CONSTRUCTION ACTIVITIES OF GAS PIPELINE

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(ISO 9001:2000 Certified)

CERTIFICATE

This is to certify that the work contained in this thesis titled "CONSTRUCTION ACTIVITIES OF GAS PIPELINE" has been carried out by Nishant Jain & Shalabh Puri under my supervision and has not been submitted elsewhere for a degree.

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ABSTRACT

The important action and methods include in constructing a onshore pipeline are describe in this segmentThere are three different types of pipeline construction methods are opencross country areas in which spread method is applied, where expert team and civi engineering methods are applied are called as crossings and third is special segment like areas which are restricted urban and environmentally sensitive.

SPREAD METHOD AS EXPLOITED IN OPENCROSS COUNTRY REGION

The introductory technique of fabricating steel welded onshore pipeline of oil n gas in open cross country region is broadly called as spread technique. The basic rule of the production line system is employed by the spread technique but the (pipeline) product is static and single work force travel along the ROU in case of pipeline. The carrying out of the spread method is depending on the pipeline being welded in above surface in maximum possible uninterrupted lengths between crossings/obstructions(which length surplus extended to 12 kilometres).These welded pipe lengths are instantly established into unobstructed/unsupported trenches taking place over an extended period in one uninterrupted length employ three or more than three mobile lifting tractors for example side booms etc.

The interruption in the uninterrupted main spread technique of working outcome from the particular place of existing service, tracks, rivers, mountains, slopes, roads etc. and are also dependent upon restricted working, time restraint and physical characteristics/obstructions. These interruptions in the main pipeline spread activities are formally guaranteed by dedicated expert crews employing a variety of spread construction methods and are generally formally guaranteed after the main pipeline segment have been installed.

The primary pipeline spread installation is formally guaranteed by devoted teams formally guaranteed one operation at a time begin at one end of the pipeline and moving forward to the other end anything from 1500ft-4500ft per day depending on the radius of the pipe, terrain, sand etc. In seven primary activity groups as describe in section A5.1 TO A5.7 inclusive there are aggregate of some 45 separate operations carried out. The program of activity and action of the teams is dependent on usable resources and the hazard of one team having an impact upon the following activities. It is necessary that the time period between teams is such that there is no hazard of one team causing stoppage or interruption on the preceding or subsequent team because a pipeline is a production line. If the time interval between teams is not managed on a continuous basis, with the accent placed in a daily moving, then a collapse effect will be the outcome with substantial disruptions and standby costs. Efficaciously there can be up to 28 days delay between teams to ensure that the collapse bunching effect of team does not occur.

Accordingly, there are in the program extensive period of time where there are no activities are going on along large segment of pipeline route. The mean time from start of right of way to commencement of land reinstatement is in time period of 70 to 100 days.

1. INTRODUCTION OFCHAINSA TO JHAJJAR GAS PIPELINE CONSTRUCTION

1.1 Project description

M/s GAIL India ltd. intend to lay 36" dia 86 km and 16" dia 18 km p/l from Chainsa to Jhajjar as a part of DVPL and GREP capacity augmentation project .This include a spur line of 18 km in length commencing from a Tap-off at Sultanpur and terminated at premises of PPCL power plant at Bamnouli. The main 36"Chainsa – Jhajjar pipeline is provided with 4 SV stations at chainage -18 km, 39 km, 61.19 km, 70.5 km and receiving terminal at 85.822km at Jhajjar.

Future Tap-off point

(TABLE-1)

S.No.	Ref. No.	Location	Size	Chainage	Length
1.	Tap-off point-1	Chainsa	24"	0.00	Future
2.	Tap-off point-2		18"	18	Future
3.	Tap-off point-3	Amberpur TOP	18"	39	Future
4.	Tap-off point-4 Tap-off point-4A Tap-off point-4B Tap-off point-4C	 For Khandsa For RHSEZ-I For Manesar	18" 12" 12" 12"	61.140	
5.	Tap-off point-5 Tap-off point-5A Tap-off point-5B Tap-off point-5C	Sultanpur For Nimrana For Bamnouli For future use	24" 18" 16" 12"	70.500	Future & Bamnouli Spur line
6.	Tap-off point-6	RHSEZ-II	18"	73.200	Future
7.	Tap-off point-7	RHSEZ-II For future use For Hissar	18" 18" 20"	85.822	Future

Part A -It covers approx. 61.140 km 36"(914mm)outside diameter pipeline commencing at Chainsa dispatch station and TOP I passing thROUgh SV I,TOP2,SV2and TOP3 and terminating at upstream tie-in points of SV3 terminal.

1. Dispatch station and TOP I (ch.0.00km)-Chainsa

2. SV 1 and TOP 2 (ch. 18.000km)-Sikri

3. SV 2 and TOP3 (ch. 39.000km) – Dhunella

Golden Tie-in point at SV 4 at ch 61.140km

Part B -It covers 24.68 km long 36" (914mm) outside diameter pipeline commencing at dispatch terminal inside the premises of PPCL power plant at Bamnouli.

1. SV 3 and TOP 4 /4A/4B/4C (ch. 61.140km) –Vazirpur
2. SV 4 and TOP 5/5A/5B/5C (ch. 70.500km) –Sultanpur
3. Receipt at PPCl power plant (ch. 18.069km) 16"ø –Bamnouli
4. TOP 6 RHSEZ II (ch. 73.200km)
5. Receiving station and tap-off for RHSEZ III Hissar future(ch.85.822km)

Design Basis

Product to be transported	-	NG(Natural gas)/RLNG
Flow	-	35 MMSCMD
Operating temperature	-	5 to 35 °c
Sub soil	-	20 to 25 °c
Operating pressure	-	45 bar to 90 bar
Design pressure	-	98 bar (99.93 kgh/cm2)
Design temperature	-	29 °c to 60 °c
Maximum gas velocity	-	20 m/s
Days of operation	-	365 days
Main 36" Pipeline	-	86 km
Material of trunk line	-	API 5L X70
16" Spur line	-	18 km
Design code	-	ASME B 31.8 / OISD 141
Operating life	-	30 yrs
Corrosion protection	-	Cathodic protection
Coating	-	3 Layer Polyethene
Sectionalizing valve station	-	4

Horizontal Directional Drilling

1. Agra Canal part A
2. State Highway and distributaries canal part B

Dispatch Station -The main dispatch station is located at Chainsa near take-off point .It will include ultrasonic check metering and Pig launching facilities.

Receiving Station - The receiving station is located at Jhajjar consisting of Pig receiving facility and three tap-off point one for Hisser, one for RHSEZ-III and one for future use.

Pigging - Pig launcher -Chainsa for 36" ø

Pig receiver -Jhajjar

Pigging - Pig launcher -Bamnouli for 16" ø

Pig receiver -PPCL power plant

Sectionalizing Valves (SV) -These are gas or oil operated shut off Ball valves. Equalizing valve/Vent lines (1/2") size are provided for pressure equalization or to vent the pipeline section upstream and downstream of each Sectionalizing Valve venting provision is by manual plug valve. Pressure transmitters are provided at remotely operated Sectionalizing Valves vent lines for leak detection by way of pressure point analysis within the control system.

Instrumentation - Smart type 4 -20 ma D.C output with hart signal superimposed .All instruments shall be weather proof and safe as per classification, metering, LEL gas detector, smoke heat detector, Scada, telecom, 24 fibre optical fibre cable

Gas Detector – There are two types of gas detector used Infra Red type and Flame ionized type

All unmanned control system shall be provided with CO2 flooding system. And all manned station shall be provide with Fire protection system

Software – Simulation –HYSYS 3.2

PFD AND PFID – AUTO CAD 2007

Carrier Pipe -Steel Pipe for transporting gas or liquid

Cased Pipe – Is a carrier pipe inside a casing that crosses beneath a rail road/highway crossing. A conduit through which carrier pipe placed.

Flexible casing – is a casing that may undergo permanent deformation or change of shape without fracture of wall ,ex steel pipe.

(TABLE-2)

S.No.	Location	Minimum cover
1.	Under track structure proper	6 ft (1.8 m)
2.	Under all other surface within the ROW or from bottom of ditches	3 ft (0.9 m)
3.	For pipeline transporting HVL	4 ft (1.2)

Highway Crossing

(TABLE-3)

S.no.	Location	Minimum cover
1.	Under highway surface proper	4 ft (1.2 m)
2.	Under all other surface with ROW	3 ft (0.9m)
3.	For pipeline transporting HVL	4 ft (1.2 m)

1.2 LINE PIPE MATERIAL SELECTION

The lines pipes used for Cross Country Pipeline transportation are manufactured as per API (American Petroleum Institute) Specification 5L. This specification covers seamless & welded steel line pipes (both plain & threaded ends) for carrying medium gas, water, oil and petroleum products.

API 5L establishes requirements for two Product Specification Levels (PSL 1 and PSL 2). These two PSL designations define different levels of standard technical requirements. PSL 2 is more stringent compared to PSL 1.

PROCESS OF MANUFACTURE

1. Seamless procedure

The seamless procedure is a procedure of hot working steel to make a tubular pipe without a welded seam. If essential, the hot worked tubular pipe may be cold finished to make the covoted shape, dimensions & properties.

2. Type of pipes

i) Seamless Pipe- Seamless pipe is made from the seamless procedure.

ii) Continuous Welded Pipe- Continuous welded pipe is defined as a pipe that has one longitudinal seam produced by the continuous welding process.

iii) Electric Welded Pipe-Electric welded pipe is defined as a pipe that has one longitudinal seam produced by the electric welding process.

iv) Laser Welded Pipe-Laser welded pipe is defined as a pipe that has one longitudinal seam produced by the laser welding process. The weld seam of the entire heat affected zone of laser welded pipe shall be heat treated so as to copy a normalizing heat treatment.

v) Gas Metal arc Welded Pipe- Gas metal arc welded pipe is defined as a pipe that has one longitudinal joint create by the uninterrupted gas metal arc welding procedures. minimum one pass will be on the inside and minimum one pass sill be on the outside.

vi) Longitudinal joint Submerged arc Welded Pipe- Longitudinal joint Submerged arc Welded pipe is defined as pipe that has one longitudinal joint create by the automatic submerged arc welding procedure. minimum one pass will be on the inside and minimum one pass will be on the outside.

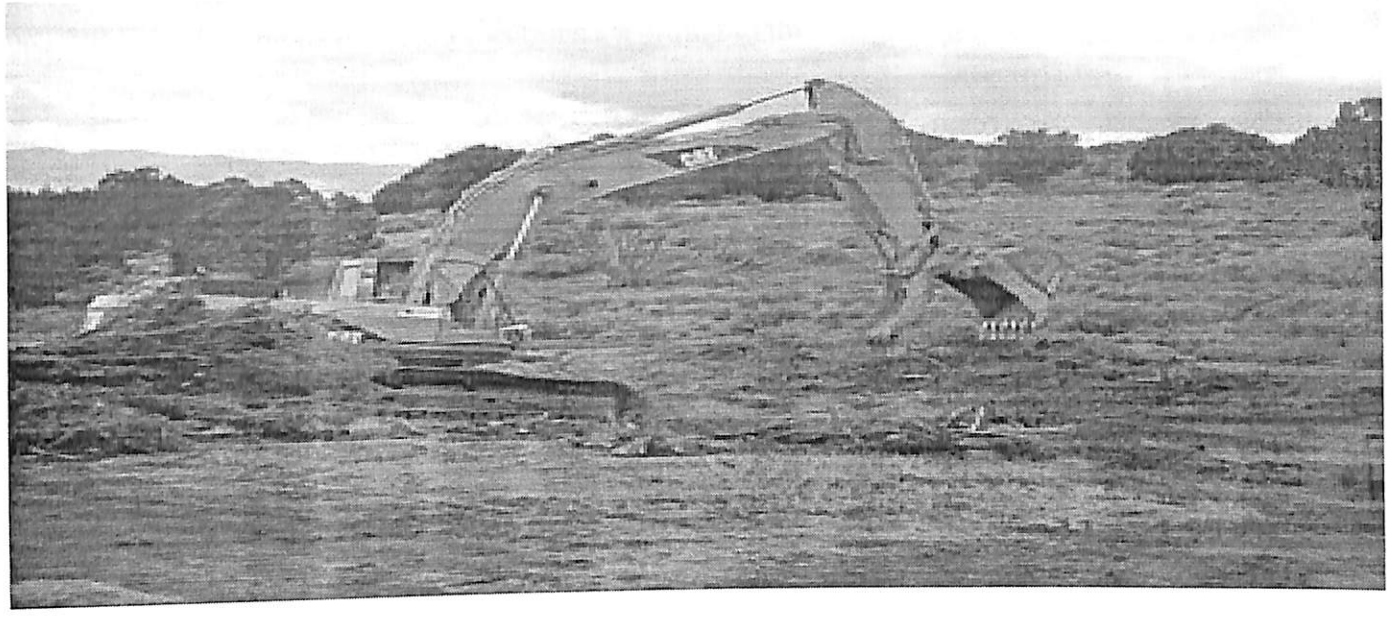
vii) Helical Seam Submerged arc Welded Pipe- Helical Seam Submerged arc Welded Pipe is defined as pipe that has one helical joint create by the automatic submerged arc welding procedure. minimum one pass will be on the inside and minimum one pass will be on the outside.

1. CLEARING THE ROW

The ROW (Right-of-way) is a narrow strip of land that contains the pipeline(s).ROW is acquired by the owner of the pipeline project under P&MP Act, 1962. All onsite construction activities occur within the ROW width. Generally the width of ROW is 30 m. The pipeline is laid at 15 m from the left edge (when facing downstream of pipeline) of the ROW. The 15 m width is utilized for stock piling of the excavated earth. The 30 m width of ROW on the right is used for movement of equipment, stringing of pipes and other on site activities.

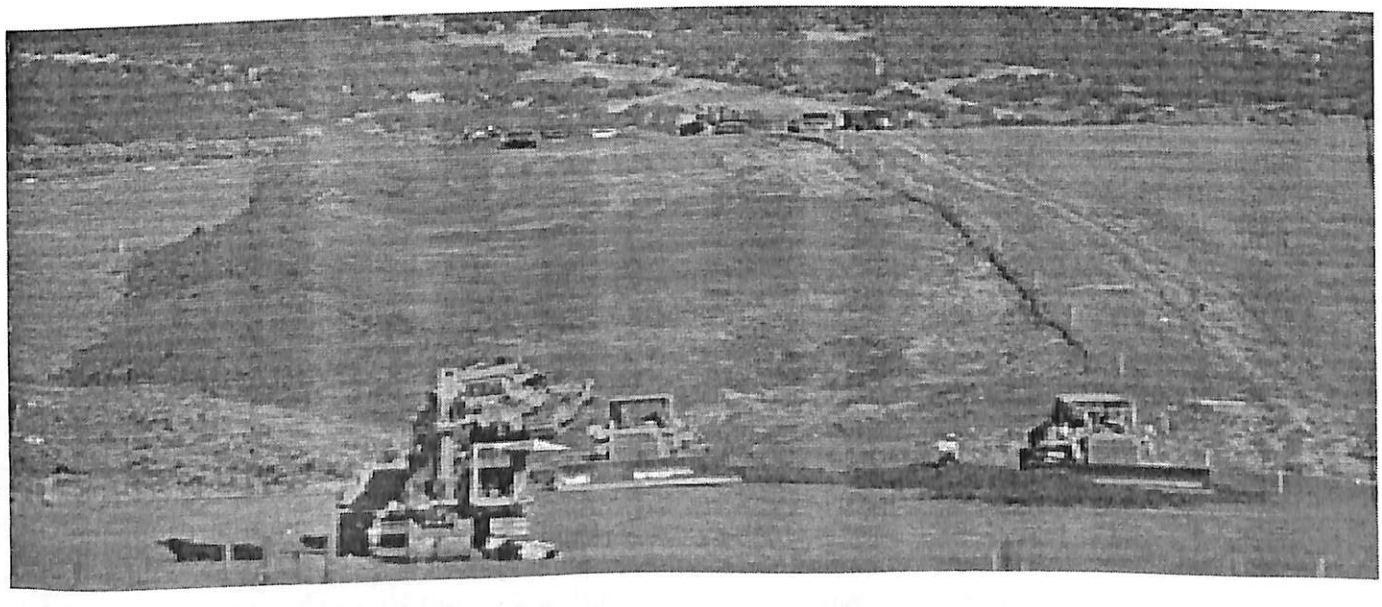
To begin construction of the pipeline, the acquired ROW of the pipeline is cleared. A clearing and grading crew prepares the corridor so that the construction equipment can operate safely. This crew removes trees, boulders, bushes and other impediments that may prohibit construction. This crew also prepares 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 ROW are cut down and the timber is removed or stacked alongside the ROW. 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 ROW.



