



**SIPI-Benin**

**TENDER FOR  
LAYING OF PE 100 PIPELINE AT  
COTONOU, BENIN OF WEST AFRICA**

**TENDER NO. - AIP/REPL/004/C-PE**



**RESONANCE ENERGY PVT. LTD.**

**VOLUME II OF II  
TECHNICAL VOLUME**

**INTERNATIONAL COMPETITIVE BIDDING**

0	10/08/2023	Issued for Bids	KM	VBS	AN
<b>Rev</b>	<b>Date</b>	<b>Description</b>	<b>Prepared by</b>	<b>Checked by</b>	<b>Approved by</b>



Laying of PE-100 Pipeline at Cotonou, Benin of West Africa



Resonance Energy

Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

S.N.	DESCRIPTION		REV NO.	PAGE NO
	TECHNICAL (VOLUME II OF II )		0	
1	PTS	INTRODUCTION	0	3-4
2	PTS	LAYING OF PE-100 SERVICE PIPELINE	0	5-26
3	PTS	ELECTROFUSION FOR PE PIPES & FITTINGS	0	27-34
4	PTS	HEALTH, SAFETY & ENVIRONMENT	0	35-51
5	PTS	WARNING MAT	0	52-56
6	GTS	PE ACCESSORIES FOR UNDERGROUND NETWORK FOR NATURAL GAS DISTRIBUTION	0	57-78
7	GTS	PE COMPOUNDS FOR MANUFACTURE OF PIPES AND FITTINGS FOR UNDERGROUND NETWORKS FOR NATURAL GAS DISTRIBUTION - ACCEPTANCE PROCEDURE	0	79-88
8	GTS	PE VALVES FOR NATURAL GAS DISTRIBUTION UNDERGROUND NETWORK	0	89-106
9	STANDARD / PROJECT DRAWING		0	-
9.1	TYPICAL DETAILS OF BARRICADING		0	-
9.2	TYPICAL DETAILS OF CAUTION BOARD		0	-
9.3	TYPICAL UNDERGROUND CABLE CROSSING DETAILS		0	-
9.4	ROAD/HIGHWAY CASED CROSSING FOR PE-100 PIPE		0	-
9.5	BRICK VALVE CHAMBER		0	-
9.6	RCC VALVE CHAMBER		0	-
9.7	POLE MARKER		0	-



## Laying of PE-100 Pipeline at Cotonou, Benin of West Africa



Resonance Energy

Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

### **1.0 INTRODUCTION**

- 1.1** Glo-Djigbe Industrial Zone is being developed as multi-product Industrial Zone in accordance with the vision of republic of Benin to create mass employment opportunities for its population and hence created by Decree N° 2020 - 062 DU 05 Fevrier 2020 of Republic of Benin to promote Transformation of Agro-commodities produced in Benin.
- 1.2** Glo-Djigbe Industrial Zone (GDIZ) is a dedicated Zone developed by “Société d’Investissement et de Promotion de L’Industrie – BENIN” (SIPI-BENIN),
- 1.3** SIPI -Benin is jointly promoted by ARISE IIP (Africa Transformation and Industrialization Fund-ATIF) & Africa Finance Corporation (AFC) & Republic of Benin having equity stake of 65% and 35% respectively in the project. At present ARISE IIP made special economic zones in Gabon, Benin and Togo seek to boost exports, enable the local transformation of raw materials and promote trade. Several industrial zones are currently being developed in Togo, Benin, Côte d'Ivoire and Chad.
- 1.4** SIPI-Benin (hereinafter referred as OWNER) is developing gas infrastructure to supply Piped Natural Gas (PNG) to Industrial consumers at Cotonou, Benin of West Africa.
- 1.5** Resonance Energy Pvt. Ltd. (REPL) has been appointed as the Project Management Consultant by the OWNER for providing consultancy services for CGD Expansion Project at Benin of West Africa.



Laying of PE Pipe at Cotonou, Benin of West Africa



Resonance Energy

Tender Document No:  
A IIP /REPL/003/PEL

Date: 10/08/2023

2.0 PTS - LAYING OF PE-100 SERVICE PIPELINE

TABLE OF CONTENTS

1.0 GENERAL INFORMATION .....

2.0 DEFINITIONS .....

3.0 SCOPE OF WORK.....

4.0 MATERIAL, MANPOWER, EQUIPMENT AND MACHINERY .....

5.0 PROGRESS OF WORK.....

6.0 CO-ORDINATION/LIAISON FOR PIPELINE LAYING .....

7.0 REFERENCE SPECIFICATION, CODES AND STANDARD .....

8.0 QUALITY OF WORK .....

9.0 SAFETY.....

10.0 ROUTE SURVEY .....

11.0 ORGANISATION STRUCTURE .....

12.0 STRUCTURES, SERVICES AND OTHER PROPERTY .....

13.0 TRENCHING .....

14.0 LAYING.....

15.0 JOINTING OF POLYETHYLENE PIPE .....

16.0 BACKFILLING .....

17.0 TRENCHLESS LAYING.....

18.0 RESTORATION .....

19.0 TESTING.....

20.0 PURGING.....

21.0 VALVE CHAMBERS.....

22.0 MARKERS .....

23.0 ASSISTANCE IN COMMISSIONING.....

24.0 STANDARD OF WORK.....

25.0 RECORDING (AS-BUILT DRAWINGS) .....

26.0 CIVIL WORKS.....



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

### 1.0 GENERAL INFORMATION

- 1.1 SIPI-Benin is developing gas infrastructure to supply Piped Natural Gas (PNG) to Industrial consumers at Cotonou, Benin of West Africa. OWNER is seeking Contractors to assist in meeting the above objective.
- 1.2 The main scope of this Specification comprises of laying of underground Polyethylene (PE-100) service pipeline. The scope covers all the activities associated with the purchasing (specified items only), laying, testing, and commissioning of PE service pipelines in new gas charged areas of sizes ranging from 32 mm upto 180mm OD, which includes PE/GI transition fitting above ground level.
- 1.3 This technical specification defines the basic guidelines to develop an acceptable design and suitable construction methodology for carrying out different activities listed out in the schedule of rates of this tender.
- 1.4 Compliance with these specifications and / or approval of any of the Contractor's documents shall in no case relieve the Contractor of his contractual obligations.

### 2.0 DEFINITIONS

Owner	SIPI-BENIN
PMC	Resonance Energy Pvt. Ltd.,
PTS	Present <<Particular Technical Specification>>and its entire appendix, if any.
TPIA	Third Party Inspection Agency
EIC	Engineer – in – charge

### 3.0 SCOPE OF WORK

Generally, the following shall constitute the Contractor's scope of work but not limited to:

- 3.1 Plan and prepare a schedule for execution and work implementation as per QA/QC plans to be issued by OWNER/PMC. Contractor has to submit the Construction/Execution procedures before commencement of work to OWNER/PMC for approval.
- 3.2 Prior to start of construction activity, contractor shall carry out the route survey and prepare the approval for construction (AFC) drawings marked for proposed gas pipeline laying and submit to OWNER/PMC for approval.
- 3.3 ROW is in owners premises and if any statutory compliances are required shall be arranged by the OWNER.
- 3.4 Transportation of Free Issue material Pipe from OWNER stores to contractor stores and proper storing, stacking, providing security, insurance cover during transportation and storage, laying, commissioning, and handing over pipelines to owner.
- 3.5 Obtaining the approval for optimum route and ROU from the EIC.
- 3.6 Intimation to the parallel utilities (Electrical/Communication/Water) owners and making trial pits to determine the underground utilities/services such as existing pipelines, cables (electrical/communication), conduits, U/G drainage, Sewers, tunnels, subways foundations etc. for deciding optimum feasible route and depths for laying the pipelines based on the route plans indicated by owner.
- 3.7 Wherever required the grass/turfing, pavement, linings, drains, roads and other such concrete area shall be locally removed to facilitate trenching and pipe laying works. The same is to be reinstated as original.
- 3.8 Installation of safety/warning signs and barricading of the entire route to be trenched. Pits to be similarly barricaded along with warning signs and caution boards.
- 3.9 To make trenches with stable slopes but restricting minimum disturbance to above ground/underground services/installation as per specifications and approved route plans keeping the trenches free from water and



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

soil till placement of pipes.

- 3.10** Storage of PE-100 pipe as per approval of the Engineer In charge (EIC).
- 3.11** Uncoiling/stringing the PE-100 pipes of required sizes pipes into trenches as per approved procedure.
- 3.12** Joining the pipe ends with fittings/valves by approved automated electro-fusion techniques only as per tender specification.
- 3.13** Use of necessary electrofusion welding tools is mandatory – (alignment clamps, restraining clams, tee-elbow jointing clamps) as per GIS standard.
- 3.14** Electrofusion welding to be carried by qualified welders with proper certification and experience.
- 3.15** Installation of PE-100 pipe fittings like Elbow, Tees, Reducers, Couplers, Tapping saddles, Transition fittings, Valves and Sleeves etc. Including construction of supports, etc. as per specification, drawing & satisfaction of the Engineer In charge (EIC).
- 3.16** Laying pipelines by any methodology including trench less technology methods with or without casing pipes (HDPE pipes) as per specifications and as directed by EIC.
- 3.17** Fabrication, supply and inspection of approved quality GI sleeve, HDPE duct and half concrete sleeves and other material, fittings to be supplied by the contractors as per the provisions of tender.
- 3.18** Back filling and compacting by jumping jack compactor wherever required, using approved 'good' soil or using excavated earth or borrow earth as per requirement and specifications and replacement of the tiles, slabs removed during the excavation. Cleaning all unserviceable materials, debris, excess earth trenches etc. to designated disposal area.
- 3.19** Carrying out pneumatic testing and purging as per specifications and approved procedures, providing all tools & tackles, instruments, manpower and other related accessories for carrying out the testing of pipes.
- 3.20** Supply, fabrication & installation of Plate markers etc. as per the directions of the OWNER/PMC.
- 3.21** Nitrogen purging (including supply), commissioning and gas charging in the tested PE line shall be done as per the approved procedure.
- 3.22** Restoration of existing ground features such as grass/turfing, paving, roads, drains, concrete, floral beds, fencing, tiles, marbles, flooring masonry etc. to original condition and to match with adjoining conditions, functionally and aesthetically up to the entire satisfaction of OWNER/PMC/any other third-party agency designated by owner and local authorities, failing which, it will be done at the risk and cost of the contractor. Obtaining No Objection Certificates for the restoration work done from the concerned authorities.
- 3.23** Returning surplus material to Owner stores after obtaining clearance from OWNER/PMC/TPIA, reconciliation of free issue material/consumables.
- 3.24** Handing over the completed works to owner along with detailed as built drawing showing pipeline route, fittings provided in the pipelines, for their operation purposes.
- 3.25** Maintaining the completed pipelines/installation for any failure and defect arising due to poor workmanship during defect liability period.
- 3.26** Preparation and submission of all documents like as graph, As-built drawings, details of crossings, utility graphs, measurement sheet, PE cards for service line and deviation statements on completion/commissioning of work by way of drawing, sketches, and tables in soft & hard copy.
- 3.27** Providing adequate manpower, tools, tackles, equipment for achieving the target of pipeline laying, data logging for pipeline, valves, and fittings inventory status, attending complaints, day to day interaction with customers and residents so that work can be executed within defined time period.
- 3.28** Following activities are also in contractor's scope:
- 3.29** Receive Customer's complaints logged during PE-100 Laying.
- 3.30** Attend and carry out joint technical feasibility survey for requests and resolve the complaint.
- 3.31** Maintain and update the complaint status.



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

**3.32** Any other activities not mentioned/covered explicitly above, but otherwise required for satisfactory completion/operation/ safety/ statutory/ maintenance of the works shall also be covered under the Scope of work and has to be completed by the Contractor within specified schedule at no extra cost to Owner.

### **4.0 MATERIAL, MANPOWER, EQUIPMENT AND MACHINERY**

#### **4.1 Material, Procurement and Supply**

##### **Material to be Supplied by Owner as Free Issue**

**4.2** Unless otherwise specified, Owner will only supply following material.

(i) PE-100 – pipes, (ii) electrofusion fittings, and (iii) PE valves.

All materials other than specified size Carrier Pipe shall be supplied by contractor as per attached technical specification to complete the laying of gas service pipelines.

**4.3** The free issue material shall not be procured from any other source by contractor.

**4.4** Material reconciliation statement of free issue material duly certified by Owner and PMC shall be submitted to OWNER on monthly basis.

