

Until recently API RP 521 came up with a clear statement that a single check valve is no check valve at all and that single or 2 checks can transmit pressure, check valves used to be considered a safety critical item. API 14 C still lists a check valve as a safety device, giving it a "halo".

I notice this in a parallel discussion in Linkedin's Hazop group on check valve failure. A member has posted "If designed for the scenario under review (especially the tightness needed), and if installed properly, and if in non-fouling service, and if tested per industry standards, then a check valve can be a valid IPL with a PFD (probability of failure on demand) of 0.1 to 0.01, depending on the class of the valve tightness and the inspection, test plan. The same general statements apply to all IPLs (such as SIS and PSVs). Installing 2 check valves in series is no better than one alone, if neither are appropriate for the scenario under review (tightness needed) and if neither is maintained properly."

Only 30% of operators consider check valve failure as a potential case and they are the ones who want the check valve located u/s of a block valve. No orphan check valve. Unless one makes effort to open and maintain the check valve, it is difficult to spot a latently failed check valve.

Most of the clients I know of want the ESDV actuator sized for full differential, regardless of the pressure equalization. If you have the EPs of oil majors you can check for yourselves. I can quote only what is in public domain. See (1) AA:http://www.talisman-energy.com/upload/media_element/210/01/emergency_shutdown_and_blowdown_valves_-_nao-spc-d-pf-002.pdf:AA and (2)BB: http://kolmetz.com/pdf/ess/PROJECT_STANDARDS_AND_SPECIFICATIONS_pipeline_functional_specification_for_piping_special_items_Rev01.pdf:BB So it is unusual in my world to limit ESDV/XSDV actuator sizing to 5 bar.

Again in my world 15 bar differential pressure is high. Usually the d/s is at atmospheric pressure before pressure equalization. If upstream is 1 bar differential above or 2 bar absolute, you will have sonic velocity d/s P1/P2>2, that can damage the soft seat of the SDVs. I am used to 2 bar to avoid leak in SDVs

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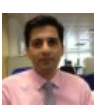

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

I guess I need to explain myself in short, as I don't like to post a scary comment which frightens the reader at first glance:

1) I did not mean that we need a valve for another valve or SDV maintenance! Putting SDV as the last isolation valve when there is a commissioning phases is not a good practice (rather acceptable) because commissioning activities (like leak testing, actuator testing, ESD signal/reset testing, etc) may require SDV to be opened and closed several times which is not favorable when one side of SDV is under pressure. You can check with commissioning or completion in group.

2)I agree that check valve failure may be rare. I did not mean that check valve needs an extra valve downstream. But if there is valve (and I bet 95% times there is) it would be better if it is moved to the upstream of the valve. Check valve will prevent back flow regardless of its location us/ds of the valve.
Just t prevent confusion again, we are talking about the importance of the location of check valves on the line connected to a headers collecting/distributing a process fluid from/ between different producers/consumers.

3) The need for SBB or DBB isolation downstream of SDV depends on the project isolation philosophy. The same philosophy may or may not allow you to use the SDV in place of SBB or one of the isolation valves in DBB arrangement.

4) About differential pressure, what is destructive is not sonic (choked) flow across the valve. Sonic condition anyway takes place as long as the valve upstream pressure is more than double of downstream pressure regardless of valve size (10" main SDV or 2" bypass). It is worth mentioning that even the flow regime through 2" bypass valve and pressurization line will be always at sonic (choked) condition due to high differential pressure.

It is important to control the flow rate (passing through the valve in the chocked condition) and the resultant velocity in the main process line which will be function of DP and valve size (throttling or flow controlling feature of the valve). In other words, the design purpose is it to limit the velocity of fluid in the main process line while high velocity (sonic condition) in valve body or even bypass line in inevitable part of the pressurization process. By the way, the criteria I explained above (15bar and 6") are picked from SHELL DEP 31.38.01.11- piping general requirements.

This criterion is to prevent the damage to vessel internals, flanged connections, elbow etc. I have no clue about limiting the velocity to prevent damage to SDV soft seat due to mill scale and dirt explained by Kumar.

I don't think that all designs should be the same (single design fits for all purposes) but I strongly believe that what has been done in the past in not necessarily the best , therefore we should understand, analyze, and explore if there is any room for improving them.

Delete • December 15, 2012

S M Kumar likes this

Learn Syan

Learn Syan Lee
Process Design Engineer

Dear Saeid,

Below comment is quoted from one of your posts above:

Quote: "The differential pressure is higher than 15bar but the valves size is 4" and less. This is because controlled opening (cracking a valve open) is easier with a small valve than with a big valve and there is no major difference between 4" main valve and 2" bypass valve."

I have also read and understood that the guideline is referred from section 3.12.7 of DEP 31.38.01.11 - Piping General Requirement.

Based on the above DEP guideline,

(a) Does it imply that controlled opening (cracking a valve open) for these 4" valve size and less will not result in damage of soft seats even if differential pressure is greater than 15 bar?

(b) What does it mean by "controlled opening": being able to fully open these smaller valve (4" size and less) faster or gradual/slow opening of the valves as a safe practice?

(c) Otherwise, does it mean that it is acceptable to allow sonic (choked) flow through these 4" valve size and less since the replacement of these valves is comparatively easier than valve size greater than 6" (i.e. easier to procure and less lead time)?

Regards,
Syan

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Vinay

Vinay Singhal
Process Engineering Manager at McDermott International Inc.

I will just add a few observations against the comments made earlier:
(1) On large size compressor discharge piping, it is quite difficult to provide flange-to-flange check valve & isolation valve. This is due to the fact that you need very long through bolts to go through the check valve & isolation valve flanges. At higher ratings / increased number of bolts, become all the more difficult. Also, when working on one valve, both have to be removed. Else, hwo do you support the one hanging heavy valve (alternately provide support below both the valves - premium in off-shore!)
(2) I personally haven't seen actuators being de-rated if pressure equalization valves are provided. I have always seen valve actuators designed to develop torque equivalent to full design pressure of the system or even to piping rated design pressure.

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Vinay

Vinay Singhal
Process Engineering Manager at McDermott International Inc.

I checked section 3.12.7 of DEP 31.38.01.11 - Piping General Requirement. In the refered DEP of August 2004, there is no section 3.12.7??
It stops at 3.12.6.
So either you guys are refering to old DEP and now SHELL has removed this section or is it some other DEP?

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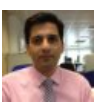

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

The one I am referring to has been issued in Feb 2012.
I guess you are looking at Version 19 or 20. They have been issued several times after 2004.

Version 20 - (January 2004)
Version 21 - (January 2005)
Version 22 - (Sep 2005)
Version 23 - (April 2006)
Version 24 - (November 2006)
Version 26 - (January 2008)
Version 27 - (July 2008)
Version 28 - (February 2009)
Version 29 - (September 2009)
Version 30 - (March 2010)
Version 31 - (October 2010)
Version 32 - (February 2011)
Version 33 - (September 2011)
Version 34 - (February 2012)

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Learn Syan

Learn Syan Lee
Process Design Engineer

Yes, Vinay. I have referred the section from Piping - General Requirement of DEPv34.

For your info, DEPv35 was also released recently. Same section is available therein.

Saeid,

Appreciate if you can shed some light on my earlier queries regarding the interpretation of the relevant section from DEP. Many thanks.

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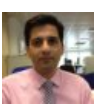

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

Dear Lee,

Nowadays, somebody has managed to overload me (which is not easily possible) :O). That is why I am responding with delay.

a) I have no clue but there are two possibilities:

1. DEP relates the seal damage to flow rate through the valve rather than fluid velocity. As

mentioned before, as long as the valve upstream pressure is more than double of the downstream pressure, the fluid will be flowing at sonic velocity.

2. The damage to seal is happening because of high velocity and debris. Therefore, DEP considers a proper pipe cleaning as a safeguard.

b) Controlled opening means ability to limit the flow. With the same differential pressure, the flow through a 10% open 4” valve is much lower than 10” valve at the same opening percentage.

c) Let’s assume that having sonic flow (high velocity) is destructive. Considering the facts that:

• The sonic (choked) flow cannot be prevented through the SDVs with high deferential pressure regardless of size of it. Therefore even if you install a bypass SDV for a 4” SDV, bypass valve will be damaged instead of main SDV. (Problem is not yet solved).

• The TSO requirement is applied to both main and bypass SDVs. Therefore, after each pressurization operation though bypass, most probably bypass SDV should be replaced as it can not serve the design purpose any more (it wont pass the leak test) which doesn’t seems to be feasible.

In view of this, your interoperation may be correct.

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Learn Syan Lee likes this

S M Kumar
Process Design Consultant
Top Contributor

S M

Saeid: Please review/ revisit your last 2 statements. In the bypass, the pressure drop is taken by a hard seated globe valve or a RO. The soft seated 2" ball valve in bypass is not taking the high pressure drop

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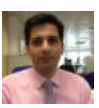

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

Now, you are referring to pressure drop across valve. I guess we have to figure out first what is destructive, velocity or pressure drop?

Or may be presence of debris or valve opening percentage during pressurization or combination of them? :O)

The basis of previous note part c was that the high velocity is damaging the valve seat. Based on this assumption, it does not matter if you have globe or ball with or without RO. As long as the valve upstream pressure is more than double of the downstream pressure, the fluid velocity in the bypass line (including fully or partially opened valve) will be sonic velocity.

You might have seen different arrangements but what I am used to see for the bypass around SDV valve (as I explained before) is:

• If the pressurization bypass is a SDV, there should be a DP indicator and automatic logic which permits the main valve to be opened by operator. The bypass SDV in this arrangement becomes quickly fully open; however, the velocity of fluid through the valve is sonic as explained above. This high velocity is not damaging the valve seat as it is supposed to be fully open, providing full pipe area for fluid to flow (Note: bypass pipe should be properly anchored due to high velocity). Furthermore, the velocity through the main process line is quite low which protect the downstream vessel internals from any possible damage during the pressurization. This arrangement usually does not need a globe valve (as operator intervention is not required) but a RO can be added on the line to limit the flow rate in the main line if it deemed to be high.

• If the pressurization bypass is a manual valve, there should be manual valve + DP indicator with high dif. pressure alarm to warn operator not to open the main valve. The manual valve can be fully or partially open during the pressurization (depending on whether there is a globe valve or RO beside the manual isolation valve for operator to control/limit the flow rate or not), nevertheless the velocity inside the valve and bypass line will be the sonic velocity which dictates a proper piping design (support).

Needless to say, that the entire paragraph was based on an assumption which may be incorrect too! I have no clue.

Having said that, I do agree that installing a globe valve or RO beside the bypass valve prevents the bypass valve from being used (throttled) during pressurization operation which seems to be damaging to the valve seat TOGETHER with unavoidable high (sonic) velocity.

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S M

S M Kumar
Process Design Consultant
Top Contributor

Sonic velocity occurs at the throat or minimum flow area or restriction, that is the globe valve or RO. Not necessarily at the upstream 2" ball valve, which will be on the high pressure side. Its downstream pressure is not half of upstream, but decided by low upstream velocity and L/D of 13. Please set up a simple flarenet model and study. Just because the velocity is sonic at the downstream side of restriction in the bypass it is not right to conclude the velocity is sonic in the upstream or high pressure side of bypass.

Following statements are not right:
1. the fluid velocity in the bypass line (including fully or partially opened valve) will be sonic velocity
2.however, the velocity of fluid through the <bypass) valve is sonic as explained above
3. nevertheless the velocity inside the valve and bypass line will be the sonic velocity

The purpose of 2" ball valve (actuated or not) is to ensure isolation after the pressurization is done.

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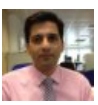

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

I agree that when there is globe or RO, the sonic will take place in throat and downstream low pressure pipe most probably. but i was writing about a bypass arrangement without globe or RO where choking takes place across isolation valve.

However, I agree with you that in some parts of my post I drew a wrong conclusion that entire bypass including the high pressure side was at the sonic velocity.

Thanks for your notification, Kumar. This is another side effect of working under tremendous load. This is not the only mistake I have made over the past week :O)

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S M

S M Kumar
Process Design Consultant
Top Contributor

Saeid: It is OK. Life is one long learning journey. We all make mistakes and at times end up saying things that another person could interpret the wrong way based on his perspective.

It is always good to have a RO in an automated bypass and a globe valve in a manual bypass or pressure equalization line. Even if the seat gets damaged, it is less expensive to change a 2" valve.

Sonic flow issues seem to confuse some process engineers as I audit process calculations or chair Hazop. I wrote a short note on my observations in another forum a few years back. Since I do not save my mails - too many on too many topics - if I could locate in that forum's archive, I will submit here.

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S M

S M Kumar
Process Design Consultant
Top Contributor

Oops, forgot to add. My sincere appreciation, admiration and salutes to you. I admire your technical skills, but only 1 in 100 will have your strength of character to say what you wrote. Usually most of them will try to confuse the issue or deny; others will keep silent; some will resent.

I take this opportunity to appreciate the time and efforts you put in to share what you know. A number of good process engineers do not share; some are hesitant afraid of saying wrong things in public.

You are far ahead of me where I was at your age. Keep going.

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