Responsibility for Implementation

The appropriate District / Division Maintenance or Operating Supervisor is responsible for ensuring the setpoints of the OPP devices in facilities located within their assigned area do not exceed the maximum settings shown on PG&E Drawing No. 183018.

Contact for Further Information

[redacted]

Deviations

Approval to deviate from the requirements of this Standard must be obtained in writing from the Manager, Station Engineering, GT&D.

Approvals and Authorizations

Todd Hogenson Date
Director, Gas Design and Planning, GT&D

DEFINITION

TRANSMISSION LINE

Transmission Line as defined in this Standard is any pipeline that operates over 60 psig and is not a gathering line Transmission lines are grouped as backbone transmission, local transmission or Distribution Feeder Main (DFM)

- Backbone transmission lines transport gas over long distances from the interconnection points with gathering systems, interstate pipelines, and storage fields
- Local transmission lines interconnect with backbone transmission or sources of supply
- DFMs branch off backbone or local transmission lines and transport gas to large volume customers, or to Distribution Systems which operate at pressures at or below 60 psig

MAOP

Maximum Allowable Operating Pressure (MAOP) is the maximum pressure at which a pipeline, pipeline segment, or component is qualified to operate in accordance with the requirements of 49 CFR Part 192

MOP

Maximum Operating Pressure (MOP) is the maximum pressure at which a gas pipeline system may be operated in accordance with the criteria established in CGT Standard 4125, "Maximum Allowable Operating Pressure, Requirements for Distribution Systems and Transmission and Gathering Lines "

MOvP

Maximum permissible overpressure by Code under any possible operating condition in the event of a failure of the pressure regulating device This maximum overpressure is based on the limitations identified below For cases where hydraulic head is a factor, the maximum pressure pertains to the pressure at the station supplying the particular pipeline section

OPP

An Over Pressure Protection (OPP) Device is a pressure relieving or pressure limiting apparatus installed to protect a pipeline from exceeding its maximum Code-allowable overpressure, as described in Subpart D of 49 CFR 192, in the event of a pressure control failure

Types of OPP devices include
- relief valves
- monitor valves
- security valves

DISCUSSION

The OPP device prevents the pipeline from being over-pressured in the event of a failure of the regulator(s) or compressor(s) supplying the pipeline In addition to properly designing, sizing, and maintaining the OPP device, the proper establishment of the device's setpoint is critical in ensuring that the OPP device provides the necessary protection to the pipeline as well as operates satisfactorily

The OPP setpoint evaluation must account for the potential pressure buildup in excess of the setpoint which could exceed the Code-allowable overpressure An OPP device is not capable of preventing pressure from increasing above its setpoint under **all** conditions This is especially true for conventional relief valves, since their wide-open relief capacity may not occur until the pressure increases to 110% of setpoint

On the other hand, if the OPP setpoint is adjusted too close to the supply devices' setpoint, the OPP could interfere negatively with the operation of the pressure regulator or compressor Therefore, the following must be considered

Upper Setpoint Limitation

Based on 49CFR192 201(a), the overpressure protection device shall be set to ensure the pressure in a transmission (or DFM) system does not exceed

1) the maximum allowable operating pressure plus 10 percent, **or**

2) the pressure that produces a hoop stress of 75% of SMYS, **whichever is lower** For this document, this pressure shall be considered the maximum overpressure or **MOvP**

For the GT&D transmission system, the setpoint of the OPP device shall be determined based on the line's MOP, not the MAOP Generally, whenever the line's MOP is less than its MAOP, another transmission line with a lower MAOP is tied directly to it, thereby requiring the line's MOP to be lower The OPP device shall be set to protect the transmission line with the lower MAOP

Hydraulic Head Effect

If there is a substantial drop in pipeline elevation downstream of the regulator station to its next change of MOP, the low point of the pipeline will see an increase in pressure, and thus, will require the setpoints of both the supply and OPP devices to be lowered commensurate with pressure increase due to the elevation change The pressure increase at the low point of the pipeline is due to the **hydraulic head effect** (weight) of the natural gas However, hydraulic head effects are not considered relevant unless the elevation of the low point of the pipeline (downstream of the regulator station) is 400 feet or more below the regulating station In these situations the responsible GT&D Station or Pipeline Engineer should be contacted to compute this effect *Attachment 1* provides an equation for computing the pressure increase due the hydraulic head effect

Lower Setpoint Limitation

The relief valve or monitor valve controls should be set just sufficiently above the MOP of the system being protected to permit the system to be operated at the MOP without causing the relief valve to weep (vent gas) or the monitor valve to interact negatively with the regulator This pressure setpoint shall be determined considering the operating characteristics and operating tolerances of the valve being used It shall **not** be any higher than necessary, and **under no condition** shall it be set so high that it will permit the pressure in the piping to exceed the MOvP

In some cases, it may be necessary to lower the setpoint of the main supply device to below the pipeline's MOP in order to prevent the supply device(s) and overpressure protection device(s) from interacting negatively with each other Another option is to replace the OPP device with another more responsive device (e g , replace conventional relief with either a quick-opening relief valve or a monitor valve)

Types of OPP Devices and their Operating

Characteristics

Monitor Valves

Monitor valves are essentially backup pressure regulators set to operate above the pipeline's MOP These monitor valves operate if the primary supply device fails to maintain pressure below its setpoint The monitor valves may be controller or pilot-operated Although monitor valves are designed to control pressure, several factors (controller responsiveness, monitor vs regulator actuator speed, etc) can contribute to an outlet pressure initially exceeding the monitor valve setpoint