**4.5 Material to be supplied by the contractor:** The supply of items as indicated in SOR shall be strictly as per relevant Technical Specifications enclosed with the Tender and as per guidelines of various clauses of SCC and SOR. All materials shall be handled safely and stored in a permanent, covered, lockable store/ warehouse preferably near site in such a manner as to prevent any damage to the materials from scratching, gouging, indentation, excessive heat or by contact with any sharp objects or chemicals. The PE-100 pipes and fittings shall be stored in covered storage to protect material from sunshine, rain etc.

#### **4.6 Backfilling material**

The Contractor shall be responsible to arrange the supply of approved coarse sand (size 0.6 – 2 mm) free from any impurities like clay, mica, and soft flaky pieces, as per the instructions of OWNER/PMC. For supply of sand in trench for rocky terrain, no separate charges are payable.

**4.7** In case specified trench depths are not achieved & if directed by Engineer-In Charge Contractor has to provide concrete casing pipes / slabs or cement concrete, without any cost implication to Owner.

**4.8 Other Materials :**The Contractor shall supply the following items wherever required:

- All materials required for framework, trench support and temporary trench crossings.
- All sign boards, barricades, tin sheets, lighting arrangement and protective equipment.
- Supply of warning mat shall be in vendor scope.
- All minor items not mentioned in the Contract but necessary for the satisfactory completion and performance of the Work under this Contract.
- GI/ Half Round Concrete Sleeves.

#### **4.9 Manpower**

The Contractor shall provide the skilled labour, tools, material, and equipment necessary for the proper execution of the Work.

#### **4.10 Equipment, Machinery & Tools**

This will include but is not limited to the list of specialized items included in Annexure # 1.

All vehicular type machinery shall be in good working order and shall not cause spillage of oil or grease. To avoid damage to paved surfaces, the Contractor will provide pads of timber or thick rubber under the hydraulic feet or outriggers of machinery.



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

Contractor must also have to arrange his own equipment for restoration work like water tanker and jumping jack compactor for compaction of backfilled trenches and roller and other required equipment/ machinery for asphaltting/ road works.

**In case there is non-availability of approved equipment, tools and tackles during the work at site, the work could not be allowed by EIC and other conditions, as per commercial tender document, will be levied and deducted from the running bills.**

### 4.11 Acquisition, Receipt & Storage of Materials

The Contractor shall collect all free issue materials from OWNER during stores/other specified locations in working hours following all documentation procedures laid down and as directed by the EIC. The Contractor shall carry pipe in such a manner as to preclude damage during transportation and handling. PE pipes supplied in straight lengths may be carried in straight pipe racks.

The Contractor shall at the time of receipt of material physically examine all materials and notify the EIC immediately of any damage or defect noticed by the Contractor. The EIC shall duly note any damage or defect in a site instruction book and both parties shall countersign the entry. Any damage not so recorded will be deemed not to have existed at the time of receipt of material by the Contractor and the cost of repair or replacement or rectification shall be borne by the Contractor. Any material once issued from OWNER store, if found in non-working condition at site shall be brought to the notice of EIC with PO reference in written within 15 days and after subsequent approval shall return defective material in OWNER stores within 30 days.

If delay is more than 30 days and material is under warranty, the material will be accepted as per the tender document, else the material will not be reconciled and amount of the same will be deducted from bills and same shall be levied as per SCC. The contractor shall ensure that no defective material will be returned to store at the time of closure of contract. The format for defective materials returning to stores will be made available by EIC.

The contractor shall maintain permanent locked store preferably near site so that all the materials are stored in such a manner so as to prevent any damage to the materials from scratching, gouging, indentation, excessive heat or by contact with any sharp objects or chemicals. The PE pipes and fittings shall be stored in covered storage to protect material from sunshine, rain etc.

**The Contractor shall maintain logbook at their respective stores stating issue and availability of free issue material at a given day. Further, it is mandatory that the contractor is required to undertake and submit inventory details of free issue and purchased materials on monthly basis to OWNER / PMC as per the approved format of the owner. The inventory details shall be in correlation with the Daily progress chart and material reconciliation sheet.**

**The material reconciliation shall be submitted on first week of every month to the EIC.**

### 5.0 PROGRESS OF WORK

The contractor shall proceed with the work under the contract with due expedition and without delay. The EIC may direct in what order and at what time, the various stages or parts of the work under the Contract shall be performed. Contractor has to regularly submit daily progress reports, weekly progress reports, graphs with utilities, testing reports, material consumption and inventory reports, deviation statements, completion schedule etc.

### 6.0 CO-ORDINATION FOR PIPELINE LAYING

Contractor has to CO-ORDINATE after receipt of permissions. Applying and receiving of Permission are in scope of Client. Liasioning shall be carried out by the contractor in the interest of Project. No extra payment shall be made.

To ensure smooth execution of the work on a day-do-day basis, the contractor has to liaison with respective authorities. The contractor shall plan and ensure that work taken up under a single permission shall be completed within the stipulated time period and revalidation process is avoided. No separate Road Restoration Charges are liable to OWNER for revalidation cases.

It is the responsibility of the contractor to obtain "No Objection Certificate" (NOC) from OWNER / PMC after completion of the restoration to their satisfaction and getting released the security deposit / bank guarantees submitted by OWNER for obtaining permissions on production of documentary evidence.





## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

On behalf of the owner, contractor shall prepare in advance and submit the proposed route plan complete in all respect and well ahead of time so that the actual construction work is not delayed because of approval/inspection / permission by concerned authorities. Further, the contractor shall also coordinate with the relevant authorities for necessary approvals of these proposed pipeline route drawings / certificates. The inspection of work by statutory authorities shall be the responsibility of the contractor without any extra cost to OWNER.

In case contractor delays laying of pipeline work under a single permission, the work or part of work may be offloaded to some other contractor at his risk and cost.

Any change / addition required to be made to meet the requirements of the statutory authorities shall be carried out by the contractor without any extra cost to OWNER. The inspection and acceptance of the work by statutory authorities shall, however, not absolve the contract from any of his responsibilities under this contract.

### **7.0 REFERENCE SPECIFICATION, CODES AND STANDARD**

The contractor shall carry out the work in accordance with the requirement of latest relevant applicable standards, this specification, Owner's Engineering Standards; relevant International Safety Norms & Regulations, ASME B31.8-Gas Transmission and Distribution Piping Systems; Australian Standard 3723-Installation and Maintenance of Plastics Pipe Systems for Gas; and the American Gas Association Document – Purging Principles and Practice.

Should the contractor find any discrepancy, ambiguity or conflict in or between any of the Standards and the contract documents, then this should be promptly referred to the Engineer-in-Charge (EIC) for his decision, which shall be considered binding on the contractor.

### **8.0 QUALITY OF WORK**

All works carried out under this contract shall confirm to applicable standards, codes of practice, construction procedures and other technical requirements as defined in the technical specifications.

The manpower deployed on the respective activities shall be adequately trained & shall have necessary skills to execute / supervise the work. However, the assessment on the qualification of the personnel shall be at the discretion of EIC.

Fusion operators and other skilled personnel shall be approved by OWNER / PMC and identification cards duly signed by EIC shall be issued to them. Only those personnel who are approved by EIC shall be allowed to execute the critical activities like Electro fusion jointing of PE-100 Pipes & Fittings. OWNER may provide Training and certification on chargeable basis where the cost shall be borne by contractor.

### **9.0 SAFETY**

- 9.1** The Contractor shall conform to the safety requirements outlined elsewhere in the tender document. In addition, the Contractor shall observe safe working practices in the storage and handling of cleaning fluids, flammable fluids, etc., and ensure smoking or naked flames are not permitted in the vicinity when these materials are being used.
- 9.2** Trench walls shall be battered with sufficient slope in order to minimize a trench collapse. Where there is a danger of an earth slide or collapse, the trench shall remain open for the minimum time possible with proper barricading. The Contractor is to ensure that no person enters a trench, which is of a depth of 1.5 meters or greater, unless the trench has adequate shoring, or the sides are battered to such an extent as to prevent a trench collapse.
- 9.3** The Contractor shall also protect all work sites with warning signs, barricades and night lighting. The Contractor shall inspect all fenced excavations daily and maintain them in good order.
- 9.4** The trenches / pit shall not be kept open in night times. However in case the same is essential the same shall be properly barricaded with proper lighting arrangements & manned.
- 9.5** The Contractor shall provide PPEs like helmets, safety shoes, etc. to the labour which are necessary for safe working practice.
- 9.6** Any accident-causing injury to any person or damage to property or equipment shall be reported to the EIC and



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

the cost of repair / replacement of the damage equipment shall be borne by the contractor. Where the EIC determines that the work is being performed by the Contractor in an unsafe manner, he may suspend the Work until corrective action is taken by the Contractor.

**9.7** For further details Refer “Special Terms and conditions of Contract”.

### **10.0 ROUTE SURVEY**

**10.1** Planning, detailing the size, underground utilities, foreign pipelines, crossings, FRS / DRS / MRS as well as service line location.

#### **10.2** Service lines

- Consultant/Third Party Inspection Agency and the contractor will conduct a joint survey at each probable premise to be supplied with gas. The survey record will note customer’s detailed potential gas supply points, proposed regulator positions and estimates of material quantities. The contractor’s representatives will make sketch of the agreed pipe routes.
- The contractor will be responsible for contacting the customer and making the necessary arrangements for access and appointments to carry out the work. Contractor shall maintain job card and complaint books at site. Owner will not be responsible for time lost due to failed appointments or disputes with customers.

### **11.0 ORGANISATION STRUCTURE**

**11.1** Contractor shall designate Project Manager / Coordinator who will be responsible to interact with OWNER/PMC/TPIA and authorized to attend review meetings, receive material, authorized to sign documents, claims, and receive payments etc. Contractor shall employ a Project Manager / Coordinator on company roll. The Project Manager / Coordinator must have qualification of Graduation / Diploma in Engg. with min. 5 - 8 years of work experience in gas pipeline job respectively. Project manager shall be single point of contact for all the works and must represent company in the review meetings.

**11.2** All construction work will be carried out as per direction of EIC, and this will be the primary point of contact between the contractor and Owner on site. All work will be issued and sanctioned through the EIC, and site control exercised by Site Engineers. The contractor shall ensure that technical quality standards are maintained that construction is carried out cost effectively and that a good customer and public image is maintained for Owner.

**11.3** The contractor will deploy his own supervisors as directed by site engineers/EIC. These personnel will be reporting to the Site Engineer for monitoring construction standards and for ensuring that all technical requirements are met for the job being carried out. The contractor’s supervisor(s) will have day-to-day liaison with the Site Engineer and will provide the Site Engineer with technical reports and audits, and other management information as is required on work progress and construction quality standards.

**11.4** The contractor’s supervisor shall have mobile telephones to ensure that they can be contacted at all times. The contractor will also nominate one person who can be contacted if necessary in odd hours, for the duration of the works. The contractor’s supervisor will have access to transport at all times to allow them to visit sites and attend meetings with Owner. The normal day-to-day issue of work instructions, communication between Owner and the contractor’s supervisor and the Site Engineer.

### **12.0 STRUCTURES, SERVICES AND OTHER PROPERTY**

#### **12.1** Location of Underground Utilities

The contractor shall locate all buried utility pipes, underground cables, water mains and other obstructions intersecting or adjacent to the Works. Utility data shall be provided by the OWNER. This shall be done far enough in advance of excavation to facilitate gradual change in grade or position found necessary to clear any obstructions.

In addition, the contractor shall excavate trial pits as necessary to determine the pipe route. The number of trial



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

pits will be agreed with the Site Engineer in advance of any excavation. In any event, trial pits shall be made at intervals of a maximum of 30 meters. Restoration of the abandoned trial pits and trenches shall be the contractor's responsibility. No payments shall be made for such type of jobs. The trial pits shall be excavated to minimum depth of 1.5 meters so as to locate any utilities present in the trench.

It is contractor's responsibility to interact with other utility agencies regarding their existing utilities and finalize the route along with these agencies and OWNER / PMC.

There will be no additional payments in respect of abandoned trenches incurred because of insufficient or inadequate trial pits, or any associated loss of time or delays.

### **12.2 Protection of Structures and Utilities**

The Contractor shall at his own cost support and protect all buildings, walls, fences or other structures and all utilities e.g. Electrical cables, Telephone Cables, Water pipelines, Sewer pipelines etc., and property which may be damaged as a result of the execution of the works. He shall also comply with the requirements in the specification relating to protective measures applicable to particular operations or kind of work. Special care shall be taken while laying of pipelines near the trees.