2. ROW GRADING

The ROW is graded to allow for the movement of ditchers, equipment, materials and other pipeline construction activities.



3. HAULING AND STRINGING OF PIPE

Once the ROW has been cleared sufficiently to allow construction equipment to gain access, sections of pipe are laid out along the ROW. 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 ROW. After the pipe is delivered to the ROW, a stringing crew carefully distributes the line pipes in various sections according to the design plan.

4. BENDING THE PIPE

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, ecosensitive areas, Sanctuaries etc. or due to hilly undulating terrains etc.Number and degree of bends are determined in advance based on the detailed ROWte survey. Long Radius (LR) bends are prefabricated at the workshop and then bROWght on site for installation. For slight bends, a specialized pipe-bending machine is used in the field to account for changes in the pipeline ROWte 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".

5. WELDING 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 one continuous length, using manual, semiautomatic or automatic welding procedures. Generally automatic welding is used instead of manual welding for larger pipeline projects. 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. 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. All the pipe welds are X-rayed and the X-ray films are examined for any flaws in the welds. Based on the assessment, the defective welds are repaired or cut out, and new welds are made. The weld quality inspection may also be carried out using ultrasonic technology

5.1 PIPE WELDING PROCEDURES

Horizontal Pipe Fixed Position Weld (5G)

After tack welding, the pipe is set up so that the tack welds are oriented appoximately as shown in figure below. After welding has been started, the pipe must not be moved in any direction.

When welding in the horizontal fixed position, the pipe is welded in four steps.

Step 1 Starting at the bottom of 6 o'clock position, weld upward to the 3 o'clock position.

Step 2 Starting back at the bottom, weld upward to the 9 o'clock position.

Step 3 Starting back at the 3 o'clock position, weld to the top.

Step 4 Starting back at the 9 o'clock position, weld upward to the top overlapping the bead.

When welding downward, the weld is made in two stages. Start at the top overlapping the bead. Work down one side 1 to the bottom, then return to the top and work down the other side 2, to join with the previous weld at the bottom

6. WELDER QUALIFICATION PROCEDURE

Method:

A. Welders will be selected based on certificate of previous experience and or conducting show test pieces at site by CIPL.

B. After selection of welders, CIPL / JPK will be informed to witness the welder's qualification test at site. Using a qualified Welding Procedure and a visual report as per Format prepared. Every welder shall execute for his qualification test a weld at least one half the circumference of the pipe starting from the top of the pipe until the bottom.

C. After acceptance of visual inspection, test piece will be taken for radiography.

D. Radiography accepted welders will be engaged on the job.

E. Welder ID numbering system shall be as follows :-

- During qualification a temporary number like initial (i.e. Mr. R.T.V.Prasad = R.T.V.P.) will be given.

- After success acceptance of NDT, a permanent number will be allotted to the welder as mentioned below :

  For CJPL: W 01 to W100

  Welder's qualification test record as per the approved format will be prepared.

  I.D. Card for qualified welders as per the approved format will be prepared. The original I.D. card will be retained by CIPL welding engineer and a Xerox copy will be

carried by the welders working at site. Original card will be produced to CIPL / JPK for any verification on demand.

A welder will participate only once to the qualification test.

Qualification validity of any welder is subject to satisfactory performance during production welding.

Welder's performance will also be assessed fortnightly based on NDT result of the joint welded by each welder and reports for the same will be submitted to CIPL / JPK by CIPL.

4.0 **Documentation:**

Witness of Welder Qualification report:

Welder qualification report :

Welder's ID card

:

MAINLINE WELDING AND FORMAT

All work shall be carried out as specification No. 11-0234-02-P-01-011-Rev0- Before the fit-up pipe shall be checked for correct thickness, specification etc. Bevel ends shall be visually checked, if any damages are found the same can be repaired as mentioned below:

a. Dents less than 1 mm depth shall be removed by grinding.

b. Dents 1 mm to 3 mm depth shall be re-beveled by grinding.

c. Depth more than 3 mm shall be gas cut and re-beveled.

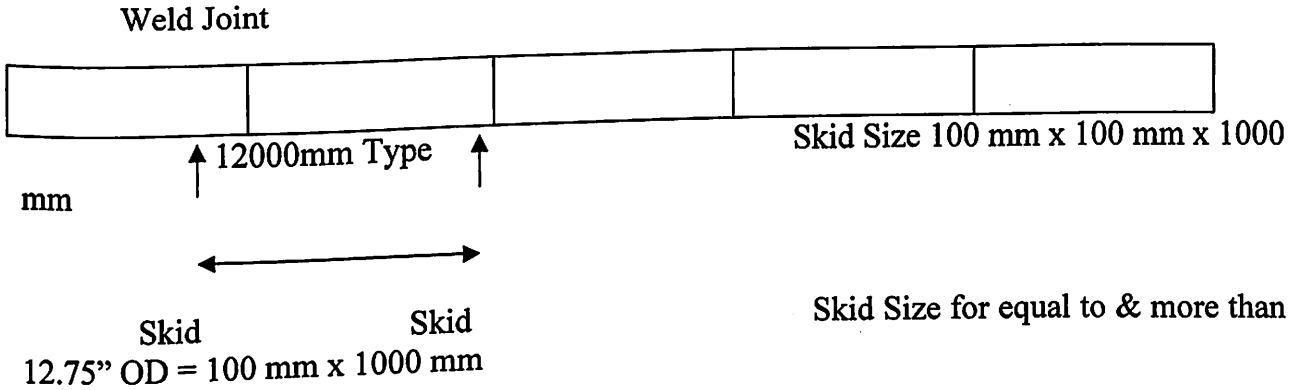
Before welding, all rust and foreign matter shall be removed from the beveled ends by power operated tools at inside and outside edges for minimum distance of 25mmfrom the edge of the weld bevel. Manual cutting and repairing of pipes and bevels by welding is not allowed.

On pipes, which have been cut back, a zone extending 25mm back from the new field bevel, shall be ultrasonically tested to the requirement of the line pipe specification to ensure freedom from lamination. the new bevel shall be 100% visual and 100% dye penetrate/ mpi tested a report shall be written for all testing. The rebevelled pipe heat number identification shall be maintained by transferring information to the new pipe end. Where the pipe is to be field cut and welded, the shop-applied coating shall be neatly peeled and gROWnd for a distance of 100 mm from the weld.

During alignment and fit-up first pipe will be rested and locked on the pre- positioned skids and the second pipe will be held by hydra crane with internal fit- up clamp (Mechanical), the second pipe will be carefully lowered on pre- positioned skids. Skidding arrangement shall be as shown below and skids may be removed only after

completion of the entire welding and the pipe shall be rested on the sand bags. Longitudinal weld seams of adjoining pipes shall be staggered such that a minimum distance of 300 mm is maintained along the circumference and both longitudinal weld are at top 90° quadrant of the pipeline (Except for bends). A longitudinal joint shall pass an appurtenance of a structural element at a minimum distance of 50mm.

Welding shall be not done in open areas during blowing sands, dust storms, high wind, rains or relative humidity is higher than 75% as JPKT specification.



Maximum offset of the same nominal wall thickness pipe shall not be more than 1.6 mm. Maximum length of weld string shall be 1000 Meters. And the off-set may be checked by using dial gauge.

In case of slight misalignment, cold hammering is permissible only by brass hammer. Hot dressing is not permitted. Root gap shall be as per the approved WPS.

After alignment & fit-up, pre-heating shall be carried out and the same shall be checked with thermo chalks / temperature indicating pyrometer before starting the root run. as per WPS.

Ear thing clamps used for welding return circuit shall only be placed on bevel area or cir. Welds.

Internal line-up clamps shall not be released before the root run is completed. In case of external clamps at least 60% of the root weld (between all spaces of the bars) shall be completed before releasing the clamp. Weld joints shall be protected from rains / sand storms. Windshield shall be used in there for said conditions.

Pre-heating and inter-pass temperature shall be done as per the approved WPS / Procedure. Minimum pre-heating shall be 100 degree centigrade.

Before any pipe length is cut, the painted serial number and the heat number shall be transferred to the either side of the joint which is to be made by cutting and records shall be prepared as per approved format.