Relief Valves

Pressure relief valves for transmission lines fall into three categories 1) conventional (direct spring or conventional pilot-operated), 2) quick-opening pilot-operated, and 3) controller-operated

Conventional relief valves require up to 10% over the setpoint to obtain full open flow capacity This factor may necessitate the setpoints of some valves being set at 10% below the MOvP These valves also characteristically weep small amounts of gas when the pressure begins to approach the setpoint

Quick-opening relief valves (e g , Anderson-Greenwood type valves with pilots) achieve full open flow very near their setpoint This type of relief valve also can operate near its setpoint without valve leakage

The controller-operated relief valve may require several psi over its setpoint to obtain full open capacity These relief valves generally utilize a pneumatic-powered plug valve with a pneumatic controller

Variables Affecting the Operating Characteristics of OPP Device

Several factors may affect the responsiveness of the OPP device to minimize any pressure increase above the OPP setpoint These factors include proper tuning and calibration of the controller, pilot and/or OPP device, speed of operation of the regulator, internal volume of downstream piping, design of the OPP system, and maintenance of the device

Guideline for OPP Device Setpoints

Due to the difficulty in computing the maximum setpoint of OPP devices to ensure the downstream pressure never exceeds the limitation allowed in the code, the following guidelines have been established based on minimal interference experienced in present and past applications

MOP	< 250 psig	≥ 250 psig
monitor	5 psig over MOP	10 psig over MOP
relief (conventional)	5 psig over MOP	10 psig over MOP
relief (with quick-opening pilots)	5 psig under MOvP	5 psig under MOvP

It is important to note that the setpoint of any OPP device shall always be set lower than the MOvP (In another words, **never set the monitor or relief valve at MOP + 10% or at a pressure which produces a hoop stress of 75% SMYS.)**

If there is a substantial length of piping between the relief valve and the piping it's protecting and the relief valve is not directly sensing the pipe that it's protecting, the anticipated pressure drop between the main piping and the relief valve should be subtracted from the setpoint recommended above

Following these guidelines will ensure that the pressures under emergency conditions will not exceed the allowable values Due to operational problems, certain OPP installations may require the setpoint to be increased above these guidelines Contact the appropriate Facilities or Pipeline Engineer for concurrence to increase the setpoint above these guidelines The Engineer will compute the expected pressure increase to determine whether it complies with Code

The following table provides an example of typical setpoints of overpressure devices for various operating pressures

Records

Maximum setpoints of OPP devices shall be documented on PG&E Drawing No 183018, "Overpressure Protection Device Maximum Settings " The latest revision of Drawing No 183018 shall be kept in the Electronic Library System (ELS)

The Manager of Station Engineering of GT&D is responsible for

approving the annual updates to PG&E Drawing No 183018

The Manager of Station Engineering shall be responsible for issuing/distributing, PG&E Drawing No 183018 annually on or before March 15th, to reflect setpoint changes or additions that have been submitted for posting

EXAMPLES OF OVERPRESSURE PROTECTION DEVICE SETPOINTS

		Monitor	Relief (Conventional)	Relief (Quick Opening)
MOP	MOvP	MOP + 5 or 10 psi	MOP + 5 or10 psi	MOvP - 5 psi
100	110	105	105	105
200	220	205	205	215
300	330	310	310	325
400	440	410	410	435
500	550	510	510	545
600	660	610	610	655
700	770	710	710	765
800	880	810	810	875
900	990	910	910	985
1000	1100	1010	1010	1095

NOTE Table is based on limitation of MAOP + 10 % 75% SMYS limitation and/or hydraulic head effect must be considered where applicable

ATTACHMENT 1

HYDRAULIC HEAD EFFECTS ON PIPELINE PRESSURES

Example A regulator station is supplying a pipeline with (0 585 relative density) natural gas at 535 psig The station is located at an elevation 850 feet higher than the lowest point of the pipeline

Determine The increased pressure at the low point due to hydraulic head effects Assume the gas is at static condition (i e , no flow)

Solution

$$\Delta P = \Delta H \times density_{gas} / 144$$

where,

ΔP = pressure increase in lb/in^2

ΔH = elevation in feet

$density_{gas}$ = density of gas (lb/ft^3) at actual pressure & temperature for given gas composition

= 1 81 lb_m/ft^3 (interpolated from density table shown on the following page for 535 psig)

$$\Delta P = 850 \text{ ft} \times 1\ 81\ lb_m/ft^3 / 144\ in^2/ft^2 = \underline{10\ 7\ psi}$$

Therefore, the pressure at the lowest point of the pipeline is 10 7 psi higher than the pressure leaving the regulator station or (545 7 psi)

DENSITY OF NATURAL GAS CALCULATED WITH AGA-8, 1992
(Based on 0 585 Sp Gr , 60 deg F, 0 75% N_2, & 0 75% CO_2)

PSIG	Density	PSIG	Density	PSIG	Density	PSIG	Density
0	0 05 lb_m/ft^3	250	0 84 lb_m/ft^3	500	1 69 lb_m/ft^3	750	2 60 lb_m/ft^3
25	0 12	275	0 92	525	1 77	775	2 70
50	0 20	300	1 00	550	1 86	800	2 79
75	0 28	325	1 08	575	1 95	825	2 89
100	0 35	350	1 17	600	2 04	850	2 99
125	0 43	375	1 25	625	2 14	875	3 08
150	0 51	400	1 34	650	2 23	900	3 18
175	0 59	425	1 42	675	2 32	925	3 28
200	0 67	450	1 51	700	2 41	950	3 38
225	0 75	475	1 60	725	2 51	975	3 48
250	0 84	500	1 69	750	2 60	1000	3 58