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Can we take credit of SDV closure to avoid Gas Blow-by scenario to d/s system?

Sampath Kumar R

Upstream Process Engineer at Technip

Dear Friends,

One clarification please.

System description:

Oil from HP Separator is routed to LP separator and oil level in HP separator is maintained by a LCV. Design pressure of HP Separator and LP Separator is 20 barg and 10 barg respectively. Maximum operating pressure in HP Separator is 15 barg. Hence, gas blow-by scenario is applicable for LP Separator as the maximum operating pressure of upstream system is higher than the design pressure of downstream system. HP Separator is provided with 2003 LTs (dedicated for ESD system) which will close SDV located on oil outlet.

Question:

During stuck open of LCV (located on oil outlet of HP separator), level in HP separator will be getting low. Such situation, 2003 LTs (dedicated for ESD action) will come into picture and close the SDV located on the oil outlet line. Can this (2003 LTs) be taken as credit to avoid gas bow-by scenario?

My understanding:

Even 2003 LTs function properly, there will be a chance that SDV will not close. Hence, gas blow-by scenario will be applicable.

One of our team members raises a question saying that LCV stuck open and non-closure of SDV cannot be considered as this will lead to double jeopardy.

My response was that SDV and LCV are related (as these come under Instrumented Protection System) and hence failure of these two can be considered while analyzing the scenarios and its not a double jeopardy.

Please share your experiences.
Thanks in advance.

Kind Regards

Sampath Kumar R

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Wilfredo

Wilfredo Garcia

Process Specialist at Ecopetrol

Dear Sampath,

I think your colleague is right, you can not consider the LCV fails open and the SDV will not close in the same scenario, I think SDV has been incorporated to the system in order to prevent the gas blowby condition. On the other hand, LCV and SDV are routed to different control loops, the 2003

condition is to guarantee the SDV system will work, so the SDV fail to close situation is far from reality. My conclusion is that you can have credit for the SDV.

Cheers,

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Amir Mofidi

Sr. Process Engineer at Wintershall

Amir

In situations like this, I always consider gas blow-by through the control valve stucked at open position. The 2oo3 voting is related to the safety loop on the SDV and has nothing to do with mechanical failure of SDV. It is the same for LCV; mechanical and internal failure of the valve has nothing to do with control loop. We normally consider double jeopardy for simultaneous failure of two control or safety loop. But in this case, for gas blow-by scenario, even if both level control and shut-down loops are working properly, there will be possibility of mechanical failure of the valves.

To conclude, I would suggest to consider gas blow-by scenario.

Cheers,

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Komal Maskariya

Process engineer

Komal

Hi,

As per my knowlege, SDV is provided to eliminate gas blow-by senario in case of low level in upstream vessel. Considering stuck open of LCV & non closure of SDV is double jeopardy. I would not have considered gas blow-by case for this senario.

Comments are welcome.

Thanks,

Komal Maskariya

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S M Kumar

Process Design Consultant

Top Contributor

S M

For Sizing PSV on LP Sep: Fundamental rule one in Relief or over-pressure protection: No credit is taken for any SDV or Control valve action. You have to consider gas blowby to size LP Sep PSV

Otherwise you do not need any PSV at all in an Oil& Gas plant. SDV could have latently failed. As explained in Hazop training classes, control valves are like breaks in a car. You will know that the break has failed as soon as you drive a car. But if your head lights have failed and you use your car only for day trips to office and back, you will realize that headlights have failed only on a night drive when you need them badly. Same goes for SDV's latent failure that may not be known until a demand is placed on it to close. This is not a double jeopardy.

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Mr. Mayank Lad

Process Engineer at WorleyParsons

Mr.
Mayank

Hi Sampath, according to Shell DEP guidelines on Process Safeguarding, two layer of protection need to be provided for all under rated system for governing over pressure scenario.

Governing overpressure scenario for LP separator: Gas blow by from HP separator.

1st protection for LP separator (pen-ultimate): 2oo3 LTs (dedicated for ESD action).

2nd protection (ultimate) : LP separator PSV sized for governing over pressure scenario of gas blow by.

Concluding LP separator PSV need to sized for gas blow by.

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S M Kumar

Process Design Consultant

Top Contributor

S M

Forgot to add. PSV is the claeen route. If you wish to avoid PSV sizing for blowby the HIPPS is the only route – 2 SDVs in series with 2 independent sensors, LALL of first vessel and PAHH of second vessel?

General comment to all Process Engineers: High pressure in a vessel can be read by PAHH in a u/s or d/s vessel most of the times. That is for pressure, there is a redundancy available in the system. Not for level in a vessel. It is a good engg practice (GEP) to ask for LT of LIC and LT of LALL/LAHH track each other and provide a discrepancy alarm for no cost.

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Saeid R. Mofrad

Principal Process Engineer at Petrofac (P.E.)

