DESIGN CONSIDERATION OF GAS PIPELINE

A
Major Project Report

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This is to certify that the major project report on "Design Consideration of Gas Pipeline" completed and submitted to "University of Petroleum and Energy Studies, Dehradun" by Dheeraj Bafila in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology ,is bonafide work carried out by them under my supervision and guidance.

To the best of my knowledge and belief the work has been based on investigation made ,data collected and analyzed by them and their work has not been submitted anywhere else other than the university for the for the award of nay degree or diploma.

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CONTENT:

1.1 INTRODUCTION:

Pipeline is the most preferred option to transport oil, gas or product in bulk. It could be thousand of km. long, branched and networked.

Configuration of both oil and gas pipeline are very similar. A cross-country oil or gas pipe line system starts with pumping oil or compression of gas to develop the requisite pressure to travel a long distance. The pressure required is depends on the length of the pipe line, diameter of pipe line or destination pressure requirement. For long pipeline booster compressor for gas pipeline and booster pumps for oil pipeline are used along the length.

Gas or oil is distributed along the length to many of the customers. Normally the following minimum processing facilities are required upstream oil field .

- Separation of oil, condensate and free water.
- Compression of gas, if necessary to deliver at required pressure at shore.
- Pumping of oil.
- Dehydration of gas to protect of pipe line from corrosion.
- Sweetening of gas to remove H_2S.
- Metering
- Corrosion inhibitor injection

1.1.1CONFIGURATION OF CROSS COUNTRY PIPELINE:

A typical cross country pipeline system starting from an offshore field has the following facilities along its route.

- An offshore platform where the oil and is produced.
- PLEM near the platform (pipeline end manifold) from where the pipe line starts.
- An SPM (single point mooring) connecting sub sea pipeline to tanker, if oil is transferred from a tanker instead of platform.
- Pig launcher.
- Subsea pipeline reaching shore at what is called **Landfall Point**.
- A receiver terminal at the land fall point. It has equipment like pig receiver, filter, storage for oil, pumping of oil, processing of gas.

From the receiving terminal oil and gas is sent through cross country pipe line, which could be hundreds of kilometers in length to several customers along the route. There could be several of along the length like power station, fertilizer plants or other industries.

For distribution to each customer, there will be a Distribution Terminal having filter, meter etc.

Normally there are booster stations with booster pumps for oil and booster compressor for gas after every hundred of km. to compensate for the pressure loss in the pipe line.

The entire facility is monitored and managed by SCADA system. SCADA is a central monitoring system, which monitor the entire pipeline parameters over several hundred kilometers by tele-metry and tele-control.

1.2 TYPES OF GAS PIPELINES:

(A) According To Location :
- On-Shore Pipeline
- Off-shore pipeline

(B) According to Product :
- Gas pipeline
- Petroleum product pipeline
- Crude pipeline
- Water pipeline
- Slurries pipeline

(C) According to role
- o Main pipeline
- o Spur pipeline
- o Trunk pipeline
- o Feeder pipeline

Pipeline is used for all the petroleum product transportation because of these reasons:
- Pipelines are economical
- Pipelines are safe for petroleum product transportation
- Pipelines are environmental friendly
- Minimum impact on land use pattern
- Minimum loss of product

1.3 GAS PIPELINE :

GAIL (India) Ltd and the ONGC will invest about Rs 3,000 crore for laying a pipeline from Kakinada in Andhra Pradesh to Haldia in West Bengal to transport natural gas discovered by the ONGC in the Bay of Bengal.

"GAIL and the ONGC have signed a preliminary agreement to form a special purpose vehicle for laying the 1,000-km pipeline," a GAIL source said.

The pipeline passes through Peddapuram to Srikakulam (in Andhra Pradesh), Ganjam, Khorda, Bhubaneshwar, Cuttack, Jaipur, Balasore, Bhadrak (in Orissa), Kharagpur, Medinipore, Hugli and Naida to Pandua near Kolkata (in West Bengal). The pipeline is likely to be completed by 2011-12.

The ONGC has discovered huge gas reserves in deep-sea block KG-DWN-98/2 off the Andhra coast. Though the reserves have not yet been ascertained, the production potential according to some estimates could be as high as 50 million standard cubic metres per day.

The source said the ONGC and GAIL would hold an equal stake in the SPV to lay the pipeline, which would run almost parallel to a similar pipeline proposed by Reliance Industries for transporting gas found in the neighbouring KG-DWN-98/3 block.

