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### Flare Network Purging Upon Hot Gas Relief

**Mojtaba Habibi**

Process Engineer at Petroleum Engineering and Development Company (PEDEC)

Top Contributor

Dears,

As you know contineous purge connections are considered for all flare networks to make a positive pressure during plant normal operation inside of the flare network.

There is one emergency case which is descibed at API 521 section 7.3.3.3.4 and also design practice of companies which is excessive vacuum formation at flare network upon hot gas relief into flare network and subsequent coold down of hot relieving streams.

As I checked several projects, I found contineous purge connection has been considered but no emergency purge connection has been considered for hot gas relief case.

Based on good engineering practice, purge gas is injected upon hot gas relief and temperature increase above a pre-set value which activates a temperature switch.

I have following queries:

1. Why many projects have not considered such provision for flare network purging upon hot gas relief?
2. Should we provide separate contineous and emergency purge connections?
3. Which configuration and instruments should be considered at P&ID for emergency purge connection?
4. What should be the set point of the high temperature or low pressure alarms if used?
5. How to ensure about reliability of the high temperature or low pressure loop? All the times there is the concern that instrumented protections can not be regarded as ultimate safegaurds.
6. Which points should be considered to calculate purge gas flow rate upon hot gas relief?

Many thanks for your time.

Best,  
Mojtaba

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Vijay Prasad

**Vijay Prasad K**

Principal HSE Engineer at PDO FEED Office

I have seen this implemented in one MTBE Project where I was involved in commissioning and operations in 1993. In this case there was possibility of introduction of significant amount of hot vapors from 3 PRVs of De-Iso-Butanizer (DIB) column and several other columns as well (e.g. total CW failure or power failure). In this case it was "sort of" SIL2 rated system of high high temp which introduces N2 at several locations in the flare header on sensing Hi Hi Temp. I have not seen this feature in any other projects (not even in similar MTBE plants). Probably it has something to do with the particular corporate's risk acceptability (ALARP) criterion. I think the reliability of sealing (e.g. velocity seals) has probably increased in the course of time. Flare

systems are built to 7 bar design pressure or more to prevent rupture due to deflagration. I am curious to know whether this feature is implemented in any typical gas processing plants if not the reason why.

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**Saeid R. Mofrad**

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Air ingress due to vacuum conditions in flare can occur because of:

1. Flare gas recovery system, although not common
2. Condensation or shrinkage of the contents of the relief system caused by heat removal as a result of a hot release, rain shower on the header, or daily ambient temperature cycles which is believed to require a purge rate more than normal operation purge gas rate (especially in case of hot gas release).

Following protections/safeguards can be provided to prevent vacuum/air ingress:

- a) If the flare gas recovery system causes air ingress into the system, it should have a low pressure trip on the flare gas recovery compressor suction.
  - b) One of the most effective safeguard is a properly designed liquid seal drum because it isolates the flare network from the stack. Injecting purge gas downstream of the liquid seal drum can minimize air ingress through stack. Keep in mind that since gas at stack base is most probably at much lower temperature than initial releasing temperature, shrinkage through the stack won't be considerable and normal purging may be adequate.
  - c) Where no liquid seal drum is used or as an additional barrier to b), the system should be analyzed for air ingress and reverse flame propagation. If the air ingress is greater than the volume of the flare stack, then a suitable safety system can be included. The safety system is typically:
    - A high rate emergency purge for petrochemical facilities triggered by the detection of a hot release.
    - A high temperature alarm plus operator action to open identified purge valve(s) after hot gas release where the sensitivity to reliability of purging system is lower (typically oil and gas plants).
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