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Gas Plant Inlet Facility - Whether to take credit for Normal flow rate during PCV Failure open scenario

[Haribabu Chittibabu](#)

Senior Engineer at Bechtel Corporation

Scheme:

Consider single LNG train of 500 MMSCFD. Slug catcher outlet there is PCV. Upstream of PCV is at 900# rating and downstream at 600# rating. Immediately downstream there is a PSV for Blocked outlet and PCV full open scenario.

During normal operation the upstream of PCV is at 125 barg and downstream at 85 barg. PSV is set at 95 barg.

During PCV fail open momentarily there is about 1200 MMSCFD of gas.

Question is:

- o Whether Gas treating and downstream processing unit can handle 1200 MMSCFD immediately after the PCV fail open or it will be tripped?
- o Whether to relieve the entire 1200 MMSCFD to flare and its impact on capital cost?
- o Whether to relieve the difference 700 MMSCFD to flare assuming downstream can handle only 500 MMSCFD?

Approach:

Some companies size the PSV for the entire 1200 MMSCFD of gas assuming the gas train will be tripped. Some companies size the PSV only for the difference.

Even when there is blocked outlet in the Gas processing unit this PCV will open fully but eventually it will be full flow relief

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[S M Kumar](#)

Process Design Consultant

Top Contributor

S M

API RP allows you to take credit for normal outflow – as long as you are not counting on a control device but as you pointed out the industry practice is to ignore it and size the PSV for full flow from failed PCV.

If you have 2 inlet PCVs with independent PIC loops, the load will be cut to 600 MMSCFD. Process engineers should strive to cut the flare load – from PCV failure or Blowdown to match plant inflow capacity. It is not a good design to have a 1,200 MMSCFD flare in a 500 MMSCFD plant

1. Whether Gas treating and downstream processing unit can handle 1200 MMSCFD immediately after the PCV fail open or it will be tripped? DYNAMIC SIMULATION IS A GOOD TOOL
2. Whether to relieve the entire 1200 MMSCFD to flare and its impact on capital cost? HAVE 2 PCVS. STUDY THE IMPACT ON INFLOW WITH DOWNSTREAM AT PSV RELIEVING PRESSURE
3. Whether to relieve the difference 700 MMSCFD to flare assuming downstream can handle only 500 MMSCFD. GOOD SYSTEM STUDY AND DYNAMIC SIMULATION

Even when there is blocked outlet in the Gas processing unit this PCV will open fully but

eventually it will be full flow relief. NOT RIGHT. ON BLOCKED OUTLET PCV WILL HOLD DOWNSTREAM PRESSURE AND PINCH CLOSE IF D/S PRESSURE RISES

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Saeid R. Mofrad

Principal Process Engineer at Petrofac (P.E.)

Top Contributor

In this case, I believe relief valve should be sized for the difference (700 MMSCFD) if 500 MMSCFD can be processed in downstream unit in any condition i.e. there is no trip/flow obstruction below 95 barg (till relief valve opens).

PCV can go to open fully position during blocked outlet (when PCV controls the slug catcher pressure) but the difference is that:

when blocked outlet condition downstream of PCV happens. At worst case, it is very close to the PCV and just a piece of pipe is going to be pressurized before relief valve opens. This may take few seconds. so the effect of this case will be seen much more faster in PCV downstream than upstream volume (slug catcher). This means that most probably control valve wont act that fast because of system lags due to slug catcher holdup and control system delays. In such situation, relief valve will open quickly and then PCV will become stable (and even slightly closer than normal operation) against 95 barg at discharge.

you are expert in dynamic simulation. if dynamic simulation shows different PCV behavior (faster response) than what i explained, relief rate will be comparable with PCV failure case.

when PCV fails, it is assumed that it rapidly reaches fully open condition. In such situation, it acts like an orifice to depressurize upstream (pressurize downstream) passing higher flow rate than blocked outlet.

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Mojtaba Habibi

Process Engineer at Petroleum Engineering and Development Company (PEDEC)

Top Contributor

Mojtaba

Dear Mr.Kumar,

1. About this part of your points:

"If you have 2 inlet PCVs with independent PIC loops, the load will be cut to 600 MMSCFD."

Could you please explain more how this configuration looks like? Do you mean 2x50% control valves each with separate PIC loop? If so, do you think this can provide proper pressure control? (2 PIC loops can be affected from each other)

2. About this part of your points:

"Even when there is blocked outlet in the Gas processing unit this PCV will open fully but eventually it will be full flow relief. NOT RIGHT. ON BLOCKED OUTLET PCV WILL HOLD DOWNSTREAM PRESSURE AND PINCH CLOSE IF D/S PRESSURE RISES "

By this do you mean you take credit for corrective action of control loop?

Many thanks for your time.

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S M Kumar

Process Design Consultant

Top Contributor

S M

Sorry. I missed the possibility that PCV controls upstream Slug Catcher pressure and assumed that PCV is controlling downstream pressure. If PCV is maintaining upstream pressure, then on PCV outlet blocked scenario, the PCV will go wide open. Haribabu to clarify. Usual configuration is PCV controlling upstream pressure goes to flare; PCV maintaining downstream pressure goes to process.

Mojtaba: 1. Yes, you are right. Do you mean 2x50% control valves each with separate PIC loop? This will avoid high investment in flare system. 2 Based on my assumption that PCV controls downstream pressure, you don't have to consider blocked outlet and PCV failing open at the same time.

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Mojtaba Habibi

Process Engineer at Petroleum Engineering and Development Company (PEDEC)

Top Contributor

Mojtaba Dear Mr.Kumar,

1. I do not mean blocked outlet and PCV failing open happening at the same. I mean unavailability of downstream facilities during plant operation due to any reason except inadvertent closure of a valve that causes blocked outlet and I do not think this is double jeopardy.

2. Could you please shed some lights if 2x50% control valve with separate PIC loops can work properly without affecting each other?

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Haribabu Chittibabu
Senior Engineer at Bechtel Corporation

Haribabu

PCV is controlling the slug catcher pressure.

Elaborate on the scheme PT is on SG and PIC is cascaded to independent train FIC acting on the control valve. Consider the worst scenario pipeline and slug catcher is operating in high pressure packed mode and only one train operating. So blocked outlet downstream of PCV of a train will drive the PCV to fully open. Consider downstream of PCV is gas treating unit (Amine and Molecular sieves) followed by an expander

Dear Rahimi,

As rightly pointed when PCV fail open scenario is like depressuring the upstream system ie the slug catcher with huge inventory and high pressure. So you expect a high flowrate (eg 1200 mmscfd). Agreed the train can take 500 mmscfd but for some time the train will see 1200 mmscfd of gas till the PSV lifts and end up tripping the expander.

From dynamic simulation point of view I have seen during PCV fail open scenario ending up as blocked outlet. Point to be noted is when PCV fail opens upstream pressure also decreases and eventually 1200 mmscfd stays only for few minutes. If the time to increase the system pressure to PSV set pressure is more then eventually it will be only full flow relief even for this scenario. It all depends upon the system and the volume.

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Wilfredo

Wilfredo Garcia
Process Specialist at Ecopetrol

Dear Haribabu, PCV can not control the slug catcher pressure, it has to control the downstream pressure instead, otherwise you can not guarantee the ARU contactor will operate at 85 barg.

In the LNG development project I was working a couple of years ago, we ended with a 10 PCVs in parallel in order to limit the flow to be relieved from a PCV failure in open position.

Mr Kumar is right in his suggestion and in order to get the real flare load, you have to run a dynamic simulation starting at the slug catcher for the determination of the optimum number of PCVs.

Cheers,

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S M

S M Kumar
Process Design Consultant
Top Contributor

Thanks Wilfredo – for the info on 10 parallel PCVs and d/s pressure control!

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

Though we deviate from main question but I feel it is possible to control Acid Removal Unit (ARU) contactor pressure with current process scheme. With Slug catcher back pressure PCV you can fix Slug catcher and pipeline pressure.

You need another back pressure control (may be downstream of ARU) to maintain the pressure of upstream unit(s).

Garcia can you clarify.

I have not seen 10 PCVs but we designed two PCVs with independent control loops. Even the

loops' powers were supplied from two substations in two different places so that it won't fail in any condition (even during fire). 100% redundancy in all conditions!

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Ashraf Abufaris

Process Engineer at Petrofac

Ashraf

Dear all .

Why mechanical stopper can't be used in this case to limit the capacity of the PCV during full open scenario. I thought this is the simple solution in this case. Keeping in mind that this valve will be safety critical item to avoid removal of the stopper during maintenance.

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