" ANALYSIS, REVIEW AND REMEDIAL MEASURES FOR THE BETTER PERFORMANCE OF THE PIPE LINE CONSTRUCTION ACTIVITIES"

Submitted By
Pranjal Sharma

Master Of Pipeline Engineering
(2007-09)

College of Engineering
University of Petroleum & Energy Studies
Dehradun
April, 2009

"ANALYSIS, REVIEW AND REMEDIAL MEASURES FOR THE BETTER PERFORMANCE OF THE PIPE LINE CONSTRUCTION ACTIVITIES

A thesis submitted in partial fulfilment of the requirements for the Degree of
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(Pipeline Engineering)

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R160207011

Under the guidance of

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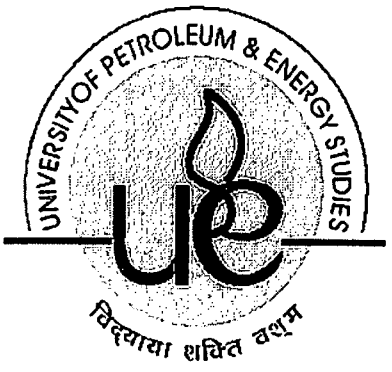

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UNIVERSITY OF PETROLEUM & ENERGY STUDIES

(ISO 9001:2000 Certified)

CERTIFICATE

UPES Guide has ascertained quality of the project – II, Anti Plag certification etc for asserting this high quality academic activity.

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TO WHOM EVER IT MAY CONCERN

This is to certify that the work contained in this thesis titled **Improvements in performance of the pipe line construction activities BSPL Pipeline Project** has been carried out by **Mr. Pranjal Sharma** under my/our supervision and has not been submitted elsewhere for a degree.

Mr. PARAM SHIVAM

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PREFACE

Cairn India has proposed to lay two number of Pipelines for transportation of Crude oil (24") and LPG (8"). Both are being laid in parallel to each other from Barmer (Rajasthan) to Salaya (Gujrat) .

The job of welding of both pipelines(50 km spread) is to be carried out by Kaz Stroy Service Infrastructure India Pvt. Ltd

We submit this report along with our sincere thanks to Kaz Stroy Service Infrastructure India Pvt. Ltd Gurgaon for their guidance and co-operation throughout the project.

I also very thankful to our mentor **Mr. Param Shivam (Residential Project Manager, Projects)** for their guidance and co-operation throughout the project.

Sincerely

Pranjal sharma

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Acknowledgement

It has been an immense pleasure and truly enriching experience doing my project at the Rajkot division of **Kazestroy Service India Pvt limited**. I take this opportunity to thank all those people who have made this experience a memorable one. Firstly, I would like to thank my guide **Mr. S. Param shivam,, Project Manager** who has been instrumental and a guiding force behind the completion of this project. He has been constantly eliciting insights and viewpoints on the subject matter.

I would also like to thank the complete Project Team especially **Mr. Sourab Jain ,Mr. Rajesh Kumar and Mr. R.P. Bacchani** who were there throughout my stint **Kazestroy Service India Pvt limited** at Rajkot for any help I needed.

We are extremely glad to express our sincere gratitude to our Course Coordinator **Mr. Brijendra Kumar** (Senior Adjunct Professor, University of Petroleum & Energy Studies, Dehradun), for giving us, with his valuable advice and assistance throughout the project.

My sincere thanks to each and everyone who are all connected with this work.

Pranjal Sharma

UPES M. Tech (pipeline engg)

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ABSTRACT

The basic method of constructing steel, welded oil and gas onshore pipelines i open cross country areas is generally known as the spread technique. The spread technique utilises the principles of the production line system, but in the case of a pipeline the product (the pipeline) is static and the individual work force, (crews) move along the pipeline track (right-of way/spread). The implementation of the spread technique is conditional on the pipeline being welded above ground in maximum possible continuous lengths between obstructions/crossings (which can extend to lengths in excess of 10 kilometres). These welded pipe lengths are then immediately installed into unsupported/unobstructed trenches gradually in one continuous length utilising multiple (three or more) mobile lifting tractors (side -booms).

The breaks in the continuous main spread method of working result from the location of existing services, roads, railways, tracks, ditches, streams and river crossings, and are also dependent upon restricted working, time constraints and physical features/obstructions. These breaks in the main pipeline spread activities are undertaken by dedicated specialist crews utilising a variety of special construction techniques and are generally undertaken after the main pipeline sections have been installed

NOMENCLATURE

KSSIIPL : Kazastroy services infra India private limited

CEIL : Cairn energy India limited

L &T: Larson and toubro limted India

ANSI: American National Standards Institute.

API: American Petroleum Institute

ASME: American Society of Mechanical Engineers.

GIS: Geographical Information System Packages.

HDD: Horizontal Directional Drilling.

ISO: Indian Standards Organization.

OISD: Oil Industry Safety Directorate. .

ROW: Right of Way.

ROU: Right of Use

SMYS: Specified Minimum Yield Strength.

SV: Sectionalizing valve.

Code and Standards

API 5L	Specification for line pipe
API RP 1102	Steel pipeline crossing railroad and highways.
API RP 1107	Movement in service pipeline
API RP 1109	Pressure testing of liquids petroleum pipeline
API RP 1111	Design ,construction and installation of offshore pipeline
ASME B31.4	Pipeline Transportation system for liquid hydrocarbons.
ASME B31.8	Gas transmission and Distribution piping system
OISD 141	Cross country hydrocarbon pipeline
NACE	Pipeline coating

CHAPTER-1

COMPANY PROFILE

1.0 COMPANY PROFILE

About Company

KazStroy Service is the leading engineering procurement and construction company in the Kazakhstan oil and gas sector. In 2006, the Company listed in the top thirty companies in Kazakhstan.

KSS's value lies in its employees. Today KSS employs more than 5,000 people. Building on a core of high quality Kazakh experience and talent, we also employ leading experts from, Germany, India, Great Britain, Russia, Ukraine, Italy, New Zealand and South Africa.

Based in and focused on Kazakhstan, KSS is now looking to leverage its local position and international partnerships to grow its business, both within the region and further a field.

The ongoing and constantly increasing exploitation of Kazakhstan's natural resources has provided massive growth potential, for not only upstream operators, but companies such as KSS, who provide the vital logistical services necessary to unlock the value of the Caspian region. KSS has successfully completed over 100 construction projects in Kazakhstan and India to the highest of international standards. We have proved ourselves to be a valuable partner for such companies as Agip KCO, KPO BV, KazGerMunay, KazTransOil, KazTransGas, Intergaz Central Asia, Exploration & Production KazMunayGas, Kazakhstan – China Pipeline, Kazakhoil Aktobe and Almaty Power Consolidated.

Through these projects, KSS has managed a key role in the economic development of Kazakhstan; helping to unlock is vast natural wealth.

In line with the growing needs of the Kazakh market, KSS has diversified its business activities and therefore expanded its sphere of influence in the Kazakh engineering market.

To its original activity of construction of oil and gas pipelines, the company has successfully added:

- Operation and maintenance of industrial sites
- Construction of oil refineries and installations

- Civil construction
- Construction of railways
- Offshore construction and logistics

In 2007 KSS became the only Kazakh Company to join the International Pipeline and Offshore Contractors Association (IPLOCA).

The company's financial growth, impressive performance indicators and first class international management are all testimony to its sound development strategy. In a resource hungry world, with predicted long-term high-energy prices, we look forward to our future with confidence.

Group Structure

KazStroy Engineering India Private Limited (**KEI**), established in January, 2006 has its corporate office located in Gurgaon, near New Delhi, India.

KEI is established to serve as a knowledge base and provides Engineering, Project coordination services and specialized inputs on project control / contract administration activities to all KSS Group projects covering cross-country Pipelines, Oil Field development, Refineries and Petrochemicals and GasProcessing plant projects in Kazakhstan and India.

KEI has a multi disciplinary setup including Process, Civil/Structural, Piping & Plant Design, Electrical & Instrumentation Engineers and Project Management & control and Procurement services and the setup is well equipped with state-of-the-art facilities to provide specialized technical support services to projects

JOINT VENTURES

1. Keppel Kazakhstan Limited

Keppel Kazakhstan Limited (KKL), 50 % owned by KSS, is located in Aktau and is engaged in offshore construction services for the Kashagan project. Strategically located adjacent to port Aktau, KKL has excellent access to resources and infrastructure, vital for supporting heavy industrial construction projects.

2 PSN KazStroy

PSN KazStroy - is a 50 / 50 joint venture with Aberdeen based Production Services Network, located in Atyrau. The company is engaged in the management of sea and coastal oil, gas, chemical, petrochemical and power projects, and assistance to companies, which work on a late development cycle.

3. KGNT

KSS owns 50 % of KGNT. KGNT is the leading Kazakh hydrocarbon engineering technology development company. For more than thirty years, KGNT has rendered highly skilled engineering services to the companies, engaged in field development, transportation and the processing of oil products.

4. PLK-KSS Caspian Offshore Construction LLP

"PLK-KSS Caspian Offshore Construction LLP" is a Joint Venture between "PUNJ LLOYD KAZAKHSTAN LLP" & "OGCC KAZSTROYSERVICE" for executing Offshore and shallow water Pipe laying & other construction activities associated with Oil & Gas Sector in Caspian Region.

CHAPTER- 2

INTRODUCTION

2.0 INTRODUCTION

A cross country pipeline is generally laid across country locations in addition to pipeline Operator's own premises, mostly passing thru agricultural and waste lands and crossings various roads, railways, canals rivers and other utility lines enroute. The pipeline stations like pumping stations etc will be developed in the lands under the Pipeline owner's possession for respective purpose.

Oil and natural gasses are transported through pipelines from the production fields to refineries and the hub bases for consumers.