The state-run firms are also likely to collaborate in setting up pipeline networks to supply gas to households and commercial establishments for cooking purposes and compressed natural gas (CNG) to automobiles in cities falling on the pipeline route.

"At current prices, revenue from the sale of one mmscmd of gas through CGD networks such as in Delhi and Mumbai is Rs 500 crore," the source said.

GAIL has plans to lay a 853-km pipeline from Haldia to Jagdishpur, where its trunk 000Hazira-Vijaipur-Jagdishpur pipeline terminates.

The company has identified 28 cities for implementation of projects for supplying CNG to automobiles and piped cooking as to households and commercial establishments.

The cities include Agra, Lucknow, Kanpur, Varanasi, Pune, Faridabad, Patna, Ahmedabad, Sholapur, Hyderabad, Bangalore, Kolkata.

1.4 COST CONSIDERATION

Pipeline is the most economical way to transport petroleum product. Before starting LPG pipeline product GAIL under took cost optimization study for KANDLA – JAMNAGAR – LONI pipeline result indicated that pipeline are cheapest mode of transportation more than 200 km. for the shake of comparison result are:

1. Road	Rs. 2.44/MT/Km
2. Railways	Rs. 2.03/MT/Km
3. Pipeline	Rs. 1.38/MT/Km

2. ELEMENT OF PIPELINE DESIGN:

Many factors have to be considered in the engineering and designing of long distance pipeline including the nature and volume of fluid transported length of pipeline, type of terrin and environmental constraints.
Many factors influence the pipeline system as:

2.1 Fluid property

2.2 Environment

2.3 Effect of pressure and temperature

2.4 Supply and demand scenario

2.5 Material and construction

2.6 Economics

2.7 Pipeline protection

2.1 FLUID PROPERTY

It is either given for system design or have to be determined by design engineer. The following properties have to be determined for gas at a specific temperature&pressure.

1. Specific volume
2. super compressibility factor
3. specific heat

4. J-t coefficient
5. enthalpy
6. entropy
7. viscosity

FOR LIQUID:
1. Viscosity
2. Density
3. Specific heat.

2.2 ENVIRONMENT

2.2.1 Ground temperature

2.2.2 Soil conductivity

2.2.3 Soil density

2.2.4 Soil specific heat

2.2.5 Depth of burial

2.2 EFFECT OF PRESSURE & TEMPERATURE

As the temperature increases , fluid viscosity and density decreases, thereby the lowering the pressure drop. Transmissibility of gas in pipeline decreases due to increases in pressure drop. It increases the compressor power requirement for a given flow rate.

As the temperature and pressure increases gas absolute viscosity increases and frictional losses along the pipe line increases.

2.3 SUPPLY AND DEMAND SCENARIO

Supply and demand points, as well as demand build up effect the over all pipeline system design. Location of demand and supply points determine the route and location of facilities and control points , the demand build up determines the optimum pipeline facilities size, location & timing requirement.

2.5 MATERIAL AND CONSTRUCTION

For long distance pipeline the significant cost in terms capitol investment is the cost of pipe material and installation. Pipeline installation location & technology affect the cost & design. Pipe material/ grade affect the wall thickness. For a given design pressure & pipe diameter the wall thickness decreases with higher grade material.

2.6 PROTECTION

Corrosion control maintenance on pipeline system is required to ensure:

- Safety
- Government Regulation
- Cost

Pipe Line Corrosion Control:

Pipe line facility requires huge investment and carries large bulk of oil and gas resources vital to the economy of a country. Protection of pipe line from corrosion and corrosion control are vital for preservation of the asset .It should be noted that the most pipe lines buried more than 1.5 meters deep for safety and environmental consideration.