Top Contributor

Sampath,

Even if you provide HIPPS, DON'T forget to provide a relief valve sized for the next largest relief case as HIPPS will protect the LP vessel against the gas blow-by from HP one by closing the SDV on the interconnecting pipe - not any other emergency cases (such as fire).

By the way, 2oo3 voting system to close the SDV(s) + relief valve sized for the next largest relief case which is called DRITY HIPPS can be also adequate depending on the project overpressure protection philosophy. The degree of redundancy (measuring points, control and shutdown system configurations, number of shutdown valves, etc) is the outcome of SIL study where the worst consequence of such a design depending on system condition, content (toxic/non toxic) and its impact of asset, personnel and environment is discussed.

Furthermore, I am not convinced if comparing the pressures is the right way of making out whether:

- gas blow-by is (or is not) applicable to the system!
- gas blow- by is going to be the largest relief rate that can happen due to LCV failure.

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S M Kumar

Process Design Consultant

Top Contributor

S M

Saeid: Pls add more on the 2 points your last para

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Sampath Kumar R

Upstream Process Engineer at Technip

Sampath

Dear Friends,

Thanks for your responses.

Mr.Saeid: The LP Separator is provided with a PSV sized for next largest relief case (which is external fire scenario).

Mr.Mayank Lad: Agreed. Any system shall be provided with Primary as well as Secondary protection. The point here is that the Primary protection is provided with high degree of reliability (2oo3 with SIL rated SDV). Do we require secondary protection to be designed considering the failure of primary protection as a probable scenario or not?

Mr.Kumar Sir: Thanks for your response comparing with Car breake and Headlight. Nice one remember.

Mr.Amir: Your point is well taken. Mechanical and internal failure of the control / SD valve has nothing to do with control loop.

Thanks to Ms.Komal and Mr.Wilfredo too.

In my opinion, its very difficult to provide a concrete resposne for such kind of problems. The statements given in the codes and standards can be interpreted in different ways by different engineers. Among us, there were various responses. Ultimately, its decided by Client irrespective of our justification, I guess.
This is a FEED and no wonder during EPC, some other HAZOP chairman may ask for Gas blow-by scenario!!!

Anyway thanks once agian for your time and responses. Let me update the conclusion of this issue, once it is finalised. Its on-going...

Kind Regards



Saeid R. Mofrad

Principal Process Engineer at Petrofac (P.E.)

Top Contributor

I am going to review the whole process in order to clarify above point.

First of all I would like to draw your attention to the fact that we are talking about the FAILURE OF CONTROL VALVE in the liquid service. I emphasis on this because I have noticed a strange tendency in process designers too review this case differently from other control valve failure scenarios. It seems they have been charmed by the GAS BLOW-BY title!

The failure of such control valve in the open position causes rapid drainage of the liquid from the HP vessel in to the LP vessel. So, the first thing to check is " What is the LP vessel filing time based on maximum liquid flow through control valve at fully open condition (+ bypass flow if there is any)?"

If this time is so high that there is enough time for the (control room/ field) operator to take a proper action, there is no need to size the relief valve for control valve failure.

I know you may not like this idea, but as long as there is relief valve on the LP side sized for the next largest relief rate + high-high level trip + adequate operator intervention time, the design should pass any safety review. The only point is that the reliability of trip (IPF) function will be higher. This solution is quite comparable with the way we ignore liquid overflowing in vessel and rely on high-high liquid level to close the SDV on LP vessel inlet line + small relief valve and LP vessel gas outlet line which can contribute in releasing the liquid + operator intervention time.

If the draining time is shorter than operator intervention time (typically 10-30 minutes) or you don't like above proposed design, there are two possibilities:

1. The liquid from HP vessel can fill the LP one (for example, the liquid volume in HP vessel is larger than free volume (LAH or LAHH to top TL) in LP vessel). In this case the liquid will completely fill the LP vessel after control valve failure. This means that it is liquid that will be initially released through relief valve before the gas flow is established. But the gas won't reach relief valve unless the liquid in the interconnecting pipe, upper part of LP vessel and relief valve inlet line is discharged into the flare header.

- This period of time is firstly important from the flare header and KOD sizing view point.
- Secondly, since the liquid is pushed by a piston of gas, the liquid relief rate during this time will be corresponding to volumetric flow of gas through wide open control valve. In other words, the liquid in LP side needs to be displaced with a rate equal to the flow rate of gas which comes in.

$$W_{liq} \text{ (in kg/hr)} = W_{vap} \text{ (in kg/hr)} \times \text{liquid density} / \text{gas density}$$

This transient flow is even higher than gas blow-by case which is usually ignored as designers as they would like to go straight away for gas blow-by.

Gas blow-by only takes place in the next step when there is enough disengagement space in the LP vessel.

2. Liquid from the HP vessel cannot fill the LP one. In this case, the designer can go straight away for the gas blow-by case.

Hope this clarifies.

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