The basic method of constructing steel, welded oil and gas onshore pipelines open cross country areas is generally known as the spread technique. The spread technique utilises the principles of the production line system, but in the case of a pipeline the product (the pipeline) is static and the individual work force, (crews) move along the pipeline track (right-of way/spread). The implementation of the spread technique is conditional on the pipeline being welded above ground in maximum possible continuous lengths between obstructions/crossings (which can extend to lengths in excess of 10 kilometres). These welded pipe lengths are then immediately installed into unsupported/unobstructed trenches gradually in one continuous length utilising multiple (three or more) mobile lifting tractors (side -booms) in unison.

The breaks in the continuous main spread method of working result from the location of existing services, roads, railways, tracks, ditches, streams and river crossings, and are also dependent upon restricted working, time constraints and physical features/obstructions. These breaks in the main pipeline spread activities are undertaken by dedicated specialist crews utilising a variety of special construction techniques and are generally undertaken after the main pipeline sections have been installed.

The main pipeline spread installation is undertaken by dedicated crews undertaking one operation at a time commencing at one end of the pipeline and travelling forward to the other end at anything from 500m to 1,500m per day depending on the diameter of the pipe, terrain, soils,

etc. The programme of activities and the start-up of the crews is dependent on available resources and the risk of one crew having an impact upon the following activities.

Because a pipeline is a production line, it is essential that the time periods between crews is such that there is no risk of one crew causing stoppage or disruption on the preceding or subsequent crew. If the float between crews is not managed on a continuous basis, with the emphasis placed on the daily moving, then a concertina effect will result with substantial disruption and standby costs. Effectively, there can be up to a 4-week delay between crews to ensure that the concertina bunching effect of crews does not occur. Consequently, there are in the programme extended periods of time when there are no activities taking place along large sections of the pipeline route. The average time from start of ROW to commencement of land reinstatement is, typically, in the order of 10 to 15 weeks. In the construction of the transportation pipelines, the thousands of joints of pipes are increasingly welded using manual, semiautomatic or mechanized gas metal arc welding processes. Welding includes the alignment and welding necessary for the construction and completion of the pipeline.

This project report includes the following:

- A description of the Construction process.
- A proposal on the essential variables.
- Construction procedure by KSSIIPL specification.
- Construction equipment which are used.

2.1 Brief Overview of Barmer Salaya Pipeline Project

Total length of the pipeline for the project(3rd Spread)	50 KMs
Pipe Diameter	24",8" (219.16mm)
Pipe Grade	API 5L X56
Pipe Wall Thickness	10.2mm,6.4 mm
Total number of pipes required	4167
Total number of joints	4166

2.2 Health, Safety & Environment

All relevant elements of HSE plan BSPL-2000-L&T-HS-PLN-0001 shall be followed. Tool box meeting shall be conducted for involved persons to make sure that they are aware of safety requirements for construction activities. The Contractor shall take all necessary safety precautions during the whole process of construction. As a minimum, the following shall be taken during the construction: Warning signs stating 'PIPELINE UNDER CONSTRUCTION-KEEP OFF" with local language translation shall be placed where the pipeline is uncovered, and particularly where the provisional traps/test headers and stations are located. Such areas shall be suitably fenced in such a way as to prevent access of unauthorized personnel and no unauthorized personnel shall be closer than 40 m to the testing equipment or pipeline under test. Warning tapes and signboards shall also be placed near the crossings and regular intervals along the route to warn the public around those areas. Provisional scraper traps shall be installed in compliance with methods and suitable location so that their rupture cannot cause any injuries to the personnel or third parties.

CHAPTER- 3

ACTIVITIES IN PIPELINE

3.0 SEQUENCE OF ACTIVITIES DURING PIPELINE CONSTRUCTION

Construction of a pipeline generally involves the following steps, performed sequentially, For a given line section

- CLEARING THE ROU
- ROU GRADING
- **HAULING AND STRINGING**
- **TRENCHING**
- **BENDING THE PIPE**
- **WELDING THE PIPE**
- **FIELD JOINT COATING**
- **LOWERING**
- **BACK FILLING**
- **CROSSING**
- **TESTING**
- **CLEANING UP**

3.1 Surveying and clearing the right-of-way.

The right-of-way is a narrow strip of land that contains the pipeline(s) and is where all onsite construction activities occur. It is surveyed, cleared of brush and trees, and levelled to give workers and equipment access to build, inspect and maintain the pipeline.

Clearing The ROU

The ROU (Right-of-User) is a narrow strip of land that contains the pipeline(s).ROU is acquired by the owner of the pipeline project under P&MP Act, 1962.All onsite construction activities occur within the ROU width. Generally the width of ROU is 18 m. The pipeline is laid at 6 m from the left edge (when facing down stream of pipeline) of the ROU. The 6 m width is utilized for stock piling of the excavated earth. The 12 m width of ROU on the right is used for movement of equipment, stringing of pipes and other on site activities. ROU width is generally restricted to 10 m where pipeline crosses forests to avoid minimize felling of trees.

To begin construction of the pipeline, the acquired ROU of the pipeline is cleared. A clearing and grading crew prepares the corridor so that the construction equipment can operate safely. This crew removes trees, boulders, bushes 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 ROU are cut down and the timber is removed or stacked alongside the ROU. Bushes are commonly shredded or burned. Also, as may be necessary in agricultural areas etc., topsoil is stripped to a predetermined depth and stockpiled along the sides of the ROU.

Clearing the field at site

3.2 Grading Operation

Right-of-way preparation The right-of-way will be graded, and ice and snow or gravel pads will be built to allow for the movement of ditchers, additional equipment, materials and other pipeline construction activities.

Stacking of ROW.

Marking of ROW boundaries.

Clearing of trees, bushes, farm crops, undergrowth and routes, electrical and telephone poles falling within the 18 M width of ROW.

Grading of ROW sufficient to be consistent with the maximum permitted pipe bending radius.

Providing ramps, diversion at road crossings, pipe culverts for maintaining water flow across the ROW.

Grading of ROU

3.3 Hauling and stringing the pipe.

Lengths of pipe are moved from stockpile sites to the right-of-way. They are lined up along the right-of-way, ready for welding.

All care shall be taken for transportation of the pipes from coating yard to the ROW without damage to coating and pipe.

Stringing shall be done in such a manner that pipes are easily accessible and shall not hinder the movement of equipment.

In rocky areas, pipe stringing shall be done after rock trenching.

Stringing shall not be done for more than 10 km ahead of trenching.

Pipes of special grades or wall thickness shall be strung at the required specific locations

Once the ROU has been cleared sufficiently to allow construction equipment to gain access, sections of pipe are laid out along the ROU. This process is called 'stringing' the pipe.

The pipes are transported from the pipe storage yard to the vicinity of the pipeline location or directly to the ROU. After the pipe is delivered to the ROU, a stringing crew carefully distributes the line pipes in various sections according to the design plan.

Stringing of pipeline

3.4 Trenching

After stringing the pipe sections in place, a trench is dug along the ROU 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. As per ASME B 31.4, the cross country pipelines to be buried at least 1 m below the surface from the top of the pipe. In addition, the pipeline is buried deeper in some locations such as at road crossings and water body crossing.

Digging the trench. A trench, or ditch, must be dug to allow the pipe to bury the pipe. The way the trench is dug, and what equipment is used, depends mainly on the type of soil. Alternates include bucket wheel trenchers, like those used for the Norman Wells pipeline, and chain trenchers, like those used for the Ikhil pipeline. Other digging equipment will include backhoes.The pipeline shall be laid at a distance of 5 mtr. from one edge of the ROW.

Stacking of trench line.

The width of the trench shall be equal to the pipe diameter plus 400 mm. The depth of the trench shall be equal to diameter of the pipe plus 1 mtr. Extra width and depth shall be provided in rocky terrain. Stripping of the top soil up to 30 cm of the trench and storing separately. Suitable crossing for passage of men, equipment, cattle etc. shall be provided. In areas where rock is confirmed as such by the initial ground investigation works then the trench is excavated ahead of any pipe operations. This sequence of working is undertaken to ensure that the excavation of the

trench cannot cause any damage to the pipe and/or pipe coating and provide an extended safe working width for the excavation crews allowing double -sided trench working by excavators/ breakers.

Backhoe trenching at site

Trench ready for lowering

3.5 Bending the pipe.

A pipeline must cross over hills and curve around special places such as lakes and sacred sites. To accomplish this, a specialized pipe-bending machine is used to bend some pipe to the shape of the land. The pipe retains its strength and remains circular where it is bent because of the characteristics of steel and the bending techniques used

Bending of pipe is required to negotiate changes in vertical and horizontal alignment of the pipeline. Bending procedure has to be approved before bending of pipes Cold field bends shall only be used The radius of bends shall be limited to 40 D for pipes upto 18" dia and to 60 D for pipes of 20" and above. Weld seams to be kept in the plane passing through the neutral axis of bending. Tangents of minimum 2 M length to be left at both ends of the pipe. Check for ovality, thinning, wrinkles and buckles.

Bending of line pipes is required when pipeline has to deviate from straight line in order to avoid obstructions like houses, industries, monuments, ponds, lakes, eco- sensitive areas, Sanctuaries etc. or due to hilly undulating terrains etc. Number and degree of bends are determined in advance based on the detailed route survey. Long Radius (LR) bends are prefabricated at the workshop and then brought on site for installation For slight bends, a specialized pipe-bending machine is used in the field to account for changes in the pipeline route and to conform to the topography. The pipe retains its strength and remains circular where it is bent because of the characteristics of steel and the bending techniques used. The bending machine uses a series of clamps and hydraulic pressure to make a very smooth, controlled bend in the pipe. The radius of cold field bends shall not be less than 40 times the pipe nominal diameter for pipe diameters 18" and above and shall not be less than 30 times the pipe nominal diameter for pipe diameter less than 18".

Bending at site

3.6 Welding

Welding is a technique where another metal is melted and used to join lengths of pipe. The area of the weld where the two pipes are joined is actually stronger than the pipe, by design.

This step is repeated a number of times until multiple pipe sections are joined to form a pipeline. Automatic welding machines are used where possible and some hand welding also takes place. A rigorous quality assurance and quality control program is followed to ensure the strength and quality of the welding

Welding procedure specification has to be prepared for approval of the procedure and qualification of the welders as per API 1104. Welding is done using vertical down technique with cellulose coated electrodes. The main welding process used to weld pipelines is the manual metal arc (MMA) welding with coated electrodes. There are many reasons for this choice. The first is the most obvious: the manual electrode is the first product invented that is suitable for arc welding.

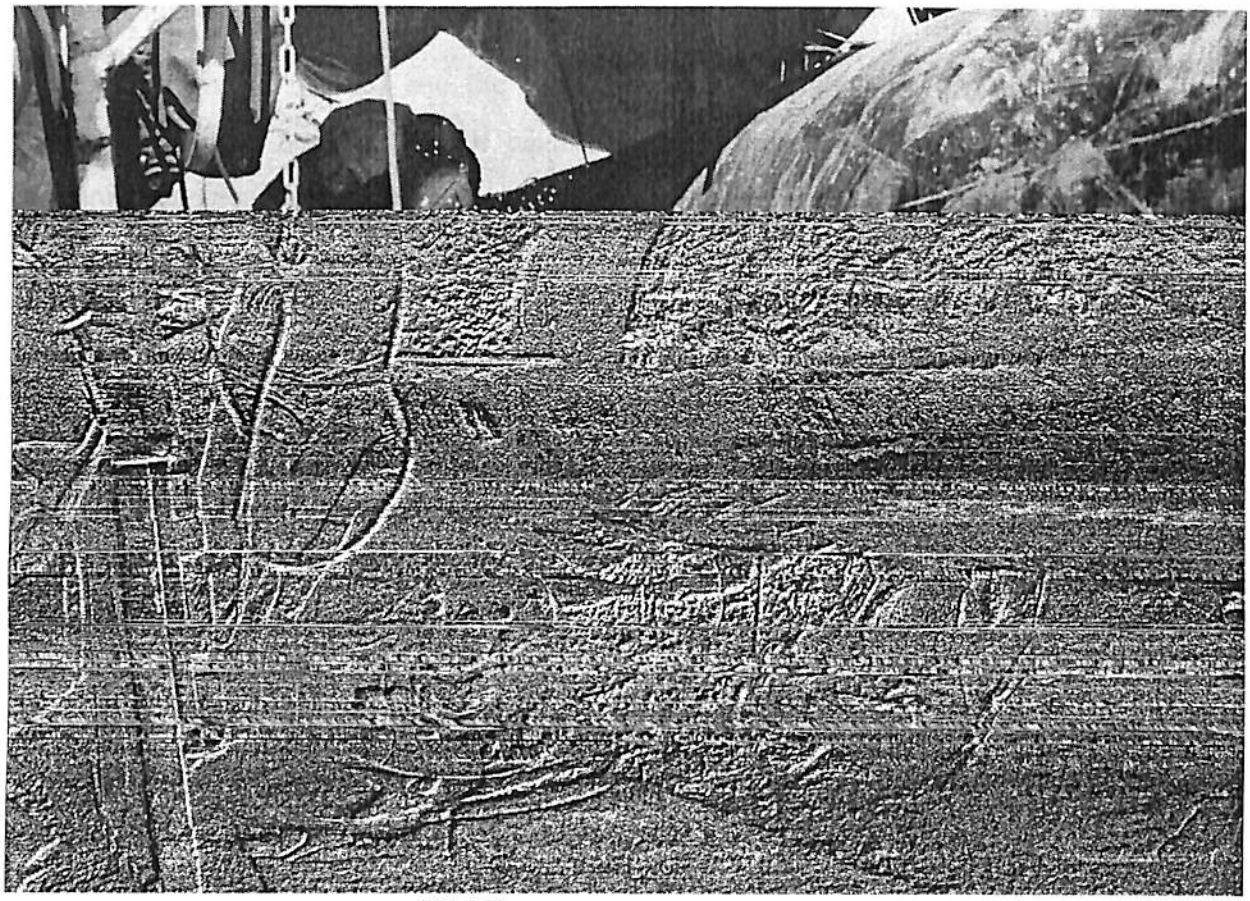
Some classes of cellulosic and basic electrodes have been specially designed to meet the requirements of the grade of steel used to manufacture the pipeline and the safety specifications laid down by standards, but also to equip the user i.e. welders with versatile products created for this specific purpose. Welding is the simplest and easiest way to join sections of pipe. The need for complicated joint designs and special threading equipment is eliminated. Welded pipe has reduced flow restrictions compared to mechanical connections and the overall installation costs are less. The most popular method for welding pipe is the shielded metal-arc process; however, gas shielded arc methods have made big inroads as a result of new advances in welding technology.

The pipeline welding needs highly skilled welder and thus because of the hazardous materials that most pipelines carry, pipe welders are required to pass specific tests before they can be certified.

Internal line up clamp shall be used for proper alignment of joint.

Initial weld	: Root/ stringer bead.
2nd run	: hot pass to reinforce root bead.
3rd/ 4th run	: Fillers;
5th	: Capping

To carry out welding, the pipe sections are temporarily supported along the edge of the trench and aligned. The various pipe sections are then welded together into continuous length, using manual, semiautomatic or automatic welding procedures. Generally automatic welding is used instead of manual welding larger pipeline projects. Special pipeline equipment called side booms are used to 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. Each welder must pass qualification tests to work on a particular pipeline job, and each weld. procedure is approved for use on that job. Welder qualification takes place before the construction begins.



Welding

3.7 FIELD JOINT COATING

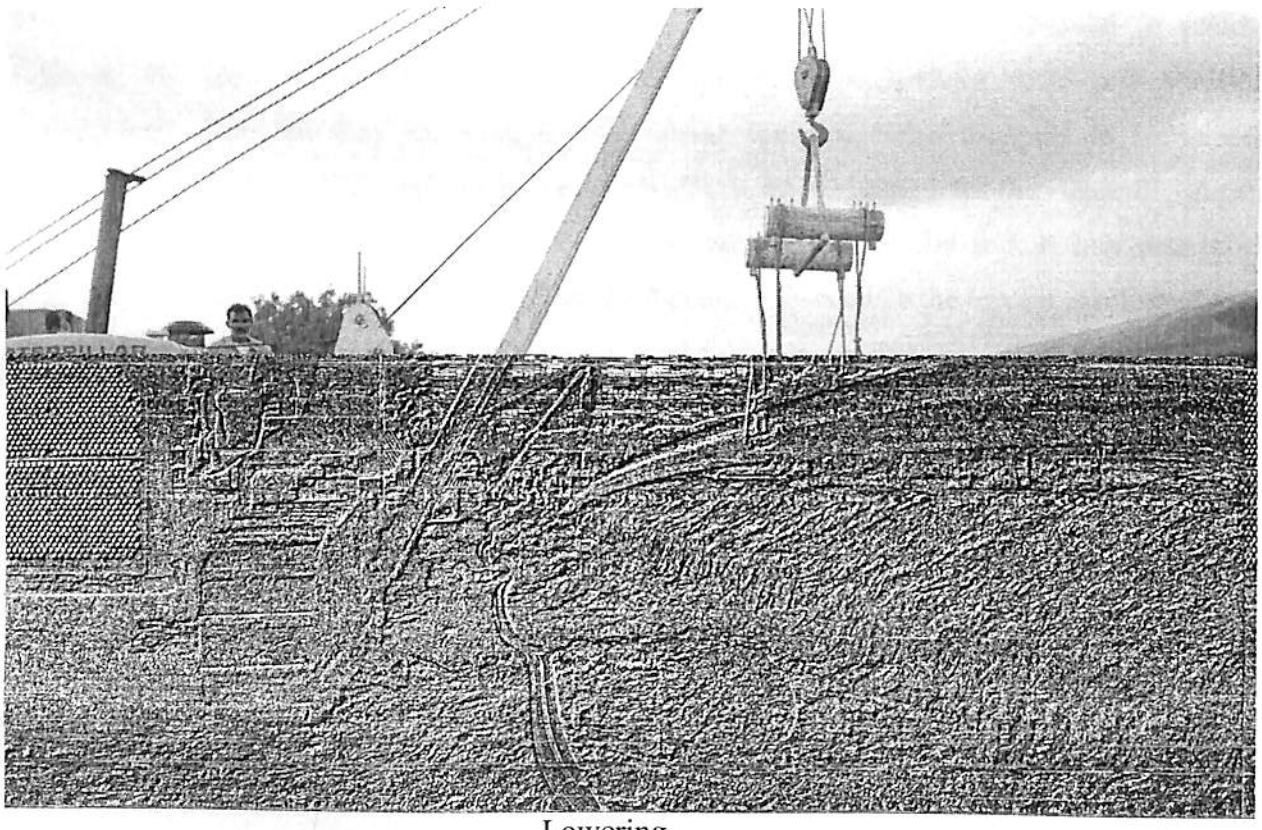
After the pipe is welded and the welds are examined, joint coating is applied to the welded areas at the ends of the pipe sections to prevent corrosion. The bare pipe is thoroughly cleaned to remove any dirt, mill scale or debris. The coating is then applied. After field coating and before the pipe is lowered into the trench, the entire coating of the pip e is inspected by a holiday tester to ensure that it is free from defects. 250 mm on either side of the pipe is left un-coated in the coating yard to facilitate welding. The width of the sleeve shall depend upon the cut back length provided in the yard coated pipe. Heat shrinkable sleeves are used for coating welded joints

3.8 Lowering the pipe

Tractors with special arms called side booms are used to lower the pipe into the trench. Care is taken to avoid damaging the pipe and its exterior coating. Once sections of the pipeline are welded and joints are coated, they are lowered into the trench. Lowering is done with careful synchronization of multiple side booms working concurrently. 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 and its external coating.

The excavated trench should be free from excess earth, rock, hard clods and other debris.

Coating of the pipe string shall be checked for damages by using holiday detector. Repair of coating damages. Sand padding and rock shield are provided in rocky areas before lowering.



Lowering

3.9 Backfilling the Trench

Before testing the pipeline, the ditch is backfilled. Sometimes the excavated soil is used to fill the trench and sometimes other selected backfill is used. Care is taken to protect the pipe coating from potential damage Back filling shall be done immediately after lowering. Back filling shall be done with earth free of hard lumps, boulders, rock etc. Sand padding over the pipe shall be provided in rocky areas. Slope breakers shall be provided in steep gradients to avoid wash out of the trench.

Once the pipeline is lowered into the ground, the trench is carefully backfilled, to ensure that the pip e 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 back fill 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 inreverse order, with the subsoil put back first, followed by the topsoil. This ensures the topsoil is returned to its original position

Backfilling

3.10 Crossings.

A pipeline will need to cross rivers and streams, roads and other pipelines. Plans are developed in advance. Water crossings can be completed either by "open cut" techniques or by horizontal directional drilling. The selection of a crossing method depends upon site specific criteria such as fish habitat, water flow, and soil conditions such as rocks and boulders. Generally, horizontal directional drilling is selected for major river crossings where local soil conditions permit the technique. The pipeline right-of-w ay and temporary facilites such as camps will be reclaimed. A pipeline will need to cross rivers and streams, roads and other pipelines. Water body crossings are carried out either b y "open cut" techniques or by Horizontal Directional Drilling (HDD). The selection of a crossing method depends upon site specific criteria such as fish habitat, water flow, and soil conditions such as rocks and boulders. Generally, horizontal directional drilling is selected for major river crossings where local soil conditions permit the technique Major roads (National Highways, State Highways) and Railway crossings are carried out b y HDD method. Other road crossings are carried out by open cut method.

3.11Testing

Radiographic inspection

Radiographic inspection is a method of inspecting weldment by the use of rays that penetrate through the welds. X rays or gamma rays are the two types of waves used for this process. The rays pass through the weld and onto a sensitized film that is in direct contact with the back of the weld. When the film is developed, gas pockets, slag inclusions, cracks, or poor penetration will be visible on the film. Because of the danger of these rays, only qualified personnel are authorized to perform these tests.

In addition to producing high quality radiographs, the radiographer must also be skilled in radiographic interpretation. Interpretation of radiographs takes place in three basic steps: (1) Detection,

(2) Interpretation, and

(3) Evaluation.

All of these steps make use of the radiographer's visual acuity. Visual acuity is the ability to resolve a spatial pattern in an image. The ability of an individual to detect discontinuities in radiography is also affected by the lighting condition in the place of viewing, and the experience level for recognizing various features in the image.

Radiographic inspection is carried out by using X-rays.

Visual inspection of all welds shall be carried out by qualified welding engineer having minimum qualification of Level - II certification.

All joints at the following locations shall be radiographed.

- Initial 1 km.
- At cased road / rail, submerged crossings,
- Tie-ins (including golden tie-ins)
- Marshy areas.
- Valves and insulating couplings
- 20% of balance mainline joints(100% here)

Hydrostatic Test

Objectives The post-pipeline construction testing operations are carried out to ensure that the installed pipeline complies with the appropriate regulations and can be declared fit for its intended use. The testing of the pipeline is undertaken on completion of all pipeline construction work including if possible final reinstatement, which is weather dependent.

First of all, the pipeline is cleaned and filled with fresh water by the use of internal pigs. The use of the pigs ensures that all air is removed from the pipe. The pipeline is then tested, depending on the code and type of pipeline (oil, gas, etc), to, say, 125% of the maximum operating pressure for a continuous period of 24 hours. On acceptance of the pressure test the water will be removed by the use of the internal pigs propelled by air

To establish that the pipeline has the required strength to which it has been designed.

To demonstrate leak tightness of the pipeline.

Parameters for choosing test sections

Availability of water

Suitable place for disposal

Ground profile

Logistics Test procedure

Air cleaning the pipeline to clear of all debris and muck

Gauging

Water filling with corrosion inhibitor

Thermal stabilization

Pressurization

Evaluation and acceptance

3.12 Final clean up, Restoration and Installation of Markers

After construction, ROW is leveled and restored to the entire satisfaction of the land owners/ authorities.

All drains, utility lines, water lines damaged during construction is restored to the original position.

Pipeline markers such as kilometer post, turning points/ direction markers, warning signs and boundary pillars are provided.

ROW is notified for closure.

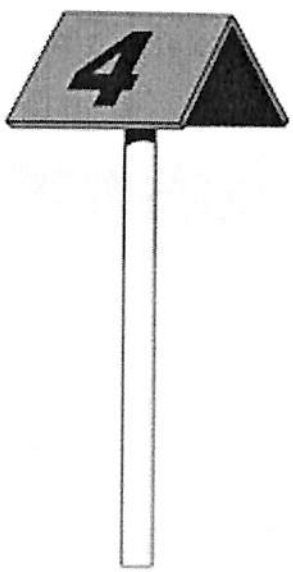
Payment of crop compensation.

Clear field

3.13 Markers, ROU markers, direction markers, warning signs

Underground pipelines are marked by above ground signs to provide an indication of their presence, location, product carried and the name and contact information of the company that operates the pipeline. Pipeline markers are generally yellow black and red in color The primary function of these above ground markers is to identify the location of the pipeline generally as an alert to the people who might be working along the pipeline corridor for another utility or during the construction of homes or industries nearby.

Warning signs



PART-2

CHAPTER- 1

INTRODUCTION

PART 2

CHAPTER 1

Construction Activities at BSPL

Your Construction work is to carry out the Main line Civil and Mechanical jobs related to Barmer Salaya pipeline project from Ch: 157 km to 207 Km (50 km) of Section II for laying of 24" & 8" pipeline as per approved procedure & CEIL specifications. The construction activity is classified into two parts, they are as follows:

- Mainline Civil Construction work
- Mainline Mech. work

The scope of work is enumerated herewith is included, but not limited to the followings:

1.1Mainline Civil Construction work:

Following work is required as per the CEIL and L &T (client) by the KSSIIPL to be done at site as per *the procedure.*

- Carrying out survey using GPS for main line. Making profile drawings, providing all necessary input to engineering for preparation of alignment sheets (by L&T). Marking the ROW as per CEIL specifications and instruction of Engineer-In-charge.
- Removal and proper storage of Top soil from entire ROW width by using ditch bucket and restoration of the same after backfilling.
- Cleaning and Grading of ROW and supply & installation of temporary markers using wooden pegs, lime as per CEIL specification.
- Trenching to all depths to maintain clear earth cover as per specification and to fit minimum bend radius, by excavation in all kinds of terrain and soil as per CEIL specification.
- Soft padding (pre & post) and Back filling of the trench after lowering the pipeline as per CEIL specification.
- Final clean up, installation of permanent markers (free issue from L&T at designated yard), restoration of ROW, disposal of debris and surplus material to designated disposal areas.

- Getting restoration certificate from land L&Ts in the prescribed format and as directed by the Engineer in Charge of L&T.
- Scope also includes survey, ROW, trenching at all open cut crossing viz Cart tracks, metal/ un-metal road inclusive of state and national highways, canal (lined/unlined) minor watercourse, Nalas / drains (concrete coated pipes by L&T at yard) etc. KSSIIPL scope is limited to open cut crossings (except major River crossing or any crossing where width more than 200 meter) only .However all boring /HDD crossing are to be carried out by L&T.
- Restoration of the various crossings to reasonably original condition including performance of additional works for strengthening of banks of watercourse as per CEIL specification.
- Scope includes all civil work including restoration for all foreign line crossing ,Cased crossing, Open cut crossing etc falling en route.
- KSSIIPL shall supply and install PCC slab at all cart track and HT line crossings in the pipeline as per specification/drawing & Engineer-in-charge's instruction.
- Scope includes tie-in pit excavation & backfilling.
- Supplying and Installation of in situ slope breakers and bank protection works wherever required.
- Scope includes the provision of temporary supports for existing installations in the road and /or railroad, the provision of diversion, the restoration of road /railroad, embankment to reasonably original state and collection of restoration certificate from the competent authorities.
- All access roads required to perform main line civil works as above. In addition KSSIIPL is also required to make access roads wherever required and instructed by L&T site in-charge for performing main line welding/mechanical works.
- Transportation from L&T's yard, Installation of various types of markers like boundary pillars, warning signs, kilometers post etc. necessary to make the pipeline ready for commissioning. Including completion of the subsequent works in all respects as per drawings, specifications and instructions of Engineer in Charge. Markers will be supplied by L&T on free issue basis.

1.2 Rock Trenching:

- Rock trenching as Classified by Engineer in Charge to be performed by pneumatic tools or by drilling and control blasting or by chiseling out. Work to be carried out at per CEIL specification/ statuary rules and regulations/ competent authority's instructions/ approved procedure of L&T/CEIL/instruction of L&T or CEIL.

1.3. Padding:

Supplying, providing and filling fine soft soil and padding material in trenches where ever required as per specification and requirements. Padding should be done separately for 24" and 8" pipeline. There are special procedure for backfilling and padding which must be followed. Padding is of 150mm of 8" and 250mm for 24" pipeline.

CHAPTER- 2

EQUIPMENTS USED

2.0 Equipment required for the activity

List of **equipment** which shall required per spread are as per list below:

- Dozer-D80 -02 nos
- Ditch Bucket 84" -02 nos
- Motor Grader-01 nos
- Excavator/Bachoe- 15 nos
- Rock Breaker- As required
- Earth Dumpers- As required.
- Farm Tractor with graders- As required.
- Adequate no of conveyance and passenger vehicles of Labour/supervisor etc.
- Adequate equipment required for rock blasting by conventional method or rock breaking tool.
- 40T Pipe layers
- Crawler mounted crane for loading of pipes in the yard and stringing in ROW- 03 nos
- Trailers for Pipe transportation from Dump yard to ROW- As required (approved transportation procedure to follow).
- Compressor with joint coating crew
- Diesel Tanker with Dispending Unit
- 40KVA DG with truck for 24" dia joint coating activity.
- 25KVA DG with trolley and 10T truck for foaming activity.
- Mobile Toilet with all accessories.
- GPS instruments with competent surveyor.
- All hydro testing equipments/tools & tackles/consumables etc.

Manpower (personal)

CHAPTER- 3

DETAILED CONSTRUCTION WORK

The work shall be executed as per specification and as per instruction of Engineer in charge of L&T/CEIL. KSSIIPL shall prepare inspection and other reports which will be finalized with L&T after award of Order.

KSSIIPL shall mobilize competent personal (staff) (Including 3 nos expatriates) as per enclosed Organization Chart and CVs for key personnel.

3.0 Detailed Construction work:

Scope indicated below is indicative, However KSSIIPL shall carry out the work as per CEIL's Specification, approved work procedures, relevant standards /codes and as per Engineer-In-charge of CEIL/L&T.

A) ROW Grading:

ROW will be of 30 mtr wide in general, but in some locations it may be restricted if asked by Engineer-in-charge. KSSIIPL shall carry out route survey by deploying a qualified surveyor. L&T shall provide available alignment sheets. During ROU clearing, the vegetation shall be cut off at ground level leaving the roots intact. Stumps and roots directly above the trench shall only be removed. Please note that, KSSIIPL have to get clearance from L&T engineer before cutting any trees or demolition of any temporary or permanent structure coming in the route of the pipeline. KSSIIPL shall be solely responsible for any dispute found in this regard and any financial implications shall be borne by the KSSIIPL.

KSSIIPL shall to demarcate the ROW clearly before grading. Grading will be started only after getting clearance from Engineer-in-charge which will not be withheld unreasonably. The dozing work shall include all canals, Nalas, streams bands, cart track and any low laying areas either by filling or by grading–All existing utility facilities like water pipelines (PVC pipes & Hume Pipes) , Fencing and Culverts shall be restored immediately on KSSIIPL's own costs along the entire ROU area. Supply and installation of pipes (PVC & Hume pipes), barbed wire, fencing pillars, and aggregates are in KSSIIPL's scope. Preparation of approach road (motor able road) including acquisition of land to access ROW from nearby metal road is in KSSIIPL's scope. Also arrangement for any additional working area as required for temporarily dumping of

excavated earth or any KSSIIPL's owned/hired equipment's standby/movement shall be in KSSIIPL's scope.

KSSIIPL shall resolve all villager problems concerned with ROU which are due to the resons attributable to KSSIIPL. L&T's responsibility is only to hand over ROU as received from Client CEIL. All approaches, roads, accesses etc. for ROU to perform mainline activity shall be in KSSIIPL's scope.

KSSIIPL shall work within ROU limits. Any compensation or expenses due to violation/damage of land / structures beyond 30mtr ROU width shall be in KSSIIPL account.

KSSIIPL is responsible for any damage to existing foreign line all along the ROU area. Existing pipeline to be identified and marked first and than new proposed line alignment to be fixed with pegs / marking as per CEIL / L&T specification & site instructions. Marking of old existing line & and fixing of new alignment w.r.t. old existing line will be in KSSIIPL's scope. Supply and fixing of temporary fencing, RCC/PVC Hume pipe for water drain wherever required all the along the ROW shall be in KSSIIPL's scope

All work shall be done as per the specifications enclosed as annexure to this query.

B) Trenching:

KSSIIPL shall execute the following work related to trenching:

- Marking of centerline by putting wooden pegs and lime powder. Cover for various part of the pipeline like normal terrain, uncased / cased rod crossings, railway crossings etc. shall be as per CEIL specifications

Top 300-mm fertilizer enriched soil for full ROU width shall kept aside within the ROU by KSSIIPL and shall be backfilled at the top 300 mm of the trench.

Trenching to all depths by excavation in all types of soils including soft / hard rock / coal tar, including blasting, providing soil/sand padding in the trench in all types of rocky areas with equal capacity P&M will be in KSSIIPL's scope of work. Adequate slope of excavated earth should be maintained at all places so as to avoid any collapse of excavated earth in the trench. For blasting operation, KSSIIPL shall arrange license for blasters and other statutory

requirements of CEIL/L&T. Pre padding shall be done with sand or soft soil absolutely free from gravels of lumps and shall to be arranged by the KSSIIPL. Trench bed shall have minimum 200mm-compact bedding (cushion) of pre padding materials and in these areas trench shall have more depth to ensure specified cover of pipelines.

All cart track, metal road or asphalted roads are to be excavated and restored then and there in original condition after laying of pipe and duly certified by concern authorities and L&T.

De-watering from trenches shall be in KSSIIPL's scope. L&T will not entertain any extra cost for construction of any bunds, to stop the entry of water from nearby water – logged area.

The tentative crossing details are available for reference in the alignment sheets provided by L&T. However any additional crossings if encountered during execution, KSSIIPL is advised to carry out site survey and ascertain the number of crossing en route, the list provided is indicative only. No extra claim whatsoever shall be entertained on this account.

KSSIIPL shall to provide extra depth and clearance in trench to accommodate the bends. The KSSIIPL shall provide required additional depth where the pipeline crosses other pipelines, drain pipes, telephone conduits and other underground utilities. In case of mismatch of trench at bends during lowering, KSSIIPL shall to remobilize at the location for excavation without any extra cost to L&T.

Trenching requirement including extra width/ depth / select back fill at Seismic area shall be as per approved drawing and specification

Any damages to welded line during pipe lay / mainline activities by back Hoe or otherwise shall be rectified by KSSIIPL including replacement by new pipes if any. Incase occurrence of such events is not brought to the notice of L&T spread in charge but subsequently defected later on during hydro test / leak detection the entire cost there off incurred by L&T will be borne by KSSIIPL. Only damages/ leaks/ defects arising out of pipe manufactures or metallurgical defects will not be attributable to KSSIIPL. The decision of construction manager will be final & binding upon KSSIIPL under such circumstances of pipe defect / metallurgical defects.

KSSIIPL shall mobilize adequate manpower as and when required specially while clearing and trimming of trenches. Arranging of labors and equipments camps along the ROU shall be in KSSIIPL's Scope.

The following procedure will be applied in areas requiring rock trenching.

i) Normal cleaning and grading operation ,including top soil stripping and storage ,shall be carried out on the ROW , thereafter normal trenching operation will be carried by deploying excavators, back-hoe etc.

ii) If trenching cannot be completed by said operations the KSSIIPL shall deploy D-9/D-8 Dozer with ripper etc. followed by shovel of adequate capacity

iii) If desired depth of trench cannot be achieved by this method, KSSIIPL shall obtain the clearance of L&T for ROCK TRENCHING.

iv) ROCK TRENCHING excavation is included in the quoted price.

a) The length of finished trench rock sections at the bottom of the trench where the line is to be laid

b) The actual average width but not in excess of designated width as per standard trench dimension drg.

c) The depth of rock in trench actually excavated limited to minimum depth requirement.

d) KSSIIPL should responsible for all rock disposals.

e) Specifications with regards to the control blasting if permitted.(PPL)

(Peak particle velocity) - 50 mm/sec

f) Availability of Magazine - To be arranged by blasting sub-KSSIIPL

All work shall be done as per the specifications enclosed as annexure to this query.

C) Backfilling:

After lowering of pipes, KSSIIPL shall backfill the trench with available earth / select soil / soft padding and with proper precautions avoiding any damage to the pipes, cables and ducts laid in

respective position. Any dents found in the pipes thereafter due to negligence in back filling (i.e. putting rock or lumps on the pipes/ ducts at the time of back – filling), KSSIIPL will be solely responsible for the same and rectification of the same shall be the responsibility of the KSSIIPL. All debris, rocks, surplus earth and boulders shall be disposed out of ROU boundary to a barren land or any other suitable locations to the satisfaction of land L&T or authorities as per clean up and restoration procedures. Disposal of debris/ unwanted earth to designated places shall be in KSSIIPL's scope and no additional compensation is payable for the same.

Slope breakers and interface mitigations are to be provided as per CEIL specifications and wherever ground level varies beyond specified limits. However KSSIIPL shall to follow the specifications and instructions of the L&T / CEIL.

Provision of Slope breakers, Bank Protection shall be carried out where ever required as per specification / Drawing.

Padding materials will be arranged by KSSIIPL on KSSIIPL's own cost for rocky area or for any other area where excavated materials is not allowed for back – filling as per CEIL specifications i.e. gravely soil etc. Select backfill at seismic zone shall be arranged by sub-KSSIIPL at no extra cost to company

Post – padding is to be done with soft soil / sand, which is free from gravel, rocks and lumps as required by the specification / drawings / instruction of site engineer. Minimum 300 mm compact bedding shall be there above the pipe for all ground profile classified as rock.

After initial back – filling with suitable compaction by plate compactor & rollers , the surplus earth / available soil shall be crowned over the trench to a height so as to prevent the formation of depression in the soil as per CEIL specification.

Backfilling and compaction, KSSIIPL to follow approved procedure/specification and instruction of the CEIL/L&T Engineer.

D) Restoration:

This job includes restoration i.e. to restore ground after laying of pipelines as it was earlier. All field bunds, canals, culverts, fencing are to be restored to its original shape up to the satisfaction of land L&Ts or villagers or any other local competent authorities/Clients. All canals, nalas, streams, roads other structures taken up by KSSIIPL for ROW shall be restored out by the KSSIIPL .

After final completion of earthwork, KSSIIPL shall take signature from land L&Ts / local statutory authorities in the prescribed formats supplied by CEIL / L&T and KSSIIPL's final payment for restoration will be released in prorata only after production of the certificate.

Restoration of un-cased Road crossings is also included in KSSIIPL's scope of work. Payment will be made only in running meter as per Pipe Book excluding total length of bored cased crossings & River Crossings. No extra amount will be paid.

E) General:

Move in and move out of resources and workmen as per ROU releases by CEIL, stoppages due to villager problems, weather conditions, unforeseen conditions, force majeure, law and order etc. which are beyond control of L&T will not be entitled for any extra claim or reimbursement.
KSSIIPL scope includes keeping the trench fit for lowering by required dressing, free from roots and debris, free from collapses, free from water etc. till lowering operation is completed.
KSSIIPL shall be responsible for all type of dewatering activities from the trench before lowering, during tie-in, crossing etc. Dewatering pump for the purpose will be provided by KSSIIPLs along with the prime mover and fuel for the same.
KSSIIPL shall collect the markers and free issue materials from L&T yard for installation in ROU.
KSSIIPL's scope of work shall include restoration for all metal led, un-metal led and bitumen crossings. Arranging of NOC's from concerned authorities, for all subsequent crossings shall be under KSSIIPL's scope of work.
The spread chainage are tentative. However, based on site requirement spread chainage may be changed.

CHAPTER- 4

MAINLINE MECH. WORK

4.0Mainline Mech. work:

The indicative scope of work of KSSIIPL will be as below, but not limited to:

a) Loading and transportation of line pipe of 24" and 8" dia from dump yard to ROW. (Including Concrete coated pipes). KSSIIPL shall to arrange necessary Trailers with approved wooden sleepers and tie ropes etc.

b) Unloading & stringing of pre coated line pipes along ROW.

c) Welding of pipes in all type of terrain.

d) A 1" SEHMS tube shall be connected by using socket welded couplers at every weld joint. In addition pull box shall be fixed and welded to the tube including application heat transfer mastic etc. All the bulk material related to SEHMS will be free issue by L&T. All consumables/tools and tackles will be in the scope of KSSIIPL. Testing of SEHMS tube to be carried out by the KSSIIPL with required capacity of compressors.

e) Field bending, Horizontal bend angle shall be restricted to 5.5 degree per pipe and maximum 2 pipes shall be placed at each TP location. Beyond 11 degree there will be hot bends, supply of HOT bends is in the scope of L&T. For Sag & Over bend,up to 5.0 degree, cold bends are allowed.

f) Garnet Blasting and field joint coating of all pipe joints/Tie-in pipes/pipe pieces (sand blasting will not be considered).

g) Carrying out holiday detection and repair of coating damage of 8" pipeline if required.

h) Pipe lay of all type of crossings such as open cut crossings (all types' road/cart track crossings, foreign pipeline crossings, etc.), watercourse crossings and cased crossings etc.

i) Insertion of carrier pipes in the cased crossings, open cut crossings (including relevant civil work) shall be in the scope of KSSIIPL which includes transportation, stringing, welding, pre testing, fixing of casing insulators and post-testing of carrier section in case of Cased Crossing. Bentonite / Non- shrink filling is to be done by KSSIIPL between carrier and casing pipe by using KSSIIPL's labour , equipments, tools /tackles etc, however , grouting/non-shrink material to be supplied by L&T on free issue basis.

j) Assistance for Non Destructive Testing works i.e. making of pits, cleaning etc (NDT agency is to be provided by L&T on free of charge basis).

k) The laying of concrete coated pipes at specified location shall be in KSSIIPL's scope of works

l) Lowering the pipeline into the trench.

m) Cleaning of pipeline by running pigs and followed by gauge run.

n) Hydro testing of complete pipeline including Cased crossings and River crossings. It includes testing and fabrication of pigging and testing headers.

o) Detection of leak & pipe failure (if any), repair and replacement of defective stretch of pipeline during hydro test.

p) Dewatering and swabbing of pipeline.

q) Installation and Golden joint of mainline valves assembly with tapping as shown in the drawings are part of the mainline work, which includes fabrication and testing of Valve assembly.

r) Specialized agencies with calibrated tools to be provided by L&T, however manpower assistance for Caliper Pigging shall be provided by KSSIIPL. Incase defect is found during caliper pigging in the section, you need to rectify the same at your cost. Incase re-run is required due to reason attributable to you, cost of the same shall be recovered from your bills.

s) Drying the 8" dia pipeline.

t) Manpower assistance for Pre commissioning and commissioning.

CHAPTER- 5

DETAILED CONSTRUCTION WORK

5.1 DETAILED CONSTRUCTION WORK

A) STRINGING:

The pipes and pre-formed bends will be scheduled to be delivered to, and stock piled at, the proposed pipeline pipe yards some 4 to 8 weeks in advance of stringing operations. The pipe supply should ensure that the various grades, wall thicknesses and coatings are supplied in sufficient and correct quantities to meet the programme.

Immediately following ROW or topsoil strip or excavation in rock areas, the pipe stringing operations will commence, which involves laying the pipe lengths along the easement length using pipe trailers. A typical crew will consist of two cranes - one at the base camp loading the pipe trailers and the other on the pipeline easement off-loading the pipe trailers.

In the event that ground conditions do not permit travel down the easement with standard or special heavy-duty pipe trailers then the pipes will be loaded on to tracked pipe carriers at the public roads or at a point where the change in ground conditions occurs and permits the turning of the wheeled pipe trailers.

Details of L&T's stockyards:

L&T shall provide one stockyards at Surenedranagar dist (Existing yard). Loading and Shifting of pipes from stockyards to ROU and its stringing in mainline will also be in KSSIIPL's scope of work. KSSPIL to organize required Trailers and Crane for loading & transport.

Bends for 24" and 8" shall be made at one place and transported to site by KSSIIPL. One bending Machine for each size will be made available at our yard , which shall be used on sharing basis by.

Stacking of Pipes on trailer:

While stacking, the arrangement of the pipes shall be limited to 3 layers as specified in CEIL Specification for Online Pipeline construction (approved procedure to be followed).

B) Handling of Pipes:

The pipeline elements may not come into direct contact with the ground or be placed on unsuitable supports. Encrustations of gravel, stones, wood, etc. must be carefully avoided. Continuous contact of the pipeline parts with each other - in particular, pipes stacked cross-wise avoided. To this end, cushions, wickerwork, bags of straw or other flexible materials shall be provided over a sufficiently large surface area. The KSSIIPL shall arrange the stacking of pipes in such a way to avoid any permanent deformation of the pipeline element taking account of their weight and resistance. Between the ground surface and the first layer there shall be a free height of 20 cm. The pipes shall be placed on a suitable support so that damage to the coating and deformation of the pipes are avoided. The bottom layer of pipes will be sufficiently supported at the sides to ensure stable stacking. The lower pipes shall be supported from 0.75 m from their ends and crosswise at least every 4th meter.

5.2) MAINLINE WELDING:

Qualification of procedures & welders with 24" & 8" dia, API 5L – Gr X65 pipes will be done by KSSIIPL as per API 1104 and CEIL Specifications. Pipes for qualification of procedures and welder will be issued by L&T free of cost. The cost incurred on PQR and welder qualification is to be borne by the KSSIIPL. The NDT charges for successful welders will be borne by L&T. However, the cost of others will be borne by KSSIIPL.

Before taking over of line pipes KSSIIPL shall check the pipe and coating for any damages. KSSIIPL shall rectify any damages found later, without any extra cost & time. Pipe end shall be thoroughly cleaned for outside and inside for a minimum of 3" length before alignment to the satisfaction of the CEIL/L&T/ or any third party inspectors/ engineers.

For alignment, pipes shall be resting on wooden skids (provided by KSSIIPL) with soft padding at least 500mm above the ground all the time till the line gets lowered in to the trench. Every 200 Mt. Cross support is to be provided to restrict the pipe string from rolling .For alignment of pipe, cold dressing is followed to make within a maximum of 1.6mm offset by brass hammer only. KSSIIPL shall to work as per the specification and approved procedure of CEIL and as per the instruction of Engineer-in-charge.

Pre-heating of Pipe end with Gas torch to a temperature of 100 degree centigrade is included in KSSIIPL's scope of work. Necessary LPG cylinders, heating torch, shall be arranged by KSSIIPL.

KSSIIPL's work includes welding in all types of terrain like ordinary areas, Minor/major water crossing, water logged area, Marshy area, rocky, paddy field, orchards etc. and all crossings(excluding HDD) with PE, PP Coated or concrete coated pipes/insulated pipes shall be supplied by L&T on free issue basis. For any difficulty encountered due to the terrain conditions, the KSSIIPL deemed to have included the cost in the agreed price/rates.

During welding, the wooden skids shall be removed after full completion of weld joints, and the pipe shall be kept on sandbags with straw bags on top to a minimum height of 500mm. If the existing sand bags during stringing are not sufficient, KSSIIPL shall to arrange extra sand bags without any extra cost. All pipes shall be thoroughly cleaned by passing of pull through (i.e. 95% of pipe ID) and if any debris found at the time of pigging KSSIIPL will be made responsible. KSSIIPL shall to provide monthly reconciliation of FREE issue material and in case of any shortage the same shall be charged to KSSIIPL at cost mutually agreed between KSSIIPL & L&T(Landed cost plus 20% overheads). All pipe string shall be closed at the end of the day, by putting night caps/ temporary caps. KSSIIPL to ensure that no welding electrode stubs/metallic pieces/small tools etc are not left in the pipe to ensure that the line is free of foreign materials which are likely to damage the valves.

KSSIIPL shall ensure installation of the nightcaps. Any problem found latter for movement of X ray crawler due to foreign particles inside, or during Hydro testing, the cost will be recovered from KSSIIPL for any work carried out for rectification of the problem. KSSIIPL shall arrange plate for nightcaps with KSSIIPL's own cost.

After completion of the welding, joints will undergo 100% Non – destructive testing (UT and Radiography) by L&T. Charges for NDT test is in L&T scope. However, KSSIIPL shall provide necessary manpower assistance for NDT test.KSSIIPL shall attend the defects which may get noticed in NDT.

KSSIIPL is also required to render labor assistance for NDT works as required by site-in-charge. Dye penetration test will be in the scope of the KSSIIPL including required DP test material & consumables. Any repair found in the joint after interpretation of the UT or radiographic film, KSSIIPL shall rectify the same without any extra cost. If the repairs exceed 2% of total welding, the NDT charges carried out by other approved agency will be debited to KSSIIPL. Moreover, other consequences arising due to the failure of production weld will be under KSSIIPL's scope of work. Production test piece is to be cut from main line welded section. There will be production weld as per specification for welded section. Testing Charges KSSIIPL . In case the production test fails KSSIIPL shall provide necessary corrective actions to meet towards the production test will be borne by the QA/QC.

KSSIIPL shall to follow the latest editions of all International, Indian Standards applicable for mainline welding and also CEIL's specification for Welding of onshore pipeline .

5.3) COLD FIELD BENDING:

All cold field bends shall be made by KSSIIPL as per the terrain requirement, which will be, ascertain by KSSIIPL's bending supervisor/operator in line with the CEIL specifications, approved procedures and instruction of the Engineer-in-charge. Minimum Bend Radius for 24" dia pipes is 120D and 8" dia pipe is 40D. Arrangement of all tools & tackles (Except as per annexure –I) will be in KSSIIPL's scope. All horizontal and vertical bends shall be welded along with main line welding. In no case bend welding will be considered as Tie-in. Max bend degree allowed in a 12 mtr length of 24" pipe is 6 degree. KSSIIPL to make multiple bends in case more than 6 Deg. Required. Also KSSIIPL to excavate the Trench with additional depth and Length to accommodate long radius cold field bends.

5.4) GARNET BLASTING & FIELD JOINT COATING: Once the pipe has been strung along the easement, engineers will follow to determine the location of all bends required in order that the pipeline can follow the contours of the land and the required line and level as detailed on the drawings. There are two types of bends normally used ie hot pre-formed or forged bends which are manufactured off site in a factory and are to a radius of 5 or 3 times the pipe diameter and cold bends which are to a radius of 40 times the pipe diameter and are formed in the field.

All Mainline & Tie-in joints (all back end joints) will be sand blasted and welded sleeves for 24" & heat shrink sleeve for 8" (to be supplied by L&T as free issue)as per CEIL specifications for Field Joint Coating, approved procedures and instruction of the Engineer-in-charge. The joint will be holiday tested and peel test will be carried out as per requirement. KSSIIPL will carry out any repair found, without any extra charges.

Field joint coating for 24" dia heat insulated pipeline shall be done as below.

1. Blast clean to sa21/2 and apply liquid epoxy (Epoxy Paint free issue).
2. Application and testing of Welded type Sleeve system under specialist supervision (All special accessories including welding machine will be free issue by L&T). KSSIIPL shall to deploy skilled technician (will be trained and qualified like insulator) , Equipments ,consumables etc for the same.

5.5) LOWERING:

After NDT clearance, all joints will be coated and coated section of the pipeline shall be thoroughly checked by holiday m/c for coating flaws. KSSIIPL qualified insulators shall rectify any defects found. All jobs pertaining to this shall be carried out as per CEIL specifications.

For 8" line, If repair area exceeds 350 square mm. KSSIIPL have to blast the area and repair material is to be applied by KSSIIPL on KSSIIPL's own cost. Pipe section exceeding 100mtr Length shall be lowered utilizing cradles only and s-curve shall be ensured by KSSIIPL.

However repair for both 24" pipe & 8" dia pipes shall be done as per the approved procedure only.

KSSIIPL shall to deploy skilled supervisor / foreman for this purpose, along with skilled Riggers and KSSIIPL will be solely responsible for any excessive deflection or twist of S-curve due to mishandling. All manpower, equipments, tools & tackles, material and consumables required for this job will be in KSSIIPL scope.

PERP filler and PERP Paper will be supplied by M/s L&T, but other manpower, consumables (i.e. L.P.G., Garnet for blasting) will be in KSSIIPL's scope.

Lowered section shall be closed with nightcaps from both ends in such a position that no water or mud shall enter inside the section. The plates for nightcaps have to be arranged by KSSIIPL with KSSIIPL's own cost. Where ever required temporary caps shall also be provided

5.6) TIE – IN:

After lowering of consecutive section, KSSIIPL shall carry out the tie-in. This includes all civil works i.e. Tie-in pit preparation excavation of all Cart – track, Roads, canal ,Nala/drain etc all type of terrain and backfilling of balance trench for tie-in shall be done by KSSIIPL, in line with CEIL specifications.

KSSIIPL shall deploy adequate excavator for this civil work as per the instruction of Engineer-in-charge. KSSIIPL shall to carry out DPT checks. All jobs related to it to be carried out as per CEIL specification.

The tie- in with all crossings will be in KSSIIPL's scope of work. which includes tie-in at major river crossing (200 width and more) or any crossing (Bored crossing).

All Tie-in joints are to be coated and if any repair found in coating, the same shall be done by KSSIIPL at no other extra cost. 24" tie-in shall be done with un-insulated pup piece (Pipe) and necessary bending of heat tube and jointing etc. is in KSSIIPL scope. Field joint coating of this portion shall be done as per specification. All material (i.e. pipes, 1" tube, and spacer) for coating of pup piece shall be in L&T scope all other material; consumables are in KSSIIPL's account.

5.7) CROSSINGS:

The work under open cut crossings shall include necessary clearing, grading and trenching to required depths and widths, welding of casing and carrier pipes, coating, lowering-in, back filling, clean-up, restoration to the original condition and further strengthening and protective works, testing, installation of assemblies, insulators and seals, and temporary works such as sheet piling, bridges etc. as per CEIL specifications. Before starting the installation work of crossings, the KSSIIPL shall provide suitable barricades, temporary bridge/ bypass work with railing. The KSSIIPL shall install the casing pipe (provided by L&T as free issue) in for open cut crossings, if required.

Bored crossings to be executed by L&T however Welding of carrier pipe string, its pre-test, field joint coating, insertion followed by post-hydro test constitute KSSIIPL's scope of work. The work shall also include fixing of casing insulators with requisite vents with CEIL specifications (supply of casing insulators by L&T as free issue).

5.8) RECONCILIATION:

KSSIIPL shall submit the reconciliation statement for the line pipes and other L&T free issued materials to L&T as per following norms.

Scrap Allowance: The scrap allowance for Mainline Pipes shall be 0.15% of the installed pipe length. The pieces of pipe of length less than 2.0 mtr shall be treated as scrap. However all the scrap must be returned to L&T at designated yard.

The percentage allowance shall be accounted on the basis of final weld pipe book chainage for the main line welding works. All bevel protectors/guards should be handed over to the store every month and reconciliation will be submitted after completion of main line welding works.(total no of pipes issued X 2 nos of each pipe). If sub KSSIIPL fails to return the bevel

protectors to M/s L&T, the same will recovered from KSSIIPL's RA / Final bills after the reconciliation.

All pipes length shorter than 1.0mtr shall be returned as it is. All pipes between 1.0 mtr and 8mtr shall be reconditioned (i.e. Bevels, Coating, UT, lettering with pipe identification number and length) and to be returned to L&T designated yard areas together with all undamaged, unused L&T supplied materials through material return note. In case KSSIIPL fails to do so or the %age exceeds the limit of allowances specified above for scrap / serviceable materials, then recovery for such quantity not returned by KSSIIPL will be done at per actual(as recovered by client).

5.9) VALVE INSTALLATION:

Prefabrication, installation, testing and Golden joint of the Valves assembly (valve supplied by L&T as free issue) are in the scope of work of KSSIIPL. Field coating of valves shall be in KSSIIPL scope of work; however sleeve for the same shall be issued as free issue by L&T.

5.10) AIR PIGGING, GAUGE RUN, HYDROTESTING, DEWATERING, SWABBING AND DRYING:

Maximum length of hydro test section allowed is 25 KM

After mechanical clearance of the pipeline section KSSIIPL shall carry out air pigging as per the approved procedure & CEIL specification. KSSIIPL have to carry out the air pigging up to the satisfaction of the L&T /CEIL. Subsequently after successful completion of gauging, water filling shall be followed. KSSIIPL shall rectify any defect in the gauge plate attributable to KSSIIPL at free of cost. Temperature probe installation will be in KSSIIPL's scope including excavation of pit and backfilling of the same after completion of hydro testing. All pipes, fitting end cap valves (Ex corrosion inhibitor) pigs and cups etc are KSSIIPL's account.

All tools & tackles required for this job will be in KSSIIPL's scope. In addition to the above, if leak or burst occurred during Hydro testing same shall be rectified by KSSIIPL's and re – hydro testing of the particular section should be carried out by KSSIIPL at no extra / additional cost in case leak is in the weld joint (including HAZ area). After successful completion of hydro testing, dewatering is to be done and will be followed by swabbing till the section is dried to the required temperature as per drawings/ specifications. Compressors required for this job shall be in KSSIIPL's scope. KSSIIPL shall carry out the entire temporary piping connection including erection of all inline equipment and after completion of hydro test for every individual's section shall be dismantled at no extra cost to us.

Any leak found in welded joints due to bad workmanship ,even though NDT clearance is obtained which is detected during any stage of work of Hydro testing the repairing, restoring or replacing with new tested pipe or cost there off to detect such leaks are included in scope of KSSIIPL's work and the same is deemed to including in agreed price. Any damages caused to pipe during mainline activities attributable to sub KSSIIPL which leads to leak in pipe at subsequent stage will be made good as per CEIL specifications. All such works/ costs included in KSSIIPL's price.

L&T Obligations:

The following machineries, equipments and specialized gauges / recorders, shall be issued to KSSIIPL on free of charge. Items thus supplied by L&T shall be utilized for effectively, and shall be retuned to stores in good working condition. Any loss or shortage will be recovered from KSSIIPL at landed cost + 20% service charge.

All materials that are to be permanently incorporated in to the works and forming part of mainline construction facility, like line pipes, valves, fittings, etc. will be issued free of cost by L&T to KSSIIPL. However, it will be KSSIIPL's responsibility for accounting the same, including theft and pilferage.

Except the tools & tackles listed in annexure-I ,rest of the P&M,tool & tackles to be provided by KSSIIPL, cost on this account is included in agreed price.

Following Consumables will be supplied, as free issue as per agreed consumption norms by L&T. Any consumption beyond the agreed norms will be recovered at landed cost plus 20%.

1. Electrodes: E6010,E7010 &E8010

2. Coating Material viz. Sleeves, foam, PERP, Mastic, Primer A & B including Primer Pumps,

3. corrosion Inhibitor for hydro testing.

KSSIIPL's Obligations:

1) KSSIIPL shall mobilize as minimum, the manpower as per organization chart provided along with enquiry. However manpower to be augmented to meet the ultimate timely completion of the project.

2) KSSIIPL shall to arrange the Welders/ operators / Helpers (including wages, Accommodation, Conveyance etc), watch & ward for security for L&T supplied and KSSIIPL's supplied Equipments.

3) KSSIIPL shall arrange fuel (diesel/petrol etc) for L&T supplied (if any) and KSSIIPL's supplied Equipments to ensure smooth operation of the equipments. The transportation of fuel to the ROW for equipments is also under KSSIIPL's scope.

4) The KSSIIPL shall arrange conveyance for the Staff/Supervisors/Workmen to perform the work.

5) KSSIIPL shall to make arrangement for minor repair of the L&T supplied equipments at his cost. However major maintenance will be taken care of by L&T but the KSSIIPL shall arrange the required manpower assistance.

6) Following P&M ,in addition to referred above ,are in the scope of KSSIIPL: -

a)Tractor and Trolley (for pulling of machine, shifting of material etc)

b) Compressor (as per required Capacity / job requirement) for Joint coating/ tie-in work/ Air pigging/Hydro testing etc.

c)Garnet blasting Unit with all accessories for Coating.

d)Truck (for shifting of materials, consumables etc).

7) All P&M, small tools and tackles & consumables other then mentioned as per annexure-1 are in KSSIIPL's scope.

8) All instruments either supplied by L&T or by Sub KSSIIPL, shall be calibrated by KSSIIPL as per the specification and the requirement of CEIL/L&T at his cost in approved laboratory

9) Supply & Installation of Night Caps and Temporary Caps.

5.11 General Instructions :

KSSIPL have to get inspection report duly signed by CEIL/GLIS.

For the execution of job, required tools & tackles, fuel and operators shall to be arranged by KSSIIPL free of cost. KSSIIPL shall mobilize the required qualified Operators / technicians and other manpower to meet contractual completion deadlines. All the job shall be carried out as per the approved procedures and specifications of L&T/CEIL and instructions of CEIL..

Any violations of ROU limits, KSSIIPL have to compensate to the land L&Ts accordingly and keep CEIL/L&T indemnified against any third party claim of whatsoever on ROU violation. The decision of construction manager will be final & binding in this regard.

Sub KSSIIPL or his representative shall to understood & visited the project site and be aware of all the ground / terrain conditions and deemed to have included in such difficulties in the price agreed. No claim of extra payment of whatsoever on this account is admissible and will be entertained by L&T.

The KSSIIPL shall to keep the P&M tools& tackles issued by L&T in neat and clean condition during the operation of contract. On completion of work, the equipments issued to the KSSIIPL shall be returned to L&T at all designated P&M stock yard in good working condition. The certification of construction manager in this regard will be final and binding upon the KSSIIPL. Not complying with the same or damage found if any will be recovered from KSSIIPL bills or dues payable to him by L&T. Security shall be arranged by KSSIIPL on the entire pipeline route to take care of L&T supplied Line pipes, P&M, tools & tackles etc. at no extra cost to L&T.

The scope of work mentioned above is indicative, However KSSIIPL to carry out the work as per CEIL's specification, approved work procedure, relevant standard /codes and as per the instruction of Engineer –In-Charge.

CHAPTER- 6

RECOMMDATIONS

6.0 RECOMMDATIONS

REMEDIAL MEASURES THAT ARE TO BE TAKEN IN PIPE LINE CONSTRUCTION ACTIVITIES FOR THE BETTER PERFORMANCE

A. Land Acquisition and Row:

API standards shall be fallowed and Row shall be done according to the standards.

Row should be taken Min of 18m so that it will be very much help full in machinery and pipe line operation. For BSPL pipeline the ROU is 30m, which is sufficient because the area required for both the pipeline to be laid is more.

B. Stacking :

Proper care should be taken in stacking process.

Some help must be taken from survey people for correct and accurate measurements.

The area of ROU 30m is sufficient for the laying of pipelines.

C. Clearing and Grading Of Row:

Machinery and latest equipments are available in the markets.

Latest machinery can be brought up and also can be used for trenching purpose.

Caterpillar Company has been providing lot of machinery equipment for ROW operations

Manual trenching is not up to the standards.

Trenching work has been given to contractor, but if the same contract is given to the contractor who can provide latest trenching machines for the operation.

Machinery operation will be much better then manual operation.

D. Hauling and stringing

While doing hauling they should take care regarding the area where they are storing the pipes. The area should be free from sharp edged rocks and other tiny sharp particles which may cause

damage to pipe. Both pipeline should be unloaded at proper distance, so that they can be easely moveable for other activity.

(Sand can be spreader in the area before stringing the pipes in the area so that the pipe can be got protected.) Care should taken during stringing of the pipeline, so that the chance of any defect in the pipeline is less.

E. Trenching:

Machinery operation can be done instead of manual operation. Because we can not get perfect leveling with manual operation while compared with machinery operation. Lot of new machinery has been available in market for trenching such as:
Trenching machine known as (trencher), procleaners etc. The trencher machine has been manufactured by Caterpillar Company and it is also recently available in Indian market.
The depth and width of trench should be sufficient so that both the pipeline can be suitably laid in the trench. Here minimum cover for the pipeline is 1m from the top of pipe in the trench. And for gas pipeline it is different, so keeping this thing in mind trench is to be done on site.

F. Field Bending:

KSSIIPL is doing cold bending at the L &T yard near by site itself. According to the studies bending operation at the site is not safer then factory manufactured bends or bends made out of site.
Bends which are made out of site are safer than the bends made at the site.
Now a day's 5d bends which are been manufactured in factory with induced heating methods which are more matched with all properties of pipe.
By using these bended pipes the progress of work will be faster.

G. Weld Inspection:

Ultrasonic test also should be used in the weld inspection for better results and better performance of pipe.

With the help of ultrasonic test we can get more precocious results in the weld inspection.

H. **Joint Coating and Wrapping:**

The coating which has been used in KSSIIPL pipe line work are having health hazards. (3L HDPL) and cold tapes for 24".

Some of the coatings which are been used in trunk pipe line constructions mainly in India are mentioned below:

Fusion Bond Epoxy Coating,

3 ply Polythene Coating,

Cold applied Tapes.

These coatings are preferable. Environmental safe. Free From Health Hazards. And also having better performance.

I. **Lowering:**

Latest hydraulic machines are been available in market for lowering operations which will be helpful and time savable.

Use sand prod while pipe lowering operation.

Lowering Belts are also available in market can be used for lowering operation.

J. Back Filling:

Machinery operation can be done instead of manual operation. Because we cannot get perfect leveling with manual operation while compared with machinery operation.

Top of the soil which is very Fertile should be segregated at the time of trenching and should be kept separately. While back filling same soil should be restored for the original fertility of land. Trench backfill starts immediately following the placement of the linepipe in the trench, it should be done within 24 hours after lowering. Special backfill requirements are essential to control the effects of water on a trench line and mitigate against natural hazards that could result in pipeline failure or extensive operational remedial costs due to exposure and movement such as seismic conditions, erosion, mining subsidence.

K. **Cleaning and Sizing:**

MFL tool can also be used for obtaining better results in the cleaning and sizing operation of the BSPL pipe line.

There are several verities of cleaning and sizing tools are available in market but MFL provide good results in case of cleaning and sizing.

L. **Hydro Static Testing:**

The hydrostatic testing is done for 24 hours maintaining the pressure in the pipe line. Lots of questions have been raised in testing the pipe line regarding 24 hours of test.

A debit should be aroused in ONGC members regarding the reduction of time period of 24hours test in to 12 hours for the hydro static testing process.

It would be better to do hydrostatic test for a period of 12hours only.

By following these remedial aspects KSSIIPL can increase the performance of the trunk pipe line in Rajkot Asset. Following this activities will make pipeline construction activities safe and increases the speed of process.

Some other aspects for the pipeline are as follows:

- Proper safety from corrosion i.e. CP system must be given for both the 24" and 8" pipeline. Separate anode for the both the lines must be given the pipeline, recommended anodes are Zinc and Magnesium.
- All precautions shall be taken by KSSIIPL to protect all foreign pipelines, cables, and OFC along with all other under ground utilities.
- Proper guidlelines from the different code is to be followed.

List of equipment more required by KSSIIPL per spread:

- 70T Pipe layers – 06 nos for lowering (Along with Rolling cradle and lifting belts).
- JCB- As required

CONCLUSION:

Today we know that the pipeline are the most safe ,economical and reliable mode of transpiration of hydrocarbon in both offshore and onshore but some defects are also occur during design ,construction ,operation and maintenance and that defects after some time is become a chance of failure of pipeline but around 20-30 % failure is occur due to construction failure .

Thus in the end I want to conclude my report by saying that I have tried to cover entire activities which are being followed while construction of pipeline and it is concluded that construction of a pipeline is a skilled job which needs level of accuracy and for this job a well defined process and sequential activities is needed. It is also very essential that the Testing at every activity must be 100% accomplished.

So if we construct pipeline according to specific code and standard and flow the standard design procedure .So less chances of failure is possible along with less human error.

REFERENCES

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- American Petroleum Institute Standard- API 5L Specification for Line Pipe, OISD – 141
- ANSI B 31.8: Gas Transmission and Distribution Piping Systems
- ANSI B 31.4: Liquid Petroleum Transportation Piping System
- OISD – 226
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