There are two types of corrosion in pipelines:

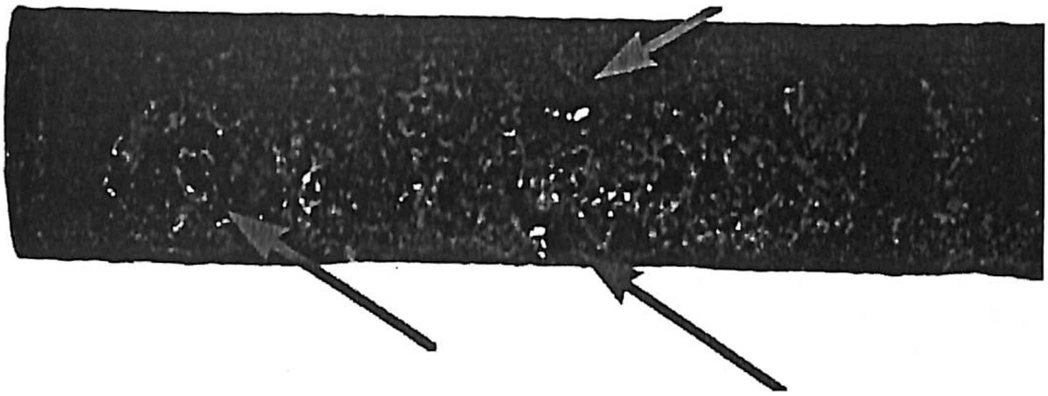
- INTERNAL CORROSION due to chemical reaction of metal with corrosive components like CO_2, H_2S.
- EXTERNAL CORROSION due to the external environment of pipe line i.e. soil, water etc. Caused by electrochemical process.

There are two principal methods of external corrosion control are:

2.6.1 Coating

2.6.2 Cathodic Protection

Corrosion or Unprotected Buried Pipe:



2.6.1 COATINGS:

There are many different types of coating on the market. The better the coating application, the less electrical current is needed to cathodically protect the pipe.

Mill Coated Pipe:

When purchasing steel pipe for underground gas services, operators should purchase mill coated pipe (i.e., pipe coated during manufacturing process). Some examples of mill coatings are:

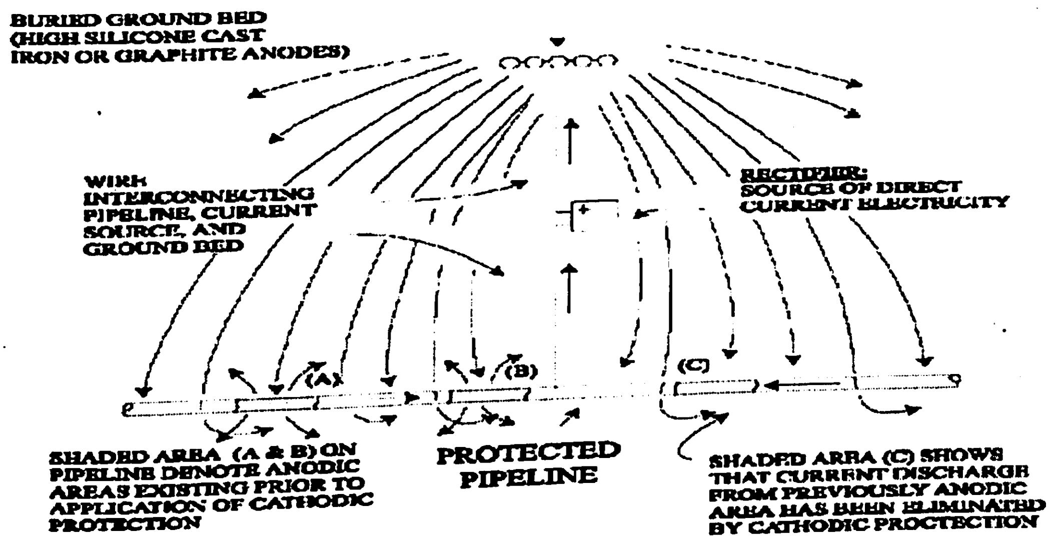
- Extruded polyethylene or polypropylene plastic coatings,
- Coal tar coatings,
- Enamels,
- Mastics,
- Epoxy. A qualified (corrosion) person can help select the best coating for a natural gas system. A local natural gas utility may be able to give master meter operators the name and location of nearby suppliers of mill coated gas pipe. When purchasing steel pipe, remember to verify that the pipe was manufactured according to one of the specifications listed in Chapter VI of this manual. This can be verified by a bill of lading or by the markings on mill coated pipe.

2.6.2 CATHODIC PROTECTION:

Because of some reason some areas of pipe line becomes anodic and some areas of pipe line becomes cathodic. Currents from the anode to cathode starts to flow. Because of this current metal from anode to cathode starts to deposit .This causes corrosion in pipe line.

Cathodic protection is a procedure by which an underground pipeline is protected from corrosion. A direct current is imposed on to the pipeline by means of a rectifier and ground bed anode. Corrosion will be reduced in such areas where sufficient current flows onto the pipeline.

FIGURE III-4



This illustrates how cathodic protection can be achieved by use of a rectifier. Make certain the negative terminal of the rectifier is connected to the pipe. **NOTE:** If the reverse occurs (positive terminal to pipe), the pipe will corrode much faster.

Potential means the difference in voltage between two points of measurement (see FIGURE III-5).

2.7 Pipeline Design Features:

The pipeline is designed taking in to consideration the operating condition and requirement over its entire projected life cycle including final abandonment, i.e.

- The maximum planed throughput and turn down.
- The characteristics of the fluid to be transported.
- The pressure and temperature required.
- The mode of operation.
- The geographical location and environmental condition.

- First we calculate the throughput, means the flow rate. The throughput will depend upon the market demand which is seasonal as in winter season the market demand is high and in summer season market demand is less for gas.

- Than we calculate the length of the pipe line which depends upon terrine. We generally choose the smallest way.

- After calculating the pipe length we calculate the pressure which is required for a fluid to reach till destination. Than we calculate the temperature inside the pipe line.

- NG is transported at high pressure in the pipeline at pressures anywhere between 30 ~ 100 bar. This reduces the volume of natural gas being transported, as well as providing propellant force to move the NG, through the pipeline.

- If pipe length is more, we establish the booster stations, where we use compressors to increase the pressure energy of gas.

- If oil is the fluid which we are transporting, we calculate the pressure in the basis of length of pipeline and the fluid characteristics like viscosity etc.

- In next step we calculate the diameter of the pipe line, the dia. has two types: Actual diameter and available diameter.
- Then we calculate the wall thickness
- In next step we select the pipe material , generally in cross country pipe line we use high grade polyethylene

Case history:

- A 20-inch cross-country pipeline (820 km) is being proposed based on the estimated demand of 20 MMSCMD. The pipeline passes through 14 districts from the receiving port (Jamnagar) to the terminating point (Bhopal). The pipeline pressure varies all along the line and intermediate booster stations at Ahmedabad, Dahod and Indore (at 309, 481 & 669 kms) are required to generate enough pressure for gas movement. The 820 km line has 68 sectionalizing valves dividing the pipeline in 69 sections. In addition to compressing natural gas, a compressor station has condensate removal system for removing moisture and higher hydrocarbons liquefied in the line.
- The pipeline is underground buried in trench 1~1.5 m deep covered with earth. The starting point is Jamnagar pumping station at an elevation of 4 m above MSL and the terminating point at Bhopal is at 523 meters above MSL. Natural gas have customers on both ends of pipeline, the producers and processors that input gas into the pipeline and the consumers and local distribution companies that take gas out of the pipeline. Hence Supervisory Control & Data Acquisition (SCADA) system for electronic monitoring of pipeline is done for the entire stretch of pipeline from the control station.

3. ROUTE SELECTION:

After a company obtains all required permits, satisfies regulatory requirements, finalizes design and acquires the right(s)-of-way, actual construction may begin.
Following is a list of steps involved in the construction and installation of a line section. A line section is a continuous run of pipe between two points; for example, between two pumping stations or two compressor stations. Regardless of the length of the line, the construction process must be carefully planned and executed to meet construction schedules and seasonal weather conditions, as well as to ensure the safety and integrity of the new pipeline. Installing a pipeline section is much like an assembly-line process, with segments of the pipeline being completed in stages. Construction of a line segment generally involves the following steps, performed sequentially, for a given line section.

Physical Construction of a Pipeline:

3.1 Site preparation
3.2 Pipe stringing
3.3 Trenching
3.4 Bending
3.5 Welding
3.6 Coating
3.7 Lowering and backfilling
3.8 Testing

3.1 SITE PREPARATION

To begin construction the selected route (construction rights-of-way) of the pipeline must be cleared. Construction work and equipment passage requires that temporary work space be used that is outside the permanent easement. The temporary use of this additional space is negotiated with the landowner. A survey crew carefully surveys and stakes the construction rights-of-way to ensure that only the pre-approved construction workspace is cleared. Next, to make the rights-of-way into a suitable work area, a clearing and grading crew prepares the corridor so the construction equipment can operate safely. This crew removes trees, boulders, brush, and other impediments that may prohibit construction. This crew also prepares a working surface for the additional construction equipment that will follow.

The crew installs silt fence along edges of streams and wetlands to prevent erosion of disturbed soil. Trees inside the right-of-way are cut down and the timber is removed or stacked alongside the rights-of-way. Brush is commonly shredded or burned. Also, as may be necessary in agricultural areas, topsoil may be stripped to a predetermined depth and stockpiled along the sides of the rights-of-way. Stockpiling of topsoil is not required in areas that are not cultivated

3.2 STRINGING AND WELDING

Once the construction rights-of-way has been cleared sufficiently to allow construction equipment to gain access, sections of pipe are laid out along the rights-of-way. This process is called 'stringing' the pipe. Pipe sections are fabricated in steel rolling mills and inspected to assure they meet applicable industry and federal government safety standards. The fabricated pipe sections are commonly from 40 to 80 feet long. Their design and manufacture are selected specifically for their intended location in the pipeline. This is because specific locations along a pipeline system may have different requirements for pipe size, pipe strength and wall thickness, and coating material due to varying soil conditions, geographical features or nearby population densities.
The pipe may be transported from the pipe mill to a pipe storage yard in the vicinity of the pipeline location or directly to the rights-of-way. After the

pipe is delivered to the rights-of-way, a stringing crew will carefully distribute the various pipe sections according to the design plan.

3.3 TRENCHING

After stringing the pipe sections in place, a trench is dug along the rights-of-way alongside the pipe sections. Topsoil is often removed from the work area and stockpiled separately to be used in site restoration. Mechanical equipment such as wheel trenchers or backhoes is used to dig the pipe trench. Occasionally, rock drilling and blasting is required to break rock in a controlled manner. The material that is excavated during trenching operations is temporarily stockpiled on the non-working side of the trench. This material will be used again in the backfill operation.

The trenches are dug deep enough to allow for an adequate amount of cover when the pipe is buried. Federal regulations require that transmission pipelines be buried at least 30 inches below the surface in rural areas and deeper in more populated areas. In addition, the pipeline must be buried deeper in some locations, such as at road crossings and crossings of bodies of water, and may be less in other locations such as when it is installed in consolidated rock. The depth of burial of the line must be in accordance with Federal pipeline safety regulations.

3.4 BENDING

A bending machine is used in the field to make slight bends in individual sections of the pipe to account for changes in the pipeline route and to conform to the topography. The bending machine uses a series of clamps and hydraulic pressure to make a very smooth, controlled bend in the pipe. All bending is performed in strict accordance with federally prescribed standards to ensure integrity of the bend.

3.5 WELDING

To carry out the welding process, the pipe sections are temporarily supported along the edge of the trench and aligned. The various pipe sections are then welded together into one continuous length, using manual, semiautomatic or automatic welding procedures. Special pipeline equipment called side booms are used to pick up, support and align each piece of pipe with the next piece to make the first pass of each weld.
All welding procedures are qualified and welding is controlled to strict specifications, including semiautomatic and automatic procedures. More and more often, especially for larger projects, automatic welding is used instead of manual welding.
As part of the quality-assurance process, each welder must pass qualification tests to work on a particular pipeline job, and each weld procedure must be approved for use on that job in accordance with federally adopted welding standards. Welder qualification takes place before the project begins. Each welder must complete several welds using the same type of pipe as that to be used in the project. The welds are then evaluated by placing the welded material in a machine and measuring the force required to pull the weld apart. It is interesting to note that the weld is actually stronger than the pipe itself.
A second level of quality-assurance ensures the quality of the ongoing welding operation. To do this, qualified technicians take X-rays of the pipe welds to ensure the completed welds meet federally prescribed quality standards. The X-ray technician processes the film in a small, portable darkroom at the site. If the technician detects any flaws, the weld is repaired or cut out, and a new weld is made. Another form of weld quality inspection employs ultrasonic technology.

3.6 COATING

After the pipe is welded, the welds are examined, usually by X-ray, and a coating is applied to the welded areas at the ends of the pipe sections to prevent corrosion. A coating is applied to the pipe during its manufacture; however, this process typically leaves the ends of the pipe uncoated to allow for welding.

Several different types of coatings may be used to coat field joints, the most common being fusion bond epoxy or polyethylene heat-shrink sleeves. Prior to application, the bare pipe is thoroughly cleaned to remove any dirt, mill scale or debris. The coating is then applied and allowed to dry. After field coating and before the pipe is lowered into the trench, the entire coating of the pipe is inspected to ensure that it is free from defects.

3.7 LOWERING AND BACKFILLING

Once the pipeline is welded and coated, it is lowered into the trench. Lowering is done with multiple pieces of specialized construction equipment called side booms. This equipment acts in tandem to lift and lower segments of the assembled pipeline into the trench in a smooth and uniform manner to prevent damaging the pipe.

Once the pipeline is lowered into the ground, the trench is carefully backfilled, to ensure that the pipe and its coating are not damaged. This is generally accomplished with either a backhoe or padding machine depending on the soil makeup.

Care is taken to protect the pipe and coating from sharp rocks and abrasion as the backfill is returned to the trench. In areas where the ground is rocky and coarse, the backfill material is screened to remove rocks or the pipe is covered with a material to protect it from sharp rocks and abrasion. Alternatively, clean fill may be brought in to cover the pipe. Once the pipe is sufficiently covered, the coarser soil and rock can then be used to complete the backfill.

As the backfill operations begin, the excavated material is returned to the trench in reverse order, with the subsoil put back first, followed by the topsoil. This ensures the topsoil is returned to its original position.

3.8 TESTING

Generally, but with certain exceptions, all newly constructed hazardous liquid and natural gas transmission pipelines must be hydrostatically tested before they can be placed into service. The purpose of a hydrostatic pressure test is to eliminate any defect that might threaten the pipeline's ability to sustain its maximum operating pressure, or to determine that no defects exist. A pipeline is designed to a specified strength based on its intended operating pressure. Hydrostatic pressure testing consists of filling the pipeline with water and raising the internal pressure to a specified level above the intended operating pressure. Critical defects that cannot withstand the pressure will fail. Upon detection of such failures, the defects are repaired or the affected section of the pipeline is replaced and the test resumed until the pipeline "passes".

Hydrostatic testing is not the only means for detecting pipe defects. For example, inline inspection (ILI) technologies are used that permit the identification of specific types of defects, such as corrosion. But because not all lines can be inspected with ILI tools and because of the need to find types of defects that are not currently detected by ILI technology, hydrostatic testing is an accepted method for demonstrating the fitness of a pipeline segment for service.

3.9 SITE RESTORATION:

Finally, the construction right-of-way is restored as closely as possible to its original condition. Depending on the location and circumstances, this could involve smoothing the construction area, replacing topsoil, repairing irrigation systems, applying fertilizer and grass seed, or other actions that may be necessary.

The right-of-way is carefully graded, and in hilly areas, erosion-prevention measures such as interceptor dikes - which are small earthen mounds constructed across the right-of-way to divert water - are installed. Stone or timber materials -- known as 'riprap" -- are also sometimes installed along streams and wetlands to stabilize soils and retain habitat following construction

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4.0 PIPELINE MECHANICAL DESIGN :

This chapter will include the design of steel pipeline for transmission of gas, liquid, and petroleum product.

4.1CODES AND STANDERDS

Design, material selection and construction of pipeline facilities is governed by codes and standard that prescribe minimum requirement. Purpose is to ensure that the complete structure will safe to operate under the condition to be used. The following codes and standard form the basis of pipeline wall thickness calculation.

4.1.1American Petroleum Institute

API5L Specific for pipeline

4.1.2American society of mechanical engineers (ASME)

ASME B31.8 Gathering, transportation and distribution piping System pipeline

4.2 LOCATION CLASSIFICATION

The most significantly factor for contributing the failure of gas pipeline is damage to line caused by human activities. It generally occurs due to construction or other services. To account the risk of damage the designer determines allocation classification based predominantly on population concentration .

4.3PIPELINE DESIGN FORMULA

The widely used formula for determining the circumferential and axial stresses in a pressurized thin walled pipe can be developed quite easily considering vertical & horizontal forces in equilibrium.

A unit tangential force F is created in the pipe wall due to application of an inertial pressure P. the resultant forces due to this pressure id PD, so the equilibrium force F in the pipe wall must be PD/2. This force acts on an area of pipe wall, A, given by the product of the wall thickness (t) and unit depth of pipe.

The longitudinal force on the pipe wall caused by the inertial pressure is approximately $F=P(3.14D^2/4)$,which will be equilibrated by the force in the pipe wall. The force act on an area approximately (3.14Dt), so the axial stress S_N is:

$S_N=F/A= 3.14PD^2 /3.14*4*D*t=PD/4t$

The axial stress by using the actual area will be;

$S_N=F*4/3.14 (D^2-d^2)=Pd^2/(D^2-d^2)$

4.4 WALL THICKNESS CALCULATION

Wall thickness and grade selection based on pipe grade location and design pressure. The design pressure should not be more than maximum operating pressure (MOP) of pipeline at the location where all forces are considered.
FORMULA USED:

The design pressure for steel gas piping system or the normal wall thickness for a given piping system / the nominal wall thickness for a given design pressure shall be determined by this formula

T=PD/2SFET

P	Design pressure
D	Pipe outside diameter
S	Specified minimum yield stress
F	design factor
E	Longitudinal joint factor
T	Temperature derating factor

The minimum acceptable wall thickness is taken as 6.4mm to prevent damages from handling of pipes during transportation and construction phase. The highest grade selected is API5LGrX-65, PSL-2.

Design pressure P : It is the max. pressure permitted by tis code, as determined by the design procedure applicable to material & location involved.

Pipe outside diameter D: it is pipeline outside diameter, one should not confused with NPS. As example:
NPS 12 Pipe has specific outside dia =12.750
NPS 8 Pipe has specific outside dia = 8.625

Specified minimum yield stress S: it is expressed in pound /in2, the minimum yield strength prescribed by the specification under which pipe is purchased from manufacturer.

Longitudinal joint factor E: If the longitudinal joint can be determined with certainty the corresponding longitudinal joint factor E may be used. Otherwise E shall be taken as 0.60 for NPS4 or smaller and 0.80for more than NPS4.

Temperature derating factor T:

Temp(0F)	Temperature Derating Factor
250 or less	1.00
300	0.967
350	0.933
400	0.900
450	0.867

Longitudinal factor for different line pipe:

Spec. no.	Pipe Class	E –factor
ASTM A 53	Seamless Electrical resistance welding Furness butt welding	1.00 1.00 0.60
ASTM A 106	Seamless	1.00
ASTM A 134	Electrical fusion arc welding	0.8
ASTM A 135	Electrical resistance welding	1.00
API 5L	Seamless Electrical resistance welding Furness butt welding Electrical flash welding	1.00 1.00 0.60 1.00

The minimum acceptable wall thickness is taken as 6.4mm to prevent damages from handling of pipes during transportation and construction phase. The highest grade selected is API5LGrX-65, PSL-2.

SAMPLE WALL THICKNESS CALCULATION:

Data for Murawan – Lucknow pipeline is as follows:

Dia (in)	F	E	T	Thickness	available thickness	L (Km)	Weight of steel (MT)
42	0.72	1	1	21.0mm	22.2mm	400	228.67
42	0.62	1	1	25.4mm	25.4mm	150	97.81
42	0.5	1	1	30.2mm	30.2mm	50	38.59
42	0.4	1	1	37.8mm		12	0.00

Design pressure P= 78.7Kg/m^2

Corrosion allowances A=0.5mm

Pipeline outside dia D= 219.1mm

Pipeline length L = 32 Km

Temperature derating factor T = for 250 or ^{0}F is 1.00

It is proposed to use E welded pipe as per API specification 5L, product specification level 2 (PSL-2)

Weld joint factor =1

API 5L Grade X-52:

For clsass-1 design factor = 0.72

t= (78.7*14.223)(219.1)/2(0.72*1*52000) + 0.5
= 3.275+ 0.5
=3.775mm

Next higher standard thickness available as per API 5L is 6.4mm

For class – 2 design factor= 0.6

t= (78.7*14.223)(219.1)/2(0.6*1*52000) + 0.5
= 3.93+ 0.5
= 4.43mm

Next higher standard thickness available as per API 5L is 6.4mm

For class – 3 design factor= 0.5

t= (78.7*14.223)(219.1)/2(0.5*1*52000) + 0.5
= 5.895+ 0.5
= 6.395mm

Next higher standard thickness available as per API 5L is 6.4mm

CONCLUSION:

- This report gives information about designing of gas pipeline. It includes the various parameters which are essential for designing a gas pipeline.
- This report reviews and evaluate the problems involved in designing and operation of pipeline.

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