Pipe pup piece for the Tie-In shall be minimum 1M. Two or more pup pieces shall not be welded together. In no case more than 03 cir. Seam welds shall be permitted in 10M length of pipe. Where different wall thickness pipes are to be welded and the difference in wall thickness is more than 1.6 mm then 1:4 taper internal grinding on the higher thickness shall be done.

Welding:

Welding shall be carried out as per the approved WPS. Minimum number of welders shall be two for mainline and Tie-In welding for each pass.

Weld Sequence:

Welder No.1 shall start from 12 'O' Clock position and proceed towards 6 'O' Clock, Welder No.2 shall start from 9 'O' Clock position and proceed towards 6 'O' Clock and then from 12 'O' Clock to 9 'O' Clock. Proper Overlap shall be ensured.

After completing every pass, the same shall be cleaned / flattened by grinding and power brushing. Electrode starting & finishing points shall be staggered from pass to pass.

Interruption between first pass to second pass and to third pass shall be as per the approved WPS. After completion of the third pass welding may be suspended if required, so as to allow the weld joint to cool down provided the thickness of the weld metal deposited shall be 50% of the pipe thickness or minimum of 03 passes whichever is more. Upon restarting the welding pre-heating shall be carried out.

Arc Strike outside the beveled area on the pipe surfaces is not permitted.

Acceptance criteria for arc strike / arc burn: < 0.5mm acceptable if gROWnd out, > 0.5mm un-acceptable and cut- out.

Accidental arc strikes / arc burns if any shall be repaired only by an approved procedure.

Repair of arc strike by welding is not allowed.

Pipe should not be pumped or shaken during welding.

Welders shall be qualified as per the approved WPS and all the welders should have identity cards duly signed by SGS.

After completion of welding the number assigned to the welders shall mark all welds on the top off pipe. After completion of welding visual inspection shall be done and all the surface defects shall be removed as per the specification. NDT shall be carried out as per the approved NDT procedures. NDT repairs shall be done as per approved WPS.

Repair procedure to be qualified separately for full thROWgh thickness and partial thickness respectively. Only 01 attempt for at repair of any region is permitted.

Repairs are limited to a maximum 30% of the weld length. for internal repairs or external repair which open the weld root, only 20% of the weld length may be repaired .

Destructive testing of weld joints (Production Joints) shall be one test per 0.1% of welding. And Production test to be carry out for each project.

7.2. WELD JOINT NUMBERING METHOD

All joints to be welded shall be numbered as indicated below:

Mainline Joints

KM X /Y / A - C - E - G Flow Direction

B – D – F – H

Here:

- X indicates chainage in Kilometer **e.g.** The welds between kilometer KM 0 and KM1 are indicated as KM 0 and the welds between kilometer KM1 and KM2 are indicated as KM1
- Y indicates the joint number **e.g.** The weld joint number between KM0 and KM1 are indicated as KM 0 /1, KM 0 /2 , KM0 /3 , KM0/4, KM0/5 etc. If there is Tie – Ins in between KM0/2 & KM0/4 and between KM0/5 & KM0 /7 follow Tie–in weld joint Numbering system as it is as per job procedure. In between KM0 /2 & KM0 / 4, KM0 / 5 & KM0 / 7 mainline are get lapsed as shown below example.

KM0 /3 & KM0 /6 get lapsed and substituted by relevant Tie- in

- A & B are Root welder ID numbers
- C & D is Hot Pass welder ID numbers
- E & F are Filler welder ID numbers
- G & H are Capping welder ID numbers

Tie-In Weld Joints

KM X /Y / A - G Flow Direction

B – H

Here:

- X indicates chainage in Kilometer **eg.** The welds between kilometer KM 0 and KM1 are indicated as KM 0 and the welds between kilometer KM1 and KM2 are indicated as KM 1.
- Y indicates the joint number **eg.** The weld joint number between KM0 and KM1 are indicated as KM 0/T1, KM 0/T2 etc.
- A & B are Root, Hot pass & Filler-1 welder ID numbers
- G & H are Filler & Capping welder ID numbers

Where pipe ends are cut :

All pipe cutting including cutback, damaged bevel ends shall be reported and revised pipe numbers allocated to each cut pipe (pup). The revision takes the form of a suffix A, B, C etc eg. Pipe No 5003 cut into three piece. Pieces shall be denoted as 5003 A, 5003 B and 5003 C. The revised pup's numbers shall be transferred inside & outside surface of the pups before cutting.

Illustration for welder numbers:

A – C - E – G ——12 – 6 – 6 o'clock position

B – D – F – H 12 – 9 - 6 Anti Clock position

Where A, B, C, D, E, F, G, H are respective welders ID numbers Clock position shall be visualized with a person facing higher chainage and with his back towards lower chainage. (Flow Direction)All the numbers shall be written with yellow chalk facing towards ROW side and afterwards by yellow / white / red paint. Such paint shall be to the satisfaction of client.

6. RADIOGRAPHY (GAMMA RAY)/ ULTRASONIC TESTING

1.PURPOSE :
This procedure is used to detect internal discontinuities of Girth welds in Cross Country pipeline. The discontinuities parallel to the scanning surface are the most ones favorably aligned for detection.

2. SCOPE:

This is specific procedure which describes Examination of weld of pipelines, by using Ultrasonic Flaw Detector with pulse echo contact beam method, for thickness 5 mm and above. This procedure is useful for examination of welds of single wall of pipes of diameter 6" and above.

3. REFERENCE DOCUMENTS:

ASME Sec. V

API 1104

J.P.KENNY SPEC.

4. PERSONAL QUALIFICATION:
The qualification of the NDT inspector to carry out this testing shall be minimum ASNT Level II & or Company's level II in accordance with Company's Written Practice WP/SI/001 which is in accordance to ASNT SNT TC 1A & / ANSI CP 189. Documents of NDT personnel as require to SGL/ JPKT for review & approval.

5. EQUIPMENT & ACCESSORIES :

Suitable Miniature and Large Probes

(Normal Probe, TR Probe, Angle Probes of (60^0 & 70^0)

Matching Cables

Couplant – Oil/ Water

Drawing & Gauging Tools

- **STANDARD & REFERENCE BLOCKS:**

I.I.W V1 AND / OR I.W .V2 sample block, or the, Step wedge,

Notch Block for D.A.C. as shown in figure 1b.

- **CALIBRATION OF ULTRASONIC FLAW DETECTOR :**

The calibration of the UFD shall be carried out in accordance with specific written procedure for its vertical & horizontal linearity once in every six months or after repair of UFD whichever is earlier. Or as per API 1104.

In addition, Amplitude control corrections, Beam spread, index point, Beam angle and Resolution will be checked and the type, Method and frequency will be as per approved procedure for weld scanning and lamination check.

9. SURFACE CONDITION:

The surface with which the probe comes into contact shall be free of metal spatter, dirt, rust and scales of any type, and the scanning surface shall be clean. Surface shall be smooth to carry out effective test for atleast 50mm wide on both sides of the weld. Any how the cleaned strip must be atleast wide enough to allow 1 ½ Skip Examination. If surface is not smooth as reference block, dB correction shall be done.

PROBE SELECTION:

The combination of probes in addition to normal probes shall be selected as per specific requirement or as per thickness of the pipe

THICKNESS RANGES	PROBES COMBINATIONS
5 mm to 10mm	TR 60^0 & 70^0
10 mm to 20mm	60^0 & 70^0

SCANNING:

Hundred percent area shall be scanned by all selected probes both side of the welds using longitudinal and shear wave probes adding +6 db. Length of scanning shall be minimum of ½ Beam Path to 1 ½ Beam Path on the both side of weld. See figure 2.

In case of only parent metal inspection, normal /TR scanning shall be carried out.

12. PROCEDURE:

Unless otherwise specified inspect the weld on both side by using longitudinal and shear wave probes.

LONGITUDINAL WAVE PROBE:

With reference to first back wall echo 80% ± 5% scanning shall be carried out before and after weld on base metal to confirm any inherent or after weld discontinuity. During scanning with longitudinal wave probe, full contact and echo height shall be maintained. Area of scanning shall be at least ½ Beam Path to 1 ½ Beam Path on the both side of pipe weld. This scanning will reveal discontinuity with major surface parallel to scanning surface.

SHEAR WAVE PROBE:

With respect to DAC, scanning shall be carried out on both sides of weld to determine discontinuity within the weld & base metal, which are not parallel to scanning surface. Both the probes shall be scanned individually on both the side. Scanning shall cover at least ½ Beam Path to 1 ½ Beam Path of beam path. Unless & otherwise specified, circumferential direction scanning shall be carried out on base metal.

13. PERIODIC CHECK OF SCREEN CALIBRATION:

Calibration of screen shall be checked prior to any inspection run, prior equipment shut down and at least in each 4 hours during continuous equipment operation.

14 INTERPRETATIONS OF RESULTS:

Each time that echoes from the weld bead appear during production testing the instrument amplification shall be altered to coincide with the reference (after reducing 6 db)

amplifications and the probe shall be moved until maximum response is obtained, paying attention all the time to the probe tube coupling.

If, under these conditions, the height of the defect echo is equal to or greater than that of the reference echo, the defect shall be evaluated according to the TECPL's specification. If the defect has also been detected by Radiographic and or visual Examination, the dimensions shall be judged according to the type of Examination, which detects the greater defect. Echoes that are less than 50% but lower than 100% of the reference echo, and if the operator has good reasons to suspect that the returns are caused by unfavorably oriented cracks, he shall inform the Contractor/Consultant. Moreover, when there is a defect to be repaired, such defect shall be removed for a length, corresponding to the one where no more return echo is given.

All indications that are equal to or greater than rejection level, established during calibration, as described in acceptance / rejection criteria agreed by client's inspector, shall be considered representing defects and may be cause of rejection or repair of the weld or base metal.

15. ACCEPTANCE OR REJECTION CRITERIA:

Acceptance or rejection criteria shall be in accordance with API 1104 or client's as per specified in client's specification. All defect location shall be marked & / or recorded for repairing.

16. RETEST:

Retest of the repaired area shall be carried out in accordance this procedure.

17. REPORTING:

All details of inspection and results of inspection shall be documented in Report Format No. 4.9 F003 and shall be signed by NDT inspector and client's representative.

WELD REPAIR METHOD:

A. Equipment

(i) DG Sets

(ii) Gas Burner

(iii) Welding Generator

(iv) Grinding M/c

B .Location

With respect to radiography or other NDT method, the location will be marked on the weld with reference to marking of ref. Points (markers).

c. Method of evaluation: -

1) Partial repair:
Each layer will be thoROWghly checked for this type of discontinuity shown in NDT reports. Smooth grinding will be done to make 'V' Groove and clean all surfaces. Only one attempt at repair of any region is permitted. Repairs are limited to maximum 30% of the weld length. For internal repairs or external repairs which open the weld root, Only 20% of the weld length may be repaired. The minimum length of a repaired shall be cut out and rebevelled to make joint.

The repair weld shall be subjected, as a minimum requirement to the same testing and inspection requirements as the original weld, The entire joint shall be re-radio graphed. A 100% ultrasonic inspection shall be done at the repaired area externally. Any repaired area that is wide, irregular or ROWgh shall be rejected and full cut out shall be done. The repair welding shall have a minimum preheat of 100°c and shall be preheated for at least 150 mm on either side of repair.

Root sealing or single pass repair deposit shall not he allowed. Internal root defects shall be gROWnd thoROWghly and welded with a minimum of two passes. However, while grinding for repair, care shall be taken to ensure that no grinding marks are made on the pipe surface anywhere.

2) ThROWgh repair

Grinding will be done up to the root, opening will be done by chisel, hacksaw blade. The entire vol., will be gROWnd smoothly to 'V' groove, root gap will be achieved using blades, thin grinding wheels and filing. Max. repair length is 20% of weld.

D. Welding

After identifying the defects the repair of weld shall be carried out in accordance with approved WPS and PQR. Care shall be taken to ensure that no grinding marks are made on pipe surface anywhere. Repair weld deposition shall be smooth, free from cuts and other

surface irregularities. The root gap shall be made carefully and shall confirm to the welding procedure. The welded area shall be thoROWghly cleared. Any repaired area that is irregular shall be rejected and a full cut out and re-beveled to make a joint. Repairs opening the root shall be carried out in the presence of experienced Supervisor. All repairs shall be carried out during the day after initial radiography. The reports of all repairs shall be maintained by CIPL and shall be submitted every day to SGS/JPKT for review. CIPL shall identify the welders giving repairs more than acceptable limit and that particular welder shall be warned by CIPL.

In case the percentage of repairs is not reduced within acceptable limits after issuing one warning welder shall be rejected by Contractor and shall maintain records.

e) Cleaning- Each pass will be thoROWghly cleaned using power brush / grinding mated

f) No. of Welders-Qualified welder for the appropriate process, consumable and direction alone will be envisaged. Welding carried out in accordance with approved PQR.

g) Parameters-As per WPS & PQR (approved)

h) NDT

i) Radiographic inspection covering the repair welds length.

ii) UT at the repair joint.

i) No. of attempts for repairing: one

7. FIELD JOINT COATING

Field joint coatings are carried out using Heat Shrinkable Sleeves.

Reference Code

DIN-30672-1991: Coating of Corrosion Protection Tapes & Heat Shrinking Products for

Pipelines - Operational Temperatures up to 50° C.

Materials

Heat shrinkable wrapaROWnd sleeve consists of radiation cross-linked, thermally stabilized ultraviolet resistant semi-rigid polyolefin backing with a uniform thickness of high shear strength thermoplastic/copolymer hot melt adhesive. The joint coating system may consist of a solvent free epoxy primer applied to the pipe surface prior to sleeve application. The backing is coated with thermo chrome paint which will change color when the desired heat during shrinking is attained. The wrapaROWnd sleeve is supplied in pre-cut sizes to suit the pipe diameter and the requirements of overlap. The thickness of field joint coating material is such that an average thickness of 2.0 mm is guaranteed on the complete finished field joint coating.

Field Joint Coating procedure

1. Surface Preparation-Oil, grease, salts and other contamination are removed from steel surface by wiping with rags soaked with suitable solvents such as naphtha or benzene. Solvent cleaning procedure is in accordance with SSPC-SP 1.

1) Surface is then blast cleaned to a finish equivalent to SA 2½ of Swedish Standard SIS-055900. The ends of existing pipe protective coating are inspected and chamfered prior to application and cleaned as necessary.Joint coating shall be applied immediately after completion of surface preparation

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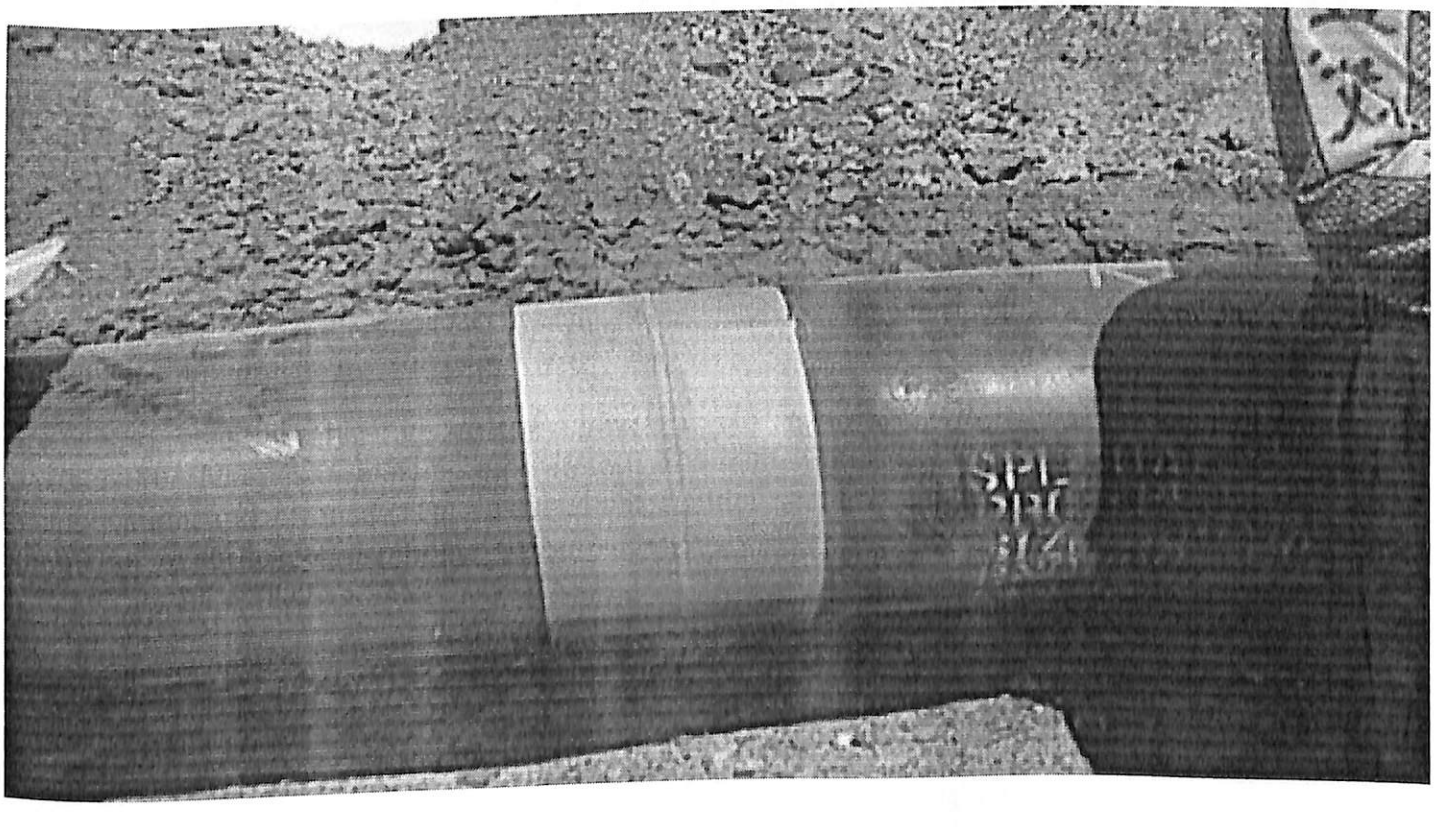
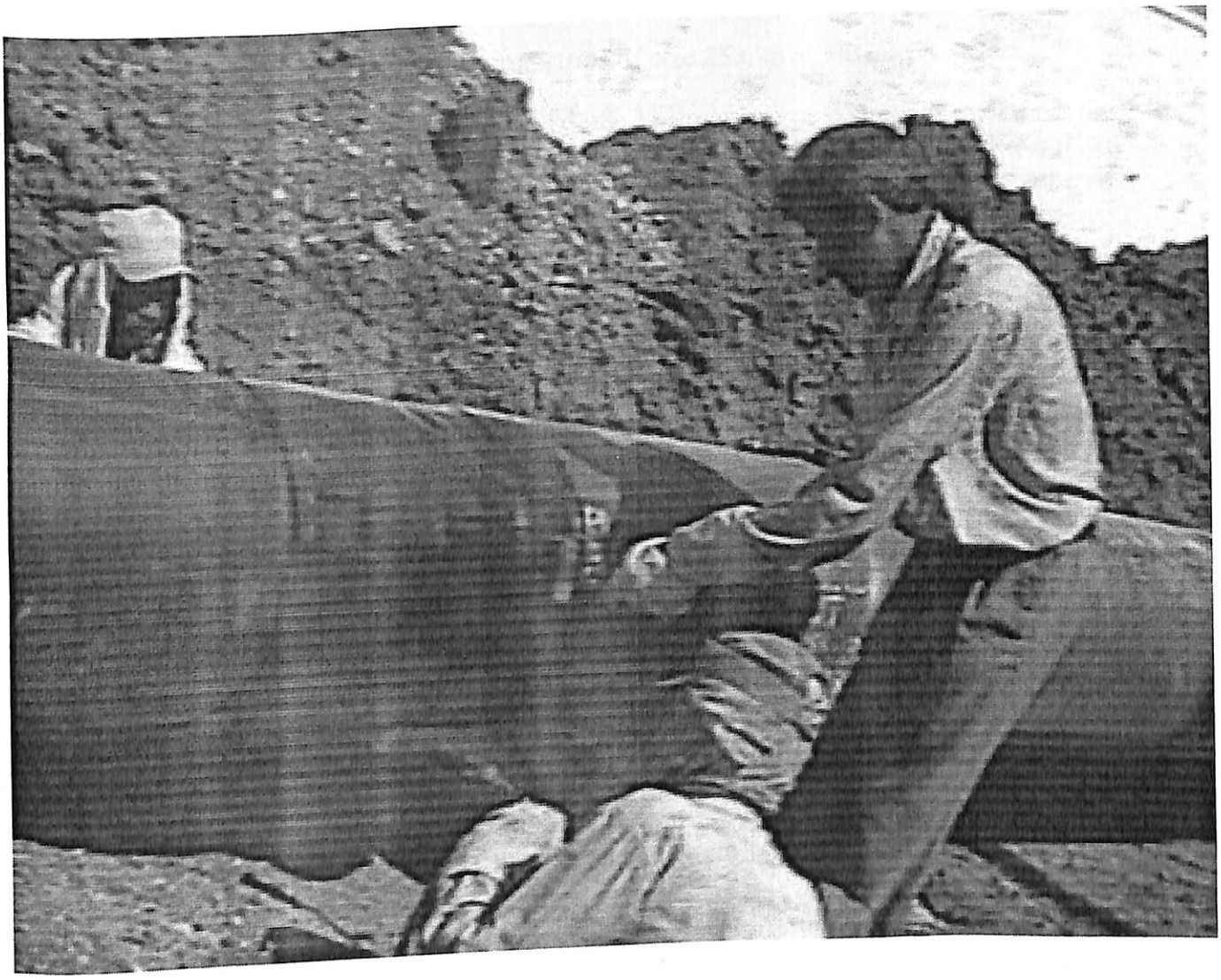


2) Application of Joint Coating

The wrap aROWnd sleeve of size such that a minimum overlap of 100 mm is ensured (after shrinking) on both sides of the yard applied corrosion coating of pipe is selected. Before

centering the wrapaROWnd sleeve, the bare steel surface shall be preheated over the surface to remove the moisture. The minimum preheat temperature as recommended by the manufacturer and shall be checked by means of pyrometer or temperature crayons. The solvent free epoxy primer (if applicable) is applied prior to sleeve application. The wrapaROWnd sleeve is then entirely wrapped aROWnd the pipe positioning the closure patch off to one side of the pipe in 10 o'clock or 2 o'clock position, and the edge of the undergoing layer facing upward. A heat shrinking procedure is applied to shrink the sleeve in a manner such that all entrapped air is removed using gloved hands and hand rollers. Heating is carried out until the thermo chrome paint has completely changed its color. Resulting coating must be free of wrinkles, cold spots and weld profile visible on the sleeve.



3) Inspection

A visual inspection is carried out for the following:

- Mastic extrusion on either ends of the sleeve.

- Punctures or pinholes or bend failure. The external appearance of the sleeve shall be smooth, free of dimples, air entrapment or void formation.

- Weld bead profile shall be visible thROWgh the sleeve.

-The entire closure patch shall have changed color uniformly.

Holiday Inspection: The entire surface of the joint section is inspected by

a full circle holiday detector after the joint has cooled below 50°C.

4) Testing from each test sleeve, one or more strips of size 25 mm x 200 mm is cut

Perpendicular to the pipe axis and slowly peeled off. The required peel strength shall meet the requirements of DIN 30672 as applicable for 23 °C or 50°C. For qualification, peel test must be carried at 23 °C or 50°C.After removal of strip the bulk of adhesive shall remain adhered to the pipe showing no bare metal, otherwise, test is considered to have failed.The adhesive layer that remains on the pipe surface shall be free of voids resulting from air or gas inclusion

8. TRENCHING After stringing the pipe sections in place, a trench is dug along the ROW 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 nonworking 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 31.8, 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 crossings. 6. Topsoil strip

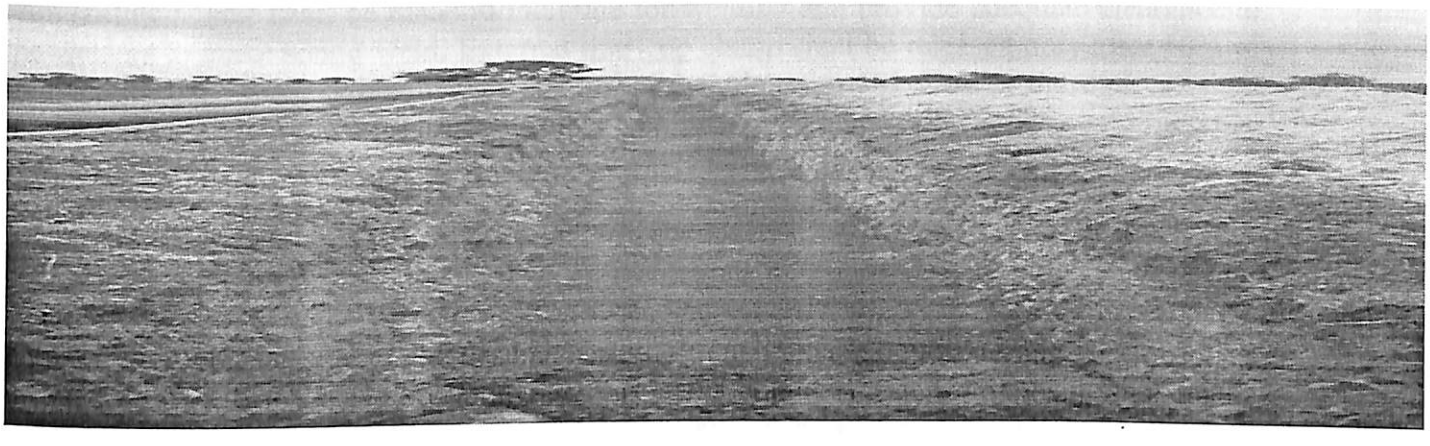
In areas where rock is confirmed as such by the initial gROWnd investigation works then the trench is excavated ahead of any pipe operations. This sequence of working is undertaken to ensure that the excavation of the trench cannot cause any damage to the pipe and/or pipe coating and provide an extended safe working width for the excavation crews allowing double-sided trench working by excavators/ breakers.

These are

(i) utilizing standard excavation,
(ii) larger more powerful excavators (face shovels converted to back-actors),
(iii) ripping/hydraulic hammer and excavation,
(iv) blasting/hydraulic hammer and excavation and
(v) Rock trenchers (saw and blade).

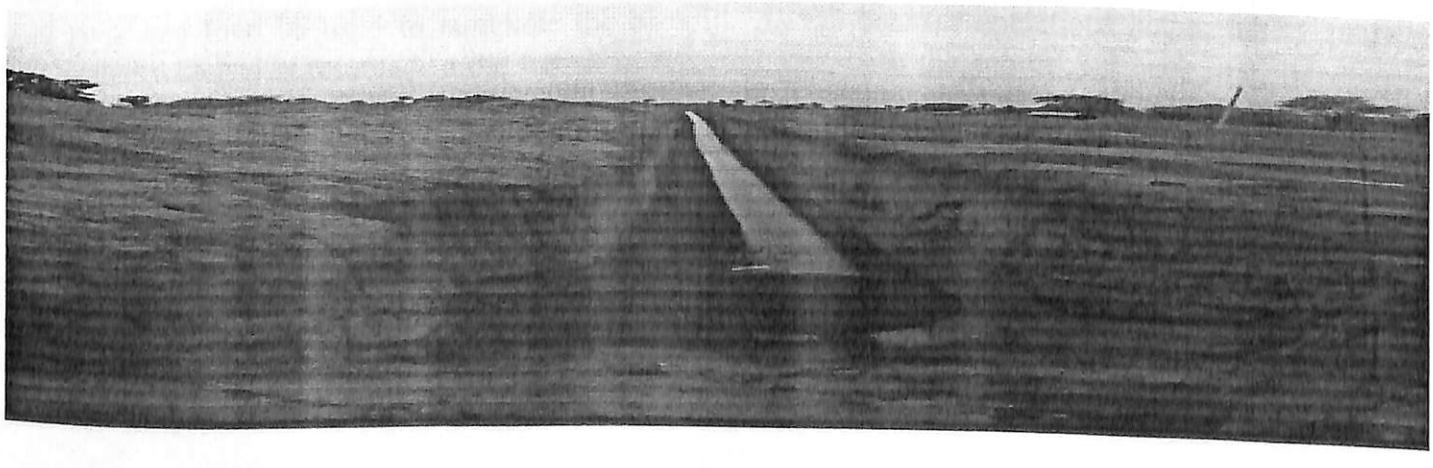
Topsoil strip operations commences after cut-off drainage operations and is scheduled to allow adequate time for completion of the drainage works in the event that unforeseen obstacles or circumstances are highlighted during the execution of the drainage installation operations. The topsoil operation consists of 1 crew with plant comprising up to 8 excavators/ bulldozers removing the topsoil to its full depth (typically, = 300mm) and storing in a single

stack on the opposite side of the easement to the trench excavation material. The topsoil is stripped with 2 to 3 excavators along the easement boundary on the opposite side to the topsoil stack area.



9. LOWERING THE PIPE

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 sidebooms 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.



10. TIE IN JOINTS

All work shall be carried out as per specification No. 11-0234-02-P-01-002/-011 -Rev-0, API 1104, ANSI 31.8, ASME Sec IIC and Approved WPS / PQR.

Tie - In shall be made in such ways that without including excessive stresses in the steel, small displacement necessary for perfect alignment and connection at the ends. Bell Holes with sufficient size shall be made to facilitate for welding and provide adequate clearance to the welders to make sound weld. External line - up clamp shall be released only after 60% of root weld. Pipe pup piece length for Tie- In shall be minimum 1M. Two or more pieces shall not be welded together. In no case more than 3 Cir. Seam welds shall be permitted on a 8M length of pipe.

Tie in welds shall be completed with out delays shall not be left incomplete over night.

In case cutting pipe end ultrasonic inspection shall be done for lamination / checking before welding of tie-in joint.

For Tie- In at already hydro-tested sections, the pre-tested pup pieces shall be used.

Welded joints which are welded using external clamps(e.g. tie-ins welds) shall be 100% tested by ultrasonic & Radiography testing with X or Gamma rays shall be carried out in accordance with the provisions of API 1104.

The mechanical cleaning must be continued to at least 10 Cm beyond the existing intact coating, in such a way that all dirt is removed and the coating is ROWghened to ensure good adhesion. The intact coating shall be chamfered at the extremities to an angle of 15^0 to 30^0 in order to form a perfect joint.

11. BACKFILLING THE TRENCH

Once the pipeline is lowered into the gROWnd, 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 gROWnd 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 bROWght 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

INSTALLING VALVES AND SPECIAL FITTINGS

Sectionalizing valves, tees and other connections are installed as the pipeline is constructed

12. TESTING

Construction Activity testing and commissioning

The pipeline operations consist of hydrostatic testing, pre-commissioning and commissioning of the pipeline. The last two activities are considered outside the scope of main pipeline construction activities and, as such, are not discussed further

A. Hydrostatic testing

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.

The first task in testing is to establish the number of test sections required for the pipeline. This is determined based on:

- Availability of suitable water and location of sources
- Location of suitable disposal sites for test water
- Variation in altitude which affects the actual test pressure and allowable hoop stress
- length of section, which should be based on a risk assessment on the effect the

  Considerable volumes of water, following a failure, could have on the local environment at any sensitive area

Under normal circumstances, test sections are limited by 100-metre change in altitude and 100km in length.

It may be that, due to conservation or supply difficulties, water will have to be transferred from one test section to another along the pipeline. If this is the case then careful consideration of the installation programme should be undertaken with completion taking full account of water supply and disposal requirements. The transfer of test water from one section to another will be via hard (steel) pipe work so that no water is lost or spilled. As the water is transferred from one section to the next, it will be filtered and its chemical composition checked and modified as necessary.

In addition, it may be necessary to chemically treat the water to prevent biological growth in the water or inhibit oxidation of the internal pipe surface (rusting). The selection of

chemicals will be subject to very strict evaluation prior to the start of the hydrostatic testing and will be based on chemical and physical analysis of the water at the actual sources. The addition of the chemicals to the test water will be subject to close scrutiny and control and the water will be checked periodically to ensure that it remains within the specified compositional limits. An environmental permit will be obtained for all water abstraction and discharge associated with the hydrostatic test(s).

Temporary pig traps will be installed at both ends of the pipeline section to be tested. These traps will be fully certified for the proposed test pressures. The temporary equipment at the 'upstream' end of the test section (where the water will be introduced into the pipeline) includes, large volume/low pressure filling pumps, break or settling tank(s), low volume/high pressure testing pumps, chemical injection tanks and pumps, hard (steel) pipe work, compressors, temperature, pressure and volumetric flow instrumentation, pig traps, testing cabins, power supply generators, filters/filtration units, office and telecommunications facilities. Similar equipment will also be installed at the 'downstream' end although the type and amount will depend on whether the test water is being disposed of transferred to the next pipeline section.

All the temporary equipment needed for the hydrostatic testing operation will be fully certified for the test pressure(s) concerned and copies of the certificates will be available onsite for inspection prior to the start of the program..

Normally, the block valves will be tested in-line with the valves 'locked' open and any instrumentation disconnected for the testing operation.

Once a test section has been completed mechanically and is declared ready for testing, the temporary equipment will be installed at both ends of the section. The section will initially be pigged with a bi-directional swabbing pig propelled by air to ensure that all debris is removed from the line. The pipeline will then be filled with water utilizing a 2 possibly 3-pig train with, typically, a 500 metre long slug of water between the 1st, 2nd and 3rd pigs. The high volume/low pressure pumps will be used for this activity and the volume of water entering the pipeline will be controlled and measured to give a line fill rate of, say, 1km per hour.

It is normal practice (and sometimes a requirement of the relevant code) for one of the pigs to have an aluminum gauge plate attached to check for pipe ovality/dents. The gauge plate is circular and has a diameter equal to 95% of the internal pipe diameter (bore).

Once the line is filled it will be left to stand to allow the water temperature to equalize to the surROWnding gROWnd conditions; this is typically 3 to 5 days but, as expected, is extremely variable. Once the temperature is stable the test will commence with an initial rise in pressure to 35 bar to ensure that the air content is less then that required by the design code (normally 0.2%). The low volume/high pressure pumps are used to add this

water into the pipeline.

With the air content confirmed, the test pressurization continues to the test pressure at a steady rate of, typically, no faster than 1 bar per minute. Once the test pressure is reached it shall be held for the required time, which for this Project is likely to be 24 hours. During this 'hold' period, the pressure and temperature will be measured, monitored and recorded continuously.

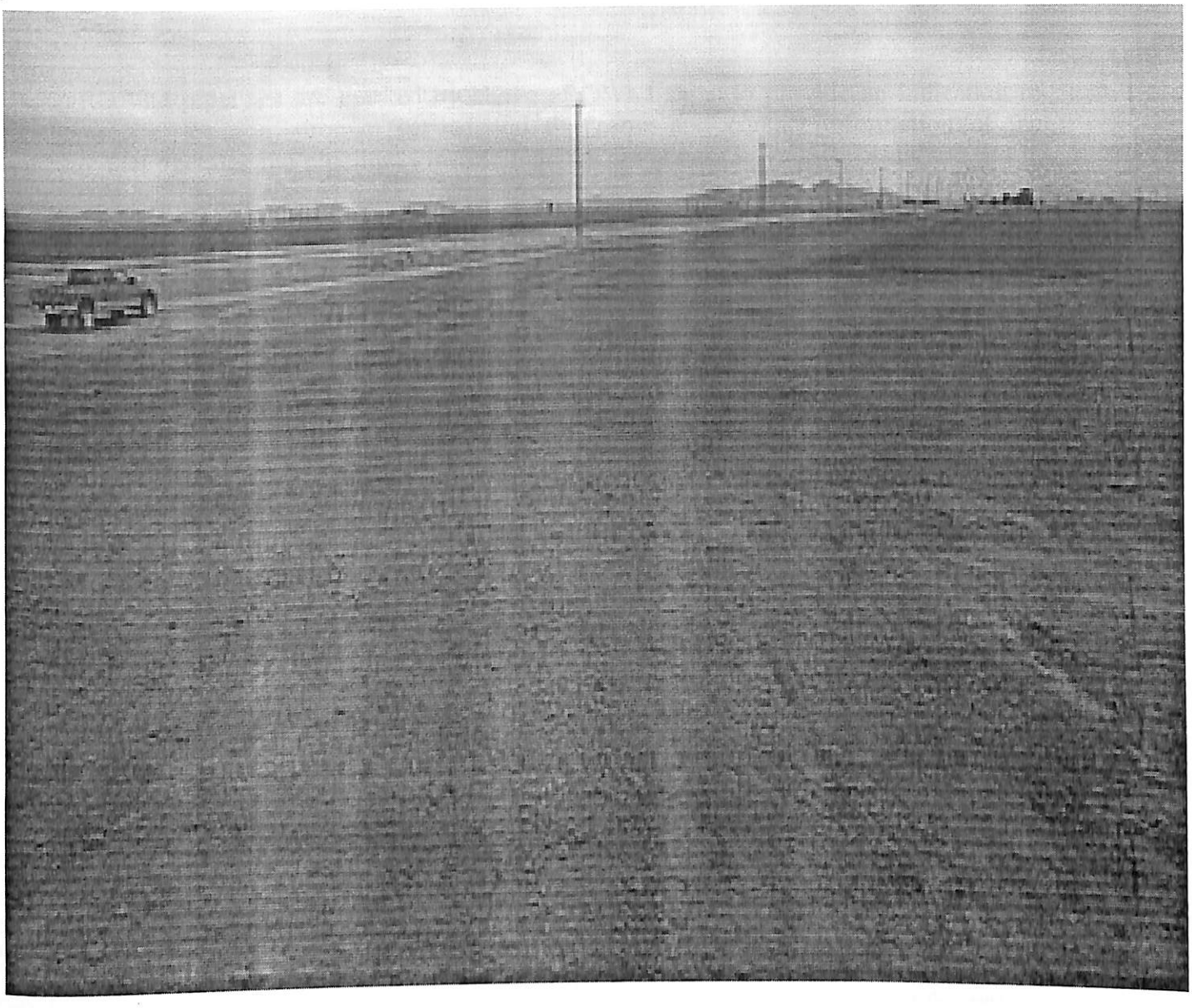
Small leaks during the testing operation can be difficult to detect and locate. A change in the water/pipe temperature may give the appearance of a leak. If the temperature of the pipe/water decreases, the test pressure decreases and vice versa for a rise in pie/water temperature. To prevent unnecessary concerns in this respect, the effects of temperature change on pressure can and will be pre-determined so that the integrity of the pipeline can be confirmed during the testing period.

On completion of the 'hold' period and successful acceptance of the test the water is removed from the pipeline by swabbing pigs propelled by dry/oil free compressed air. The water will either be sent an approved disposal site (evaporation pond/lagoon or river depending on water quality and chemical composition) or into the next test section via solid cross-over piping.

On completion of the initial de-watering, additional pigging runs will be carried out using a combination of swabbing and foam pigs to remove as much free water as possible from the pipeline. This sequence will continue with all other test sections. Once the dryness of two adjacent sections has been accepted, these sections will be tied-in by welding a short section of line pipe between them to form a complete pipeline between permanent pig traps sites.

13. CLEANING UP

Finally, the ROW 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, roads or other actions that may be necessary



14. KM MARKERS, ROW MARKERS, DIRECTION MARKERS, WARNING SIGNS

UndergROWnd pipelines are marked by above gROWnd 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 gROWnd 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. Below are examples of pipeline markers:

API 1109 for pipe line markers

Pipe line markers

S.No	Marker type	Minimum spacing requirement
1.	Km post	One marker at every 1 km
2.	Aerial marker	One marker at every 5 km
3.	Navigable water ways	One each on either bank of navigable water ways
4.	Boundary markers	One each side of boundary of ROW at 250 mtrs
5.	Warning sign	a. One on either side of Rail /Road
	National /State / Rail	b. One no. for width less then 15 mtrs
	Water /Nallah /Asphaltic metallic	c. Two nos on either side of crossing for width greater than 15 mtr and all cased crossing


WARNING
PETROLEUM
PIPELINE
Pipeline Company
WARNING
NATURAL GAS
PIPELINE
Pipeline Company
4

15. Facilities and pipeline

The main items consist of:

- Block valve sites
- Pumping stations
- Off take facilities
- Cathodic protection system
- SCADA and leak detection system
- Electrical power supply
- Telecommunications system
- Control centers

The work associated with these facilities and systems will, in the main, be carried out by separate contractors to the Pipeline Installation Contractor. However, all work involved with these facilities will be co-ordinate with main pipeline construction to ensure that the overall schedule for the project is achieved whilst optimizing in-country logistics and ensuring that the requisite HSE standards are maintained. It is not considered necessary to discuss these activities in detail as, to a large extent, they are carried out independently of the main pipeline construction.

REFERENCES:

1. **API 1104 WELDING PROCEDURE**
2. **J P KENNY SPECIFICATION**
3. **CORRTECH INTERNATIONAL PVT LTD. SPECIFICATION**
4. **ASME SEC V NDT PROCEDURE SPECIFICATION**