### **12.3 Interference with Traffic, Street Drainage and General Public**

The Work shall be executed in such a manner so as to cause a minimum inconvenience to persons using roads, lanes, thoroughfares, walkways, rights-of use or passages through which the Works are to be executed. The trench shall be back filled, compacted, levelled and extra soil shall be removed immediately after laying of pipeline to avoid public inconvenience. Closure of roads, etc, shall not be permitted without the approval of the EIC.

The Contractor shall comply with all local Authorities requirements to traffic and keep roads open to traffic and maintain access to and within any private property.

Wherever the pipe route crosses driveways, access tracks or entrances to private properties the Contractor shall give the OWNER at least 24 hours prior notice of intended commencement of excavation and shall be restricted to pass through.

The Contractor shall not use a private driveway, access track or entrance without the prior approval of the EIC in any circumstance.

The Contractor shall provide suitable access wherever necessary in the form of temporary bridges, culverts, flumes, etc., of a size and type approved by the EIC.

The Contractor shall comply with all relevant road Laws. Where limits and/or speed limits have been placed in the vicinity of the Works, the Contractor shall provide for the necessary movement of plant and equipment in accordance with the requirements of the relevant authority.

The Contractor shall not obstruct any drainage pipes or channels in any road but shall divert them wherever necessary and use all proper measures to provide for the free passage of water.

The Contractor shall handover the completed works after proper cleaning of the site.

The contractor shall conduct his operation at all times, with a view to minimize as far as practicable noise and other objectionable nuisances.

### **13.0 TRENCHING**

The schematic drawing with the details of trench is enclosed in the tender.

The Contractor shall perform the excavation works so as to enable the pipe to be laid in conformity with the levels, depths, slopes, curves, dimensions, and instructions shown in the Drawings, Specifications or as otherwise directed by the EIC.

Contractor shall excavate and maintain the pipeline trench on staked centerline as per approved drawing taking into account the horizontal curves of the pipelines.

While trenching, care shall be taken to ensure that all underground structures and utilities are disturbed to the minimum. Suitable crossing shall be provided and maintained over the ROU wherever necessary to permit the people



## Laying of PE Pipe at Cotonou, Benin of West Africa



Resonance Energy

Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

to cross or move stock or equipment from side of the trench.

Trenching shall be made with sufficient slopes on sides in order to minimize collapsing of the trench. On slopes wherever there is danger of landslides, the pipeline trench shall be maintained open only for the time strictly necessary. Owner may require excavation by hand, local route and detouring and limiting the period of executing of the works. Before trench cuts through water table, proper drainage shall be ensured, both near the ditch and ROU in order to guarantee the soil stability.

The Contractor shall ensure that trench bottom is maintained in the square form as far as possible, with equipment, so as to avoid/minimize the hand grading at the bottom of the trench. The Contractor shall do all such handwork in the trench as required to free the bottom of trench from loose rock, pebbles and to trim protruding roots the bottom and sidewalls of the trench.

### 13.1 Depth of Trench

The minimum depth of cover shall be measured from top of pipe to the top of undisturbed surface of the soil or top of the graded working strip or top of road or top of rail, whichever is lower.

In case of crossing of water bodies the minimum depth shall be measured from the top of the pipe to the bottom of Scour level.

The depth of the trench will be such as to provide minimum cover as stipulated below: For Distribution and service lines.

- Minor Water Crossing/Canal 2.5 meter
- Uncased/Cased Road Crossing 1.5 meter
- Rail/Road Cased Crossing 1.7 meter
- Normal Areas 1.0 meter

The minimum depth may be greater than as mentioned above as may be required by Government/Public authorities under jurisdictions. The Contractor shall perform such work without extra compensation, according to the requirement of concerned authorities.

Also, in case of Drains/Culverts/Utilities crossing through open cut where excavation cut is more than 1.5m, the extra excavation is inclusive in the laying rates. **No separate payment is chargeable for extra excavation and includes backfilling as well.**

In case, the depth could not be achieved due to practical problems and the same is demonstrated, EIC after examining thoroughly and considering the codes and standards may allow the contractor to provide suitable protection by way of concrete casing pipes or slabs without any extra cost to Owner.

### 13.2 Width of Trench

The width of the trench shall be wide enough to provide bedding around the pipe as specified and to prevent damage to the pipe inside the trench. Unless otherwise directed by the EIC and where ground conditions permit, the minimum distance from the inside edge of the trench wall to the outside of the pipe shall be as per the drawing enclosed in the tender.

### 13.3 Trench Base

The trench bottom shall be cut or trimmed to provide a uniform bedding for the pipe and shall be free from stones, metal, wood, vegetation, clods of earth or other debris before placement of the pipe.

In case trenching is done in rocky terrain, a bedding of soft soil or sand shall be provided in the trench base to the satisfaction of EIC.

### 13.4 Hard Rock:

Hard rock is defined as trench material with a single piece of rock, dimension exceeding 1.0 m in any direction, which requires cutting only by use of pneumatic chisel / drill / Rock breaker or sledgehammer or removal of the same by additional excavation.

### 13.5 Clearances



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

Unless otherwise approved, the following clearances shall be maintained between the external wall of the gas pipe and the external surface of other underground assets/utilities in the vicinity of the Works.

- 150 – 300 mm where the gas pipe crosses other assets/utilities, etc., for electric cables, the clearance shall be 300mm minimum or special protection shall be provided as per approval of EIC.
- 300mm minimum where the gas pipe is on a similar alignment to the other assets/utilities.

Where the above clearances cannot be achieved, or in other special circumstances, the EIC may approve/specify protection with concrete/MS coated pipe, etc. The protective material shall be supplied and installed by the Contractor at his cost subject to the discretion of EIC.

### 13.6 Under Ground Interferences

The Contractor shall locate and expose manually all underground facilities if any during trenching. Safety barriers should be erected along the trench to prevent any damages or accident. On locations where pipeline is laid under the existing facilities and near the approaches of the crossing, the trench shall be gradually deepened to avoid sharp bends.

All sewers, drains, ditches, and other natural waterways encountered while trenching shall be maintained open and functional by providing proper temporary installations if required. Suitable dewatering pumps shall be deployed to dewater, if required.

Whenever it is permitted by Authorities and /or Owner to open cut paved road crossing, or where the line is routed within the road pavement, the Contractor shall remove the paving in accordance with the restrictions and requirements of the authorities having jurisdiction thereof as directed by Owner. After laying the pipeline, backfilling shall be immediately performed, and all the areas affected connected with the excavation works shall be temporarily restored.

In case of damage to any of above referred structures/utilities the Contractor shall be responsible for repairs/replacement at his own cost, which shall be carried out to the satisfaction of concerned authorities, resident, and Owner.

### 13.7 Others

Throughout the period of execution of such work, the Contractor shall provide and use warning signs, traffic lights or lanterns, barricades, fencing, watchman etc. As required by the local authorities' jurisdiction and/or Owner.

For all roads, paths, walkways etc. which are open cut, the Contractor shall provide temporary diversions properly constructed to allow the passage of normal traffic with the minimum inconvenience and interruptions.

The paving shall be restored to its original condition after the pipeline is installed.

The Contractor shall excavate to additional depth at all the points where the contour of the earth may require extra depth, or whereas deep trenches is required at the approaches to crossings of roadways, railroads, rivers, streams, drainage, and ditches without any extra cost implication to Owner.

The Contractor shall excavate all such aforesaid depths as may be required at no extra cost to Owner. The trench shall be cut to a grade that will provide a firm, uniform, and continuous support for the pipe.

The Contractor shall take conducive measures to ensure the protection of underground utilities as per the instructions of Owner or relevant authorities.

Where the pipeline crosses underground utilities/structures, Contractor shall first manually excavate to a depth and in such a manner that the utilities/structures are located, then proceed with the conventional methods.

The locations where the pipeline has to be laid more or less parallel to an existing pipeline cable and/or other utilities in the Right-of-way the Contractor shall perform the work to the satisfaction of the Owner of the existing pipeline/cable/utility. In such locations, the Contractor shall perform work in such a way that even under the worst weather and flooding conditions, the existing pipeline/utilities remain stable and shall neither become undermined nor have the tendency to slide towards the trench.



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

### 13.8 Bedding

The Contractor shall ensure that the pipe when placed in the trench is supported and surrounded by a bed of screened excavated soil, which shall be stone free and have a maximum grit size of 5mm, in order to ensure no damage occurs to the pipe. However, in case of rocky soil the bedding shall be done with approved good quality packing sand subject to the approval of the EIC. The packing sand shall be placed to a minimum thickness of 150mm all around the pipe in case of rocky terrain.

Unless directed by the EIC the quantity of bedding and surrounding sand shall confirm specifications. There shall be no void space in the packing sand around the pipe.

### 14.0 LAYING

Laying of PE-100 pipelines shall be commenced only after ensuring proper dimensions and clean surface of the trench. The trench bottom shall be free from the presence of cuts, stones, roots, debris, stakes, rock projections up to 150mm below underside of pipe and any other material, which could lead of perforation/tearing of the pipe wall. After ensuring above, the PE-100 pipe coil shall be uncoiled smoothly through proper equipment's/care inside the trench ensuring no damage to pipe coil during laying. The contractor must ensure that Pipe caps are provided before lowering of Pipeline. The trench after this can be released for back filling leaving adequate lengths open at the ends for jointing.

Contractors shall ensure open ends of pipe placed in the trench shall be securely capped or plugged to prevent the ingress of water or other matter. The Contractor is to ensure that nothing enters inside the pipe during the laying process as this could cause a future blockage or regulator malfunction due to dust, etc.

In case of open cuts where two pipes are to be laid parallel in same trench or same pits, 30% of the respective SOR of the lower pipe size for the laid length shall be paid in addition to the rates applicable to the higher pipe size.

Valves are to be provided at every Km in PE-100 pipeline. The above spacing, however, may be increased or decreased based on risk assessment and to allow location of valve at an easily accessible location as directed by the EIC.

Valves shall be installed at locations shown in the Design Plan or as directed by the EIC and joined with PE pipes by electro fusion techniques. The valves shall be placed on a concrete square block at the bottom to achieve equivalent support of the incoming and outgoing pipe work.

Laying graphs/As-graphs with details of depth, length, offsets from fixed references, other utility crossings, fittings, sizes of the casing pipe used for the pipeline shall be prepared on daily basis and to be submitted to Owner Engineers for approval. These details will further be incorporated in to As-Built Drawings.

A pipe may pass through an open drain with prior approval from EIC. Where this is permitted, the PE pipe shall be installed inside a concrete or steel sleeve for protection with no cost implications to the owner. The sleeve material shall be procured and laid by the Contractor with prior inspection and approval of the EIC for the quality of material. In general, the GI Sleeve material specification shall be confirming to Heavy Duty specification of reputed make.

Contractor to ensure majority (up to 70% of the available potential) of service lines for connecting industries shall be laid at first instance of internal network laying, however any slippage / deviation shall be submitted with consents for approval from EIC/PMC.

In case of service lines, EIC shall decide either half round concrete sleeve or GI pipe sleeve shall be installed at any particular site depending upon site condition. The half round concrete sleeve shall be preferred over GI Sleeve, however in case where the installation of half round Concrete Sleeve is not possible due to technical feasibility and site conditions, GI sleeves shall be installed only after written approval from EIC. The rate of GI Sleeve / half round concrete sleeve shall be included in laying of PE-100 Pipes depending upon surface conditions. The details are mentioned below:

#### **GI Sleeve:**

A bending tool shall be used to bend the GI sleeve pipe so that it has the appropriate curvature and is free of kinks. The installation of GI sleeve for service lines shall be done by sealing the annulus between pipe and sleeve, firm fixing of the GI sleeves by concrete mix pedestal, clamping, sand filling, etc.

The contractor shall supply the minimum dia. Size of 2.5" & 3", 300 mm in length, GI sleeves (Heavy Duty reputed make) respectively for domestic & commercial / industrial installations. The vertical portion of the sleeves shall be fixed to the wall of the premises in a secure manner. The material test certificates/ inspection reports shall be submitted at the time of submission of bill. The material shall be inspected by PMC /TPIA before installation.





## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

### **Half Round Concrete Sleeve:**

The installation of Half Round Concrete sleeve for service lines shall be done by sealing the annulus between pipe and sleeve, firm fixing of the Concrete sleeves by concrete mix pedestal, clamping, sand filling, etc. Half round concrete sleeve shall be made as per enclosed drawing in the tender. The dimensions shown are tentative and may vary depending upon the site conditions. The material shall be inspected by PMC / TPIA at the fabrication stage & prior to final dispatch at site for installation. The material test certificates/ inspection reports shall be submitted at the time of submission of bill.

### **15.0 JOINTING OF POLYETHYLENE PIPE**

The procedure for jointing of PE pipes and fittings shall be as per applicable PTS which is part of this tender document. Only Bar coded electro-fusion machine (Automatically Readable) that can read the bar code of the fittings automatically shall be used for jointing of the PE-100 pipes/fittings. Manual feeding Electro-fusion machines are not acceptable for jointing purpose. **The contractor has to submit the certificate of calibration of Fusion machine at the time of start of work and at fixed intervals as per the instructions of Owner. Contractor shall ensure that the machines are always available at site. No stoppage of work due to the non-availability of machines shall be allowed.**

The contractor shall flush the Pipeline with air to remove dust, water, mud etc. before fusing the joints. Before jointing, the Contractor shall place packing sand under the pipes on both sides of the joint to keep the pipes in line and at the correct alignment during the jointing process. The jointing process shall start only after Alignment clamps with the correct size are aligned with the pipe and coupler during the electro- fusion cycle.

The Contractor shall ensure that polyethylene pipe is only cut with an approved plastic pipe-cutting tool (Rotary Cutter up to 63mm/Guillotine Cutter for 63mm and above). Before fusion is attempted, the contractor shall remove the oxidized surface of the pipe using Universal Scrapper up to 63mm/Rotary Peeler for 63 mm and above before inserting it into the electro-fusion coupler. The tool must remove a layer of 0.1mm to 0.4mm from the outer surface of the polyethylene pipe. No fusion will be allowed without clamping device and the approved cutting tools (Hack saw shall not be allowed for cutting the pipe).

The contractor has to supply all the consumables required for carrying fusion of the joints (like tissue paper, napkin, acetone etc.).

If, upon inspection, the EIC determines a joint is defective, Contractor shall remove the joint by an approved method. The cost of replacing joint shall be borne by the Contractor including the cost of pipe and fittings removed.

For electro-fusion jointing, the contractor must bring own tools, tackles, and equipment.

Only approved Jointers shall carry out fusion of all joints. Contractors shall provide the list of jointers to be used on the job and make arrangements for Qualification Testing of the jointers in presence of OWNER/PMC as per the standard procedures. All approved Jointers shall bear identity cards signed by OWNER/PMC during fusion job and shall furnish the same on demand by OWNER/PMC.

Contractor shall arrange generator along with voltage stabilizer for power supply to fusion machine. Taking power connection from electric poles, connections without written permission from the concerned authorities or residential premises is strictly not permitted.

### **16.0 BACKFILLING**

Backfilling shall be done after ensuring that appurtenance have been properly fitted and the pipe is following the trench profile at the required depth that will provide the required cover and has a bed which is free of extraneous material, and which allows the pipe to rest smoothly and evenly. Dewatering shall be carried out prior to backfilling. No backfilling shall be allowed if the trench is not completely dewatered.

Prior to backfilling it should be ensured that the post padding of compacted thickness 150mm is put over and around the pipe immediately after lowering where required.

Backfilling shall be carried out immediately after the post padding where required has been completed in the trench, inspected and approved by OWNER/PMC, so as to provide a natural anchorage for the pipe avoiding sliding down of trench sides and pipe moment in the trench. If immediate backfilling is not possible, a padding of at least 300mm



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

of earth, free of rock and hard lumps shall be placed over and around the pipe and coating.

The backfill material shall contain no extraneous material and/or hard lumps of soil, which could damage the pipe and/or coating or leave voids in the backfilled trench. In case it is required and directed by EIC screening of the backfill material shall be carried out with specified equipment before backfilling the trench.

The surplus material shall be neatly crowned directly over the trench and the adjacent excavated areas on both sides of the trench to such a height which will, in OWNER / PMC opinion of provide adequately for future settlement of the trench backfill during the maintenance period and thereafter. The down shall be high enough to prevent the formation of the depression in the soil when backfill has settled into its permanent position should depression occur after backfilling, Contractor shall be responsible for remedial work at no extra cost to Company. Surplus material, including rock left from this operation shall be disposed off to the satisfaction of landowner or authority having jurisdiction at no extra cost to Owner.

Where rock, gravel, lumps of hard soil or like materials are encountered at the time of trench excavation, sufficient earth, sand or select backfill materials shall be placed around and over the pipe to form a protective cushion extending at least to a height of 150mm above the top of the pipe. Select backfill materials for padding that area acceptable shall be soil, sand, clay or other material containing no gravel, required selected backfill material has been placed, provided the rock or lumps of hard soil. The padding earth shall not contain any stones, i.e. the earth shall be screened for sand padding of the Pipeline in order to avoid damage to the pipeline. Contractor shall carry out all these works at no extra cost to Owner. Loose rock may be returned to the trench after the required selected backfill material has been placed, provided the rock placed in the ditch will not interfere with the use of the land by landowner, or tenant.

In case where hard rock is encountered or as desired by EIC / site engineer sand padding is to be provided upto height of 150 mm around the pipe.

When the trench has been dug through driveways or roads, all backfilling shall be executed with sand/suitable material in layers as approved by OWNER/PMC and shall be thoroughly compacted. Special compaction methods as specified may be adopted. All costs incurred there upon shall be borne by the Contractor.

Trenches excavated in dikes which are the properties of railways, or which are parts of main roads shall be graded and backfilled in their original profile and condition. If necessary, new and /or special backfill materials shall be supplied and worked-up to.

PE Warning Grid / Mat 1mm thick and 300mm wide shall be placed on distribution main and service line inside premises, after backfilling of the trench up to a height of 300mm on the top of the carrier pipes. The warning grid is to be unrolled centrally over the pipe section and thereafter further backfilling will commence.

Backfilling activity shall include proper compaction by jumping jack compactor, wherever required and as per instruction of EIC, and watering in layers of 150mm above the warning mat. Proper crowning of not more than 150mm shall be done. All the excavated material that could be used during the Restoration process shall be stacked and kept separately and properly. Wherever Road cutting / Tiles removal/PCC cutting has been done during excavation for laying, the area shall be back filled and compacted immediately so that no inconvenience is caused to the general public.

Electro-fusion of joints is to be undertaken immediately after lowering and the activity shall not be kept pending for lack of Electro-fusion jointing. The backfilling shall be considered complete only after the jointing of pipes.

Debris and other surplus material shall be removed immediately after the back filling.

### **17.0 TRENCHLESS LAYING**

Both Manual Moiling and HDD are to be considered as methods of trenchless laying.

#### **Manual Moiling**

The Manual Moiling shall be carried out as per the requirement specified by OWNER/PMC and approved procedures. The contractor has to carry out survey of the underground utilities before going for the moiling to avoid any damage to other utilities. No extra payment will be made for any trial/abandoned pits made during the survey. The supply of all equipment required for carrying out moiling work is in contractor's scope. The type of moiling to be carried out i.e. with or without casing shall be at the discretion of OWNER/PMC and prior approval is to be taken before starting the moiling.





## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

For Moiling the contractor shall ensure that the size of the hole shall not be more than 20% of the size of the casing/carrier pipes whichever is applicable. After completion of Moiling the hole shall be properly compacted / filled with soil by watering and by approved procedures.

The length of the Hole (excluding the sizes of the pits on both ends) shall be considered for the measurement of Moiling length.

The usage of casing pipe will be decided by EIC at the time of final approval for crossing/laying.

Any damage that occurred to other utilities during the Moiling operation shall be immediately, notified and rectified by the contractor without any cost implication to Owner.

### **HDD (Horizontal Directional Drilling)**

HDD is required to be carried out where conventional trenching/Moiling is techno-economically not possible viz. roads, congested areas etc. The Contractor shall obtain details of such crossings and the Contractor in consultation with Owner shall prepare construction drawings.

Execution of the work shall be based on the OWNER/PMC approved drawings. The contractor has to do the thorough survey of the underground utilities before commencement of HDD to avoid damage to the other utilities. No other extra payment will be made for any trail/abandoned pits made during the survey. The supply of all equipment required for carrying out the HDD is in contractor's scope. The HDD operation shall be carried out in accordance with API-1102. The type and availability of machines is sole responsibility of the contractor and as per the site conditions & requirements to entire satisfaction of EIC.

Once the work is allotted, any delay in mobilizing / non-availability of HDD machines as per site requirement and conditions shall result in levying of penalties on daily basis as per contract. However, in such cases, owner may mobilize HDD machines and carry out execution of work on the contractor's risk and cost.

The type of HDD to be carried out with or without casing shall be at the discretion of Owner and prior approval is to be taken from EIC before starting. The works are inclusive of excavation of pits, jointing, pilot boring, bentonite cleaning, reaming, insertion of carrier pipe, backfilling, compaction, etc.

As per the specification, HDD to be carried out with or without casing pipe depends on the type of crossing. Any damage that occurred to other utilities during the HDD operation shall be immediately notified and rectified by the contractor without any cost implication to OWNER.

HDD profiles should be properly marked/ recorded in graphs as per scale before it is drafted in the as built drawing.

### **Casing Pipe**

The tentative sizes of the HDPE casing pipe for Moiling/Horizontal Directional Drilling shall be as follows:

	<b>PE-100 Carrier Pipe Dia. size (mm)</b>	<b>Max. Dia. of HDPE Casing Pipe (mm)</b>
	32	90
	63	160
	90	180
	125	250
	180	315

However, the size of the casing pipe may vary according to the length of the carrier pipe and requirement of laying of HDPE duct & OFC cable, if required. Also, the higher size of HDPE casing pipe shall be preferred over lower size casing pipe without any extra cost to the Owner.

## **18.0 RESTORATION**



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

Wherever the restoration to the original surface condition is required, all roads and footpaths etc. shall be restored to its original condition and the same shall be done as per the norms and to the satisfaction of OWNER /PMC. To retard curing of the installed concrete, wet sackcloth is to be placed on the finished surface and kept damp for a period of 7 days.

Where slabs and blocks are to be restored, the level of the compacted sub-base is to be adjusted according to the slab/block thickness. The slabs or blocks should be laid on moist bedding material, which should be graded sand, mortar or mortar mix. The slabs or blocks should be tapped into position to ensure they do not rock after lying.

The restored slabs or blocks should match the surrounding surface levels. Joint widths should match the existing conditions and be filled with a dry or wet mix of mortar.

The procedure for restoration of Road/Footpath, placed at Annexure # 2, is only indicative. However, the restoration shall be done in accordance with the norms of the concerned Land-owning agencies.

Turf shall be replaced in highly developed grassed area. In lesser-developed grassed areas topsoil should be replaced during the restoration process.

Where permanent surface restoration cannot be completed immediately, the Contractor shall provide and maintain a suitable temporary running surface for vehicular traffic and pedestrians. The Contractor will be responsible for the maintenance of all restoration carried out, for the duration of the Contract guarantee period.

The Contractor is to ensure the restoration work is properly supervised and that the material used is suitable for the purpose and properly compacted. Where the required standards are not achieved, the Contractor will be required to restore the defective work.

The rate of restoration includes Asphalted / bituminous, concrete pavement, Tiles (Chequered / any other type of tiles), Marbles, interlocking paver blocks, Dry brick pavements etc. and is payable under one SOR.

Note that payment for restoration will be released only after satisfactory completion and certification by Third party/Consultant.

Contractor has to obtain the No Objection Certificate (NOC) from the concerned local authorities/RWA after completion of the restoration work. The restoration specification specified in the tender is only a typical specification and the contractor has to carry out restoration to its original condition and also to the entire satisfaction of landowner (Private/Public).

The expenditure incurred towards testing of the material used for restoration, as per the applicable standards, shall be borne by contractor.

### 19.0 TESTING

Pressure testing will be carried out with compressed air (free from oil and greases). Compressed air will be provided by Contractor for testing purposes and is to be included in the laying rates.

For both main & service pipeline laying, the Contractor shall perform progressive pressure testing to ensure no leaks in long lengths of pipe. The test pressure shall be 6.0 bar (g), and there shall be no unaccountable pressure loss during the test period.

Overall scheme drawing for pressure testing shall be prepared by the contractor and get approval from Owner/Owner representative.

For main line, the test duration shall be 24 hrs. with stabilization period of 30 minutes after pressurization. Then only the holding period may commence and continue for 24 hours. Measuring instruments shall have been calibrated and their accuracy and sensitivity confirmed before the start of testing, wherein calibrated pressure gauges of suitable range shall be supplied by the contractor. The pressure gauges shall be calibrated from time to time as desired by EIC.

All testing shall be witnessed and approved by the EIC or his delegated representative. Tie-in joints may be tested at working pressure following commissioning.

In special cases, where the mainline or service line length is less than 500 mtrs. holding period for testing may be reduced to 4 hrs. with stabilization period of 15 minutes.

For service lines, in some cases, testing shall be carried out independently than of mains for which the test duration may be reduced to 4 hrs. The service line testing in this case will be performed after the service line installation is complete but before the service line tee has been tapped for gas charging.



## Laying of PE Pipe at Cotonou, Benin of West Africa



Resonance Energy

Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

### 20.0 PURGING

Purging shall be carried out in accordance with the principles defined in the American Gas Association publication “Purging Principles and Practice”.

The Contractor shall also provide nitrogen required for purging as per the direction of Site In-charge. Nitrogen shall be supplied in labelled, tested, and certified cylinders and completed with all necessary regulators, hoses and connections, which will be in good and working condition. No separate payment shall be paid for supplying Nitrogen cylinders for purging and is included in the laying rates.

In addition, the Contractor shall submit purging plan and get approval from OWNER / PMC before commencing any purging work. The Plan shall include, but not be limited to the provision of the following materials and equipment: Personal Safety Equipment, Fire Extinguisher, Purging Adaptor, Purge stack with flame trap and gas sampling point, Gas sampling equipment (may be gas leak detector), squash- off tool, Polyethylene connecting pipe.

The Plan shall also include the purging process along with detail on the sequence of events. The process is to also specifically mention the need to lay a wet cloth over the PE main and in contact with the ground, to disperse static electricity during the purging work.

A purge stack with flame trap shall be used when purging services. Care shall be taken to ensure that the purge outlet is so located that vent gas cannot drift into buildings.

### 21.0 VALVE CHAMBERS

Valve Chambers (RCC/Brick Wall) shall be constructed as per drawing. Prefabricated valve chambers with same dimensions are also allowed, however the final designing and specifications shall be approved by EIC/PMC before start of production, without any extra cost to owner.

The construction of the valve chambers shall be taken up immediately after installation of valve, before commissioning of the pipeline network.

If required, it may also be instructed for construction of new valve chambers on existing gas charged pipeline before or after Gas charging for extensions or new pipeline network.

The location for construction of valve chamber shall be proposed by contractor and approved by EIC/PMC before start extension / new PE-100 network.

#### Materials for Valve Pit

RCC Pre-cast Slab shall be confirmed. Heavy Duty RCC Manhole Cover shall be used. It shall be with raised with Lifting hooks. The RCC manhole cover shall have a clear opening as per the Construction Drawings issued to the contractor.

#### Workmanship

- The excavation work shall be done at a location given by Engineer-in-Charge. All care shall be taken not to damage existing facilities and surface of construction shall be restored to its original state. Sandbags to be placed below pipeline without disturbing the laid pipe. Gunny bags and Sand should be of approved quality.
- PCC to be placed below the pipe as indicated. Once PCC is set sand is to be filled and properly rammed so that pipe and pre-cast concrete blocks are firmly placed.
- Valve will be supplied without the operating stem. Approved quality sand is to be placed in between area. The supply of sand is included in the rates.
- Surrounding area to be properly cleared and PCC to be placed around the location where pre-cast slab with RCC Manhole cover is placed. The RCC pre-cast slab to be laid in level and finished smooth.

### 22.0 MARKERS

**22.1** Markers (As per Drawings enclosed with the tender document) shall be Fabricated, supplied and installed as per the instructions of the EIC immediately after laying of the Pipeline. The installation of the type of the Permanent Marker



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

shall be decided by the EIC depending on the site condition. The contractor shall also ensure that a sample of markers shall be inspected and approved by OWNER / PMC before shipment of the lot at site and prior to installation at the site. The inspection of all types of markers shall be carried out lot wise.

### 22.2 Guidelines for Marker installation:

- Every entry and exit pits for laying of pipeline by HDD
- For the distribution network, 180, 125, 90, 63 and 32 OD pipe, plate markers shall be installed as per the siteconditions and directions of the Site-in-Charge.

22.3 The artwork is typical for all the markers, with Owner's logo on it. The contractor must take prior approvalfor the artwork from EIC before installation of Markers. The lot wise approval shall be attached with bills.

### 23.0 ASSISTANCE IN COMMISSIONING

Contractor shall provide the required personnel, Vehicles, labour, supervision, tools, equipment, instruments and technical assistance for performance tests and commissioning activities as per requirement / satisfaction of EIC.

### 24.0 STANDARD OF WORK

All work carried out under this contract shall be to standards, codes of practice construction procedures and other technical requirements as defined in the technical specifications. The manpower deployed on the respective work shall be adequately trained and shall have necessary skills to executive/supervise the work. However, the assessment on the qualification of the personnel shall be at the discretion of EIC.

Fusion Operators and other skilled personnel like plumbers, conversion techniques shall be approved by OWNER / PMC / TPIA. Simultaneously Identification Cards duly signed by PMC / TPIA shall be issued to them. The contractor shall maintain proper record for the identification cards issued to their workers.

### 25.0 RECORDING (AS-BUILT DRAWINGS)

The following points shall be taken care of in the preparation of as built drawings.

- a) The as laid drawings should be on the scale of 1:200 and shall be submitted in an A-0 sheet. The drawings shall be in layers according to the AUTOCAD features category.
- b) Pipeline feature shall be shown as a continuous line, breaks only at joints, fittings, valves, tee point, etc. Diameter, Pipe material, length, and location of pipeline whether on the road or footpath, should be clearly indicated.
- c) UTM coordinate shall be taken at every 10 mtrs of Interval. Prior to use of Equipment, approval of Engineer In charge is required.
- d) Distance of pipeline from permanent property/structure should be provided at least every 20 meters. If there is any change in alignment / orientation and offset distances etc. of the pipeline in between the above said 20 mtrs, the same shall be clearly mentioned in the as laid. Gas objects (off valves, tees, elbows, couplers, transition fittings etc..) shall be shown as block objects (which form a single node to connect) with respect to Owner symbols / legend. The As laid drawings shall be as per the approved legends provided by EIC.
- e) Details and offset distances from other utilities present should be given in a laid drawing. If there is any change in depth of the pipeline, the same shall be clearly marked with details in the as laid drawings. The details (material, size and Length) of additional protection provided to pipeline shall also be clearly indicated.
- f) Details of the PE stop off valves &. Other fittings used (i.e. tees, elbows, couplers, transition fittings, etc..) should be shown with adequate information orientation &. Offsets from permanent structures inthe immediate vicinity.
- g) Technical deviations (if any) should be provided with reference to the building's permanent structures around, and the same should be cited clearly with all the relevant details, including separate sketches/Blowups / sectioned drawings / exploded view.
- h) Total as laid length (size wise), bill of materials should be mentioned in each sheet.
- i) Complete details of CHANNEL crossings should be shown in a separate sketch.
- j) Names of roads, major landmarks and buildings should be mentioned appropriately for reference.



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

- k) Proper chainage shall be mentioned on all the drawings to be referred to with continuation reference.
- l) Direction of gas flow shall be indicated in each of the drawings.
- m) Text on the as laid drawing should be clearly visible. Land base features shown on the drawing shall match the exact distance as they were on real ground with respect to scale (1:200).
- n) As laid drawings shall be duly signed and stamped by area PMC / TPIA.
- o) The details shall be prepared in standard format using MAP INFO/AUTOCAD MAP and submitted in Pen drive. Contractor shall also make the item wise material consumption report for the respective areas in a soft copy and to be submitted along with the as built drawings.

### 26.0 CIVIL WORKS

The contractor has to supply the adequate materials and skilled manpower for the completion of all the civil and structural works. The contractor shall also ensure that the work is carried out as per the details mentioned in the Schedule of rates.

Special cares shall be taken at the time of labors working in depths / lifting of the skids by hydras / cranes considering all the safety guidelines.

The contractor has to ensure that sample of the all the materials shall be inspected and approved by EIC before carrying out installation or erection work. The contractor has to submit the test certificates for all the materials to be used at the site. The construction shall be carried out strictly as per the drawings provided by the OWNER/PMC. The contractor shall ensure extra / surplus materials/ debris shall be immediately removed from the site after completion of the job.

#### DETAILED SOR SCOPE:

□ □ □



**Laying of PE Pipe at Cotonou, Benin of West Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

**SOR 1 - PE PIPE LINE LAYING IN ALL TYPE OF SOIL STRATA INCLUDING HARD ROCK, USING ANY (EXCEPT HDD) LAYING METHODOLOGY (OPEN CUT/MOILING/CROSSING)**

Route survey of allotted areas and Preparation /Submission of detailed route plan for approval by EIC in AutoCAD format. Receiving, handling, loading, transportation and unloading of owner supplied PE pipes and other free issue items from SIPI's designated stock yards to Contractor's own stock-yards/ work-sites. Proper storing, stacking, identification, providing security and insurance cover for the materials. Procurement / Supply and Installation of PE Fittings, PE Valves (Long stem), Transition Fittings, Warning Mats, HDPE casing Pipes, Half concrete sleeves and all other items required for execution shall also be in Contractor's scope. Liaisoning with Landowning agencies / statutory authorities and obtaining permission from them making trial pits to determine the underground utilities/ services etc., restoration of the abandoned excavation/ trial pits (excavated to depth of 1.5 m or more as per satisfaction to EIC) to original condition, barricading the work area as per the procedures & drawings provided in the tender and as per the directions of EIC / Site-in-charge; uncoiling / stringing of pipes, jointing of the pipe ends/ fittings (Isolation Valve 1/2" & 3/4") / Transition fittings/ valves by qualified personnel, using approved electro fusion techniques as per specification SOR rate for Laying should include Open cut/Moling method for Normal surface/ Hard rock/Morrum/Boulders/any kind of surface.

Trenching of normal soil / sand / Multiple layer of Bitumen road, hard rock/ boulders using manual/pneumatic chisel and disposal of excess soil/boulders/rock etc. is in the scope of contractor and the same is to be considered by the contractor.

Submission of applications as per approved drawings provided by OWNER / PMC (Initial Route Survey, Preparation of Drawings, measuring and providing details of surface type shall be in scope of Contractor with approval from OWNER / PMC ).

Coordination, Liaisoning, Obtaining written permissions from the OWNER and obtaining NOC from the OWNER. Statutory clearance shall be arranged by the OWNER.

Compliance to construction safety - PPE, Continuous hard Barricades along the trenches as per approved drawing in tender, Use of Gum Boots, Hand gloves, Reflective jackets, Hard hats (helmets), Safety shoes, eye and ear safety equipment's, Fire extinguishers etc.

Laying using any method (Open trench & Moling with or without casing it includes survey of the under ground utilities, execution of the work as per specification (as per trench dimension Drawing -attached in tender), including excavation of pits, moling with hole size not exceeding 20% of the the carrier / casing pipe dia. jointing and insertion of the carrier pipe in casing pipe (on case to case basis) and subsequent padding with soft soil, laying of warning mat in open trench only, backfilling, compaction, submission of as built drawing, as graphs as per attached specification and instruction of EIC / Site Engineer of Owner. Includes laying of pipeline in all type of surface including Kutcha, metal, concrete (PCC/RCC), bituminous, tiled, brick lined etc. after raking up of hard surface of any type; Roads, Pavement, Footpaths etc. shall be made motorable once the pipeline is laid.

All service line as required shall be laid within this SOR and no extra payment shall be made for service line in any other SOR line item.





Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

Supply & installation of GI Sleeves, 2.5" NB x 300 mm length GI pipe Sleeve / Half Round Concrete Sleeves for domestic connections, 3" NB x 300 mm length GI Sleeve for commercial and industrial installations (as per GI Pipe Sleeve drawing attached in tender document), and 1/2 Round concrete sleeve, as per GI Pipe Sleeve drawing attached in tender document)) excavation, breaking through any obstructions, insertion of pipe, sealing the annulus, fixing of the sleeves with concrete mix, preparation of pedestal & restoration of excavated pits within the size of pedestal & the same pit with the laying of 20/32 mm dia PE pipe as defined in technical specification and instruction of EIC.

Flushing, cleaning ,Pneumatic testing, purging with nitrogen and commissioning as per specification and approved procedures providing all tools and tackles, nitrogen, instruments, manpower and other related accessories including PPE and as per instructions of the Engineer-in charge.

Maintaining the completed pipelines/ installation for any defect, failures during defect liability period.

Handing over the completed works to SIPI for their operation/ use, returning of all surplus material to SIPI stores, reconciliation of free issue material area wise and obtaining no objection certificate. (Handing Over the Completed Works to SIPI Post Commissioning. It Shall Be Contractor's Responsibility to Maintain the Line in Positive Pressure till It Is Handed Over To SIPI)

On completion of gas charging of pipelines, preparation and submission of As built drawings, As graph drawings, crossings details, termination, utility graphs and deviation statements with Hard & Soft copy.

Submission of all documents required for contract closure in numbers as mentioned in contract.

Laying of PE pipeline, with or without casing, in case if existing dedicated trench of approx. size 400mm x 600mm is already provided with removable top cover; Scope includes removal of precast RCC slab covers from channel, laying of pipeline, jointing, testing, sand filling (including supply) refixing top cover of pipe trench.

In case 2 PE pipelines are laid in a common trench, SOR rate of higher dia plus 1/3 (0.333) x SOR rate of lower dia will be paid.

Any other activities not mentioned / covered explicitly above, but otherwise required for satisfactory completion / operation / safety / statutory / maintenance of the works shall also be covered under the scope of work and has to be completed by Contractor within specified schedule at no extra cost to Owner. All the work shall be executed in accordance with the provision of contract.

Note:

1. Supply & Installation of GI Sleeve 1/2 round concrete sleeve & warning mat (Open trench excavation) shall be included in laying of PE Pipe, no extra cost shall be paid else where in the SOR.
2. Any required statutory clearance / permission shall be in the scope of Owner. Collaborate, Cooperate, co-ordination and communication for completing the site work during construction/laying in the scope of contractor and shall be included in the above SOR line item. No charges for Collaboration, Cooperation, co-ordination and communication towards for laying shall be paid elsewhere.
3. Supply & installation of all PE fitting & Valves for safely commissioning of entire network shall be in the scope of Contractor.

**SOR 4 - EXCAVATION OF HARD ROCK:** Trenching of Hard Rock is defined as trench material with a single piece of rock, dimension exceeding 1.0 meter in any direction, which requires cutting only by use of manual/pneumatic chisel/drill or sledge hammer and chiesel or removal of same by additional techniques. The disposal of excess rock as per the requirement of authorities. The rates are payable over and above the laying rates as per relevant SOR Item No. 1.



Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

**SOR 5 - FABRICATION & INSTALLATION OF PIPELINE MARKERS:** Supply and Installation of Stone Route Markers, Powder Coated Plate / Pole Markers as per the attached drawings, along the route / along boundary wall, lamp posts including all associated civil works such as excavation and construction in all types of soils, construction of pedestals of RCC(C-20) and PCC (1:4:8) and grouting with concrete, cleaning, supply and application of approved colour and quality of primer and paint, stencil letter cutting of numbers, direction, chainage etc., restoration of area to original condition and performing all works as per drawings, specification and instruction of Engineer-in-Charge. The rates shall include liaison rates with statutory bodies and restoration rates and no separate rates are payable under this SOR.

( Minimum cement content required for C-20 grade concrete is = 400-450 kg/m3 of concrete )

**SOR 6 - RESTORATION OF TRENCHES:** Restoration to original conditions of dismantled surface like Asphalted/Bituminous Road, Concrete Pavement, Stones / Tiles (Chequered/interlocking etc.), Dry Brick Pavement as per the technical specifications attached in the tender after laying of pipeline in Built- Up surface, as per the directions of EIC / Site Incharge. Restoration of society to original conditions and get NOC from society for payments . Scope includes supply of the approved quality material, testing of materials by third party agencies as per technical specification Standards, submission of the restoration reports, obtaining no objection certificates from the concern local authorities /land owners / third party inspection agencies designated by land owing agencies and Owner.

**SOR 9 - INSTALLATION OF VALVE CHAMBERS:** All civil works including supply of materials, excavation of pit, piping supports including all PCC, RCC and Brick works for valve pits, sand filling to cover valve body and pits, pedestals with insert plates as required, sealing of pipes in pits, providing cover etc., finishing, clean up and restoration. The work shall be executed as per specification. Also providing water proofing agents internal and external plaster of chamber to avoid water seepage.

**JOINTING, FLUSHING, TESTING, NITROGEN PURGING AND GAS COMMISSIONING/CHARGING OF ALREADY LAID/EXISTING PE NETWORK (Including retesting & testing):** Pneumatic testing, purging with nitrogen & Commissioning of already laid PE Pipe (PE 100, SDR 11) including supply of manpower, labour (to identify the leak / making the pits), jointing of fittings, its installation and manpower, labour (for making the pits) etc. and submission of final documents (like: As-built etc.) and tapping from main line/charged line is the scope of contractor.

Jointing, Flushing, cleaning, Pneumatic testing, purging with nitrogen and commissioning including installations of all required PE fitting as per specification and approved procedures providing all tools and tackles, nitrogen, instruments, manpower and other related accessories including PPE and as per instructions of the Engineer-in charge.

Maintaining the completed pipelines/ installation for any defect, failures during defect liability period.

Handing over the completed works to SIPI for their operation/ use, returning of all surplus material to SIPI stores, reconciliation of free issue material area wise and obtaining no objection certificate.

In case, the minimum required depth is not possible due to site condition, necessary mitigation measures shall be required to be taken by contractor in consultation with EIC . No additional payment shall be admissible against the same.

On completion of gas charging of pipelines, preparation and submission of As built drawings, As graph drawings, crossings details, termination, utility graphs and deviation statements with Hard & Soft copy.

Submission of all documents required for contract closure in numbers as mentioned in Tender Documents and as per EIC.





**Laying of PE 100 PE-100 Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

**ANNEXURE # 1**

**TOOLS & EQUIPMENTS TO BE PROVIDED BY THE CONTRACTOR FOR PE LAYING**

Sl. No.	Equipment Details	Indicative Requirement(In Nos.)
1	Automated Electro Fusion Machine with valid calibration	2
2	Voltage Stabilizer	2
3	Generator (5.5 KVA)	2
4	Moiling Equipment (for all sizes)	As and when required
5	HDD Machines & Equipment (for all types & sizes)	As and when required
6	Squeeze Tools (Manual) up to 63 mm. certified as per GIS/PL2 part 7 by third party inspection agency and approved by OWNER	4
7	Rotary Peelers	2
8	Hand Scraper (Aluminum Handle with blade) certified as per GIS/PL2 part 5 by third party inspection agency and approved by OWNER	3
9	Top loading Tapping Tools/Allen Keys certified as per GIS/PL2 part 5 by third party inspection agency and approved by OWNER	Three sets of all sizes
10	Pipe Cutter (Guillotine) as per GIS/PL2 part 5 by third party inspection agency and approved by OWNER	5
11	Test Ends for pressure test as per GIS/PL2 part 5 by third party inspection agency and approved by OWNER	One set of all sizes
12	Gas Detection Unit	As and when required
13	Cable and Pipe Locator	As and when required
14	Pipe Alignment Clamps (32 - 90 mm) as per GIS/PL2 part 5 by third party inspection agency and approved by OWNER	3
15	Pipe Straightener	2
16	Re-rounding Tools as per GIS/PL2 part 5 by third party inspection agency and approved by OWNER (All Sizes)	2
17	Jumping Jack Compactor	As and when required
18	Roller for Asphaltting	As and when required
19	Calibrated Pressure Gauges (0-10 Bar)*	10
20	Water Tankers	As and when required
21	Heating Element for HDPE Butt Joint along with clamping, roller, and other accessories.	As and when required

**Note:** Pressure Gauges (0-10 Bar) shall be calibrated at every Six months. Approval Certificate of all tools to be submitted by contractor.



**Laying of PE 100 PE-100 Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

**ANNEXURE # 2**

**RESTORATION PROCEDURE/GUIDELINES FOR ROAD CUTS OF MC AND OTHER LANDOWNING AGENCIES**

**1.0 PURPOSE AND OBJECTIVE**

The main purpose and objective of this document is to ensure that all the work are carried out with proper specifications and standards with high quality and timely accomplishment, and the restoration of infrastructure is according to standards aimed at achieving the original condition of the road infrastructure.

**2.0 DOCUMENTS/FILES TO BE MAINTAINED:**

The following documents shall be maintained during execution of the job and shall be handed over to OWNER/Consultant/TPI after completion of the job.

- Copy of permission letter obtained from relevant authorities.
- Drawing/Sketch showing the details of stretch to be cut, highlighting the type of surfaces and its chainage/length (area).
- Stage wise Photographs of the stretch.
- Test Certificates of the Construction materials to be used.
- Routine Test Certificates for construction materials during progress of job.

**3.0 RESTORATION OF TRENCHES/PITS**

After laying pipeline, backfill material without containing extraneous material or hard lumps of soil or stones shall be filled and watered in layers of 150mm. Warning mats shall be placed as per specification. Earth shall be filled watered and compacted in layers with the help of earth compactor (Jumping jack compactor wherever space is available). After backfilling, the crown of the earth shall be between 50mm and 100mm above road surface and shall be free from sharp-edge stone and boulders.

After consolidation of backfill, the surplus earth shall be removed and disposed at place directed by OWNER (at suitable locations, as per direction of PMC)

Further, depending upon the Surface types of following specification shall be adopted:

Sl. No.	Surface Types	Specification Recommended
1	Cement Concrete Surface	Top Surface – PCC 1:2:4, 100 mm Thick Compacted with Plate Vibrator shall be laid over base course. Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.
2	Brick Soiling	Top Surface – Brick Soiling (as per original type) shall be laid over base course. Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.
3	Interlocking CC Paver Block	Top Surface – Interlocking CC Paver Blocks (as per original type) shall be laid over compacted fine sand 50 mm Thick over base course. Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.



**Laying of PE 100 PE-100 Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

4	Chequered Cement Concrete Tiles/Pre-cast CC Tiles/Red Stone Floor	Top Surface – Tiles/Floor (as per original type) shall be laid over Cement Sand Mortar 1:6, 20mm Thick over base course, Joints shall be pointed/finished to match colour. Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.
5	Bituminous Surface (for Category D Roads i.e.; Roads less than 13.70 M width)	Top Surface – 40mm Thick Bituminous Concrete (as per original type) shall be laid over PCC 1:2:4, 100 mm Thick over base course. Base Course – PCC 1:5:10, 75 mm Thick laid over compacted backfilled earth.
6	Bituminous Surface (for Category C Roads i.e.; Roads less than 18 M width but greater than 13.70 M width.)	Top Surface – 40mm Thick Bituminous Concrete (as per original type) shall be laid over PCC 1:2:4, 150mm Thick over base course. Base Course – PCC 1:5:10, 150 mm Thick laid over compacted backfilled earth.

**NOTE:** Wherever the Bituminous portion is cut in small patches or isolated locations where area of Bituminous portion is very less due to constraints like other utilities, the surface shall be restored, same as specified for the cement concrete surface, with prior approval of EIC.

#### 4.0 TESTING OF CONSTRUCTION MATERIALS

For the different construction materials proposed to be used the following tests are required to be carried out for approval:

Sl. No.	Material	Test	Frequency of Test
1	Cement	Setting time, soundness, compressive strength, and fineness	Once for each consignment or as and when required/directed
2	Bricks	Compressive strength, water absorption and efflorescence	Minimum five samples
3	Coarse Aggregates	Sieve analysis, flakiness index, estimation of deleterious materials, organic impurities, moisture contents and specific gravity	One test per source of supply and routine test regularly as directed
4	Fine Aggregates	Sieve analysis, clay silt and moisture contents and specific gravity	One test per source of supply and routine test regularly as directed

In addition to the above construction materials such as interlocking paver blocks, chequered cement concrete tiles, Pre-cast CC tiles, Red Stones Flooring samples shall be arranged for approval before use and if required testing shall be arranged.

For Cement concrete works the minimum frequency of sampling of concrete (CC cubes) shall be as follows:



**Laying of PE 100 PE-100 Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

Sl. No.	Quantity of concrete in Cu. M	No. of Samples
1	1 – 5	1
2	6 – 15	2
3	16 – 30	3
4	31 – 50	4
5	51 and above	4 + 1 additional sample for each additional 50 Cu. M and part thereof.

The cement concrete cubes shall be tested for 7 & 28 days as per EN 12390-1:2000.

#### **5.0 INSPECTION BY THIRD PARTY INSPECTION AGENCIES (TPIA) NOMINATED BY LAND OWNER**

It is the responsibility of the contractor to give inspection call, at least one week in advance to OWNER/PMC, to arrange for inspection by TPI nominated by land owner along with the file containing all documents mentioned in Clause No. 2 of this document. Before inspection by TPI nominated by land owner, contractor has to arrange for the inspection of the restored area by OWNER/PMC/TPI and get the work certified. Contractor has to arrange for all necessary equipment, tools & tackles, labour for carrying out the inspection of the restored area. It is the responsibility of the contractor to obtain “No Objection Certificate” (NOC) from the TPI nominated by the land owner.



**Laying of PE 100 PE-100 Pipe at Cotonou, Benin of West  
Africa**



Resonance Energy

Tender Document No:  
**A IIP /REPL/003/PEL**

**Date: 10/08/2023**

**3.0 PTS - ELECTROFUSION FOR PE PIPES & FITTINGS**



Laying of PE 100 PE-100 Pipe at Cotonou, Benin of West Africa



Resonance Energy

Tender Document No:  
A IIP /REPL/003/PEL

Date: 10/08/2023

TABLE OF CONTENTS

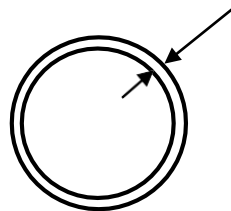
1.0 ELECTRO FUSION FOR PE PIPE .....

## 1.0 ELECTRO FUSION FOR PE PIPE

### 1.1 Electro Fusion Fitting Jointing

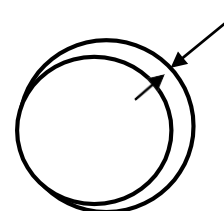
- 1.1.1 For electro fusion fitting jointing, an electrical resistance element is incorporated in the socket of the fitting which, when connected to an appropriate power supply, melts and fuses the materials of the pipe and fitting together.
- 1.1.2 The effectiveness of this technique depends on attention to the preparation of the jointing surfaces, in particular the removal of the oxidized surface of the pipe over the socket depth and ensuring the jointing surfaces area clean. Also, the pipe should be checked for ovality. If ovality causes a gap between concentrically located pipe and the fitting to exceed 1% of the pipe OD, the pipe must be re-rounded to ensure correct welding. If the gap still exceeds 1% of the pipe OD after re-rounding, then a check should be made of the pipe OD dimensions to determine if it meets specification.

Max gap 1% of pipe OD



Concentrically  
Located

Max gap 2% of pipe OD



Eccentrically  
Located

- 1.1.3 The maximum gap between eccentrically located pipe and fitting i.e. Pipe touching fitting at one point, must not exceed 2% of the pipe OD.
- 1.1.4 Sometimes coiled pipes may be too oval to fit into couplers, or the end of the pipe may make the alignment of the ends impossible. In such circumstances the use of a mechanical pipe straightener or rounding tool is necessary.
- 1.1.5 The equipment and procedures following relate to fittings with center stops. If fittings without center stops are used, the maximum insertion depth must be clearly marked on the pipe ends prior to joining (felt tip pen).

### Equipment

- a. The control box input supply is to be from a nominal 240V generator, which is normally of approximately 5kVA capacity. The nominal output of the generator is to be 240V + 15%, - 10% between no load and full load. Control boxes are to include safety devices to prevent excessive voltages being present at the control box output. The safety device shall operate in less than 0.5 second.

**Note that extension leads are not to be used on the control box outlet connections.**

### WARNING:

- b. Control boxes are not intrinsically safe and must therefore not be taken into the trench.
- c. A mechanical pipe surface preparation tool is to be used before fusion is attempted. The tool is to be capable of removing the oxidized surface of the pipe in excess of the insertion depth. The tool is to remove a layer of surface material 0.2 – 0.4 mm thick from the outer surface of the pipe preferably in a continuous strip of swarf over that length and round of the pipe.
- d. Pipe clamps for restraining, aligning, and re-rounding the pipes in the fusion process are to be used.
- e. Pipe cutters with saw and saw guide.
- f. Protection against adverse weather conditions.
- g. Hydraulic or motorized pipe cutter to be used for 180 mm dia PE pipes.

## 1.2 Electro Fusion Jointing Method / Procedure

### Preparation

- a. Ensure there is sufficient space to permit access to the jointing area. In a trench, a minimum clearance of 150 mm is required.
- b. Check that the pipe ends to be jointed are cut square to the axis of the pipe and any burrs removed.
- c. Wipe pipe ends using clean lint-free material to remove traces of dirt or mud, etc.
- d. Mark the area over which the oxidized pipe surface is to be removed, i.e. In excess of the insertion depth, on each pipe to be jointed by placing the socket of the bagged fitting alongside the pipe end. Trace a line round the circumference at the appropriate distance from the end of the pipe using a felt tip pen or similar.

**Note that the fitting should not be removed from the packaging at this stage.**

- e. Connecting the electro fusion control box input leads to the generator.
- f. Check that the reset stop button, if fitted on the control box, is in the correct mode.
- g. Using the pipe end preparation tool, remove the entire surface of the pipe uniformly, preferably in continuous swarf over the area identified, i.e. In excess of the insertion depth.

A mechanical scraper could be used; however, there is a considerable risk that the end preparation will not be adequate with the use of such a tool.

**Note that the prepared pipe surface should not be touched by hand.**

- h. Remove the fitting from its packing and clean the scraped area of the pipe surface and the bore of the fitting with a disposable wipe impregnated with Isopropanol / Acetone. Ensure the prepared surfaces are completely dry before proceeding.

**Note that while Isopropanol is a suitable cleaner, its use is subject to local Health and Safety Regulations.**

- i. Check that the pipe clamps are of the correct size for the pipes to be joined.
- j. Insert the pipe ends into the fitting so that they are in contact with the center stop.
- k. Using the pipe clamps, secure the pipes so that they cannot move during the fusion cycle. Check that the pipe ends, and the fitting are correctly aligned.
- l. Check that there is sufficient fuel for the generator to finish the joint. Start the generator and check that it is functioning correctly.
- m. Switch on the control box.
- n. Connect the control box output leads to the fitting terminals and check that they have been fully inserted.

If required by the control box enter the fusion jointing time into the control box timer. The jointing time is indicated on the fitting. Check the correct time is shown on the control box display.

**Note 1:** Automatic control boxes are available which obviate the need to enter the fusion time.

**Note 2:** Gloves and goggles should be worn during the Fusion process.



- o. Press the start button on the control box and check that the heating cycle is proceeding as indicated on the display.
- p. On completion of the heating cycle, the melt indicators should have risen. If there is no apparent movement in the melt indicators, the joint should be cut out and a fresh joint made (See note 3 below).
- q. If a satisfactory joint has been made, the joint is to be left in the clamps for the cooling time specified on the fitting or the automatic control box.

**Note 3:** If the fusion cycle terminates before completion of the countdown, check for faults as indicated by the control box warning lights and check that there is adequate fuel in the generator. DO NOT attempt a second fusion cycle within one hour / cooling of joint at Ambient Temperature of the first attempt.

### 1.3 Records

Records of appropriate servicing and calibration shall be kept.

### 1.4 Training

It is necessary that operators, inspection and supervisory personnel acquire the skills of electro fusion fitting. The necessary training should be carried out by a qualified instructor with the objective of enabling participants to;

- ❖ Understand the principles of electro fusion fitting jointing.
- ❖ Identify pipe and appropriate fitting markings.
- ❖ Carry out pre-jointing machine and equipment checks.
- ❖ Make satisfactory electro fusion fitting joints from pipes and fittings of different sizes.
- ❖ Inspect for and identify joints of acceptable quality.

**Note that some form of assessment and certification should be associated with the training. The certificate should detail the pipe and fitting size range. And the equipment used. A register of successful participants should be kept.**

### 1.5 Electro Fusion Saddle Jointing

- a. With electro fusion saddle jointing, an electrical resistance element is incorporated in the base of the saddle which, when connected to the appropriate power supply, melts and fuses the material of the fitting and the pipe together.
- b. The success of the technique depends on effective preparation of the jointing surfaces, in particular the removal of the oxidized surface of the pipe over the area equivalent to the area of the saddle base, and cleaning of the pipe surfaces.
- c. Methods of holding the tapping tee saddle during the fusion cycle are used namely, toploading and under clamping. The general parameters are similar. In some cases, if the manufacturer's procedure for holding the fitting is provided, then the same should be followed during the fusion cycle.

### 1.6 Electro Fusion Saddle Jointing Method / Procedure

#### Preparation

- a. Expose the pipe onto which the tapping tee is to be assembled, ensuring there is sufficient clear space around the pipe. In a trench, a minimum clearance of 150 mm is required.

- b. Clean the pipe over the general area on which the saddle is to be assembled using clean, disposable lint -free material.
- c. Without removing the fitting from its packaging, place it over the required position on the main. Mark the pipe surface all around and clear of the saddle base area using a felt tip pen or similar.
- d. Remove the surface of the pipe to a depth of 0.2 to 0.4 mm over the full area marked using a suitable tool. Remove the swarf.
- e. Connecting the electro fusion control box input leads to the generator.
- f. Check that the reset stop button, if fitted on the control box, is in the correct mode.
- g. Remove the two halves of fitting from its packing and clean the scraped area of the pipe surface and the bore of the fitting with a disposable wipe impregnated with Isopropanol / Acetone. Ensure the prepared surfaces are completely dry before proceeding.

**Note again that while Isopropanol is a suitable cleaner, its use is subject to local Health and Safety Regulations.**

- h. Position the fitting base onto the prepared pipe surface, and bring the lower saddle into position then gradually and evenly tighten the nuts until the upper saddle makes firm contact with the scraped pipe.
- i. Check that there is sufficient fuel for the generator to complete the joint. Start the generator and check that it is functioning correctly.
- j. Switch on the control box if applicable.
- k. Connect the control box output leads to the fitting terminals and check that they have been fully inserted.
- l. If required by the control box, enter the fusion jointing time into the control box timer. The jointing time is indicated on the fitting. Check the correct time is shown on the control box display.

**Note 1:** Automatic control boxes are available which obviate the need to enter the fusion time.

**Note 2: Gloves and goggles should be worn during the jointing process.**

- m. Press the start button on the control box and check that the heating cycle is proceeding as indicated on the display.
- n. On completion of the heating cycle, the melt indicators, where incorporated should have risen. If there is no apparent move in the melt indicators, a new saddle joint should be made. Cut the tee of the faulty joint from its base.
- o. If a satisfactory joint has been made, the joint is to be left in the clamps for the cooling time specified on the fitting label or by the automatic control box.

**Note 3:** If the fusion cycle terminates before completion of the countdown, check for faults as indicated by the control box warning lights and check that there is adequate fuel in the generator. **DO NOT attempt a second fusion cycle within one hour of the first attempt.**

**Note 4:** The connection of the service pipe to the fitting outlet should be carried out in accordance with the procedure of the appropriate section of this Item.

**Note 5:** DO NOT attempt to tap the main with the integral cutter for at least 10 minutes after completion of the cooling cycle.

## 1.7 Records

Records of appropriate servicing and calibration of Electro Fusion machines/ joints shall be kept.

### 1.8 Training

AS PER 1.6

Note that some form of assessment and certification should be associated with the training. The certificate should detail the pipe and fitting size range and the equipment used. A register of successful participants should be kept.

### 1.9 Stopping the gas flow

In the operation of a distribution system there is a periodic need to stop the gas flow for either routine or emergency maintenance. The flow may be stopped through the use of installed fittings such as valves. Where installed fittings are not available or the use of such would cause significant supply disruption, then one of the following methods may be employed.

### 1.10 Squeeze-off

- a. To control the gas flow a special tool may be used to squeeze the pipe walls together. Hydraulic jacks are used to supply the necessary force to compress the pipe walls for pipe sizes 90 mm and above.
- b. As will be seen the squeeze-off equipment comprises two bars to apply pressure to the outside of the pipe. The bars are brought together, either manually or hydraulically, squeezing the pipe material together until a seal is formed where the upper and lower walls meet.
- c. The hydraulic machines should have a spring return for the jack and locking to prevent accidental release of pressure during operation. All squeeze-off machines should be fitted with check plate or stops to avoid over compression of the pipe.
- d. Where the pipe walls are compressed the polyethylene pipe will be severely deformed in the regions of maximum compression. The pipe will eventually regain its original shape after squeezing but there will be some reduction in the pressure bearing properties.
- e. A complete stop may not always be obtainable because of wrinkling of the inside of the pipe. If a complete stop is required then a second squeeze can be used, with an intermediate vent to remove the gas which passes the first squeeze from say the trench area. A second squeeze-off procedure should be a minimum of three pipe diameters and right angles to the initial squeeze.
- f. While not essential it would be good practice to fit a reinforcing stainless-steel band / do not squeeze again adhesive tape around the pipe upon the completion of a squeezing operation.

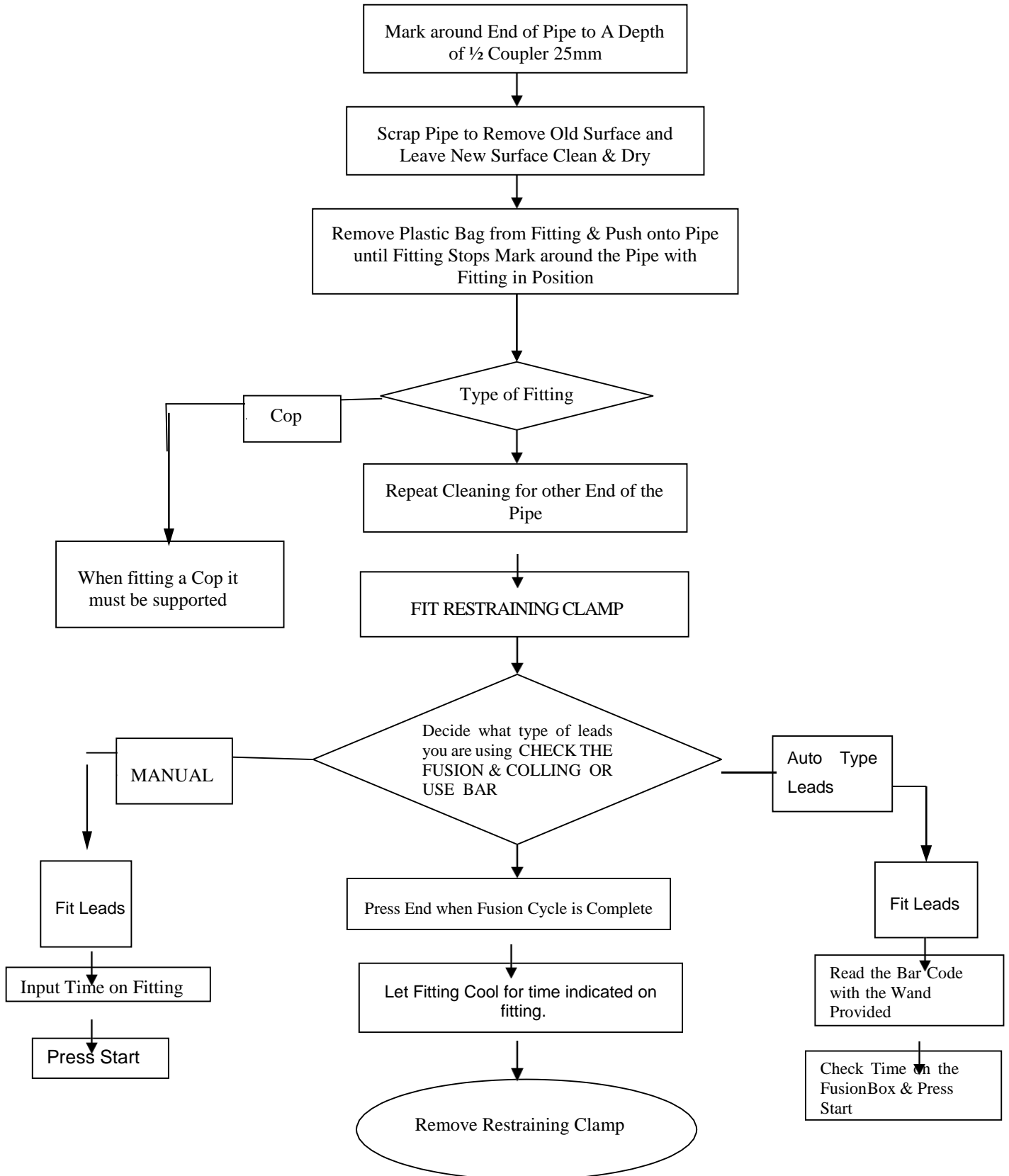
### 1.11 Bending-Back

Bending back of the pipe may be performed where the pipe has been severely damaged and stopping the gas flow is imperative. Its application is of a temporary nature and will provide relief until a permanent repair can be effected. The section of pipe, which has been bent back, will have to be replaced because of the damage caused by the severity of the bend back operation. The need for any bend back operation is most likely to occur as a consequence of damage caused to a PE service pipe.

While it is not the prime function of a saddle tee, controlling the flow in a service may be achieved by opening up on an installed saddle tee and winding down the internal tapping tool to shut off the flow into the service pipe.

**ATTACHMENT # 1**

**FUSION COUPLERS FROM 32MM TO 180MM**





**Laying of PE Pipe at Cotonou, Benin of West Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

**4.0 PTS – HEALTH, SAFETY & ENVIRONMENT**



Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

**TABLE OF CONTENTS**

**1.0 SCOPE**.....

**2.0 REFERENCES**.....

**3.0 RESPONSIBILITY & ORGANISATION**.....

**4.0 GENERAL REQUIREMENT** .....

**5.0 ACCIDENT, INCIDENT AND NEAR-MISS REPORTING** .....

**6.0 HSE REQUIREMENTS AT SITE**.....

ANNEXURE - A.....

ANNEXURE - B.....



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

### 1.0 SCOPE

This specification establishes the health, safety, and Environment (HSE) aspects to be complied with by the contractor during construction at site.

### 2.0 REFERENCES

This document should be read in conjunction with following.

- General Condition of Contract (GCC)
- Special Condition of Contract (SCC)
- Job Specifications
- Reporting Formats

### 3.0 RESPONSIBILITY & ORGANISATION

Safety activities at site shall be under control of contractor's RCM. He shall be responsible for implementation of HSE provisions. The nominated or designated safety engineer/ officer shall assist and perform day to day HSE work as per his advice.

### 4.0 GENERAL REQUIREMENT

- 4.1. The contractor should follow HSE policy of owner as applicable to construction site.
- 4.2. The contractor shall deploy a full-time HSE engineer / officer to coordinate the site.
- 4.3. The HSE officer shall be duly qualified in Industrial Health & Safety management with experience of 4-5 years.
- 4.4. The contractor shall ensure that HSE requirements are clearly understood & faithfully implemented at all level, at each site.
- 4.5. The contractor shall organize safety awareness programs regularly.
- 4.6. The contractor shall ensure his participation in every HSE meeting called by OWNER / PMC.
- 4.7. The contractors shall conduct daily toolbox talk.
- 4.8. The contractor shall submit Monthly HSE reports (Form attached in ANNEXURES).
- 4.9. The contractor shall provide all help and support to the injured person who got injury at site during construction work and arrange compensation as per insurance policy / Act.
- 4.10. The contractor shall adhere consistently to all provisions of HSE. In case of non-compliance or continuous failure the OWNER / PMC may impose stoppage of work without any cost time implication to owner. A penalty amount of €20 shall be imposed on the contractor for the serious HSE violation.
- 4.11. Three times of this penalty may count as a serious violation of contractor in line with HSE. This may affect to new work assignment/award of contractor.
- 4.12. Bidder shall also follow the SIPI-BENIN specification for HSE management.

### 5.0 ACCIDENT, INCIDENT AND NEAR-MISS REPORTING

#### Accident

Unintended occurrence arising out of and in the course of employment of a person, which results into injury with or without damage to plant/equipment/materials.

#### Incident

means an unplanned and uncontrolled event which results in damage to plant or equipment or loss of material without causing any injury to persons, like fire, spill, leak, property damage etc.



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

### **Near-miss**

An unexpected, unwanted event not causing loss, injury or illness but which under slightly altered conditions can lead to an accident.

can be defined as “Any event which under slightly unfavorable circumstances, may have resulted in any of the following:

- Injury, fatal or otherwise or ill health to people
- Loss of property, damage to plant or materials
- Damage to the environment
- A business interruption”

Accident, Incident and Near miss reporting form listed in ANNEXURES.

## **6.0 HSE REQUIREMENTS AT SITE**

### **6.1 Personnel Protective Equipment**

The contractors shall provide sufficient numbers of following personal protective equipment (PPEs) to workmen and supervisors/engineers to use them properly at work site.

Following five numbers of Personnel protective equipment are identified as MANDATORY for all.

- Safety Helmet
- Coverall
- Safety shoes/footwear
- Safety Glasses
- Hand Gloves (as per job requirement)

Other PPEs depend upon nature of job like Arc.

Welding – Welding face shield

Grinding – Grinding face shield

Height work – Full Body harness (above 2 meters)

Ask site supervisor for proper use and selection of protective clothing / equipment for specialized jobs.

### **6.2 Welding**

- Ensure that welding machine is in order and approved by site engineer.
- Ensure that welding cables are in order.
- Ensure that welding machine is properly earthed.
- Remove all combustible material from welding area to avoid fire.
- Place a fire extinguisher near welding premises.
- Ensure welding holder, cable and its lugs in good condition and use only industrial power socket and plugs (3 Pin) to avoid electricity risk.
- Make sure that welding machine is provided with ON/OFF switch and is earthed/grounding.
- Do not overload electrical appliances and cable, Shocked pin etc.,
- Ground the work piece separately from the welding return connection only.

### **6.3 Gas Cutting**

- Check the cylinder and its valve or leakage and move out any leaking cylinder immediately.
- Ensure that flash back arresters are installed with torch and NRV (Non return valve) on the gas



cylinders side.

- Ensure cylinders in vertical position (Cylinder trolley) and far away from fall of sparks and hot metal.
- Check the regulator and torches that are inspected prior to every use.
- Check for leaks around regulators, hoses/fittings & nozzle with soap solution.
- Check the entire hose length if it is cracked or worn out cut that length of hose or replace the hose.
- Check that flash back arrester used for the purpose is of approved make/specification only.
- Place a fire extinguisher near welding premises.

#### 6.4 Grinding Operation

- Grinding wheels should be stored in dry place.
- After expiry date, grinding wheel must be condemned, broken in to pieces.
- Power supply cable of adequate current carrying capacity shall be used and it should be in good workable condition without abrasions, cuts or puncture in outer insulation.
- Socket pin provided at supply end and On / Off switch in working condition.
- Proper earthing of the body in case of metallic body.
- Wheel guard properly fitted in position.
- Machine body without any damage like crack etc.
- Moving part (wheel) must be properly fixed to the machine with the help of spanner.
- Grinding wheel must be of suitable size as per the speed of grinding machine.
- Grinding wheel without manufacturer's sticker showing size, speed and expiry date must be condemned.
- Don't use portable grinding machine as bench grinder.
- Don't fit over size wheel than recommended size by machine/wheel manufacturer.
- Don't grind small, unstable object without fixing it in the vice.
- Don't over press the grinding wheel against the job for fast removal of metal.
- Put OFF the main switch, while machine is not in use (tea break etc.)
- Don't chip off grinding/cutting wheel for achieving fast cutting rate.

#### 6.5 PPEs:

- Use of safety shoes , helmet, face shield or safety goggles (where face shield is not possible.) and hand gloves.

#### 6.6 Use of Power Tools and Cables

- All electrical equipment and tools used by the contractors and their employees shall be properly checked by contractor's supervisor before use.
- All power tools must have proper guard at all time.
- Leads /cables must be placed so that they do not create a tripping hazard.

#### 6.7 Material Handling and Storage

The Contractor will only use crane/Hydra and lifting equipment that has been tested and certified as fit for purpose by TPIA. All crane operators and riggers will be adequately trained and certified. The Contractor will keep records of tests and certification of all lifting equipment crane employed on the Works.

Maintenance records shall be routinely inspected by the Contractor and made available for Safety audits.

**LIFTING GEAR:** Lifting machine, chains, ropes and lifting tackles used at site shall conform to the following:

- All parts shall be good construction, sound material and adequate strength and free from defects.
- Shall be properly maintained, thoroughly examined, and load tested by competent person.
- No lifting machine and no chain, rope or lifting tackle shall except for purpose of test be loaded beyond safe working load and this safe working load must be plainly marked on the gear concerned.
- All material must be properly stacked and secured to prevent sliding, falling or collapse.
- Stairs and passageways must be kept clear at all time.

### 6.8 Trenches and Excavation

Before commencing any excavation work the Site in charge will ensure that the proposed works have been adequately assessed and planned to ensure that they are executed safely and without risks to Health and safety. The factors to be assessed and planned will include: -

- The nature and stability of the material being excavated and the need for any support of walls.
- The effect of excavation on nearby area.
- The foreseeable presence of hazardous contaminants.
- The proximity of mobile plant.
- The provision of edge protection (fall prevention of people and materials)
- Access and egress

### 6.9 Pipe Transportation and lowering

- All drivers shall hold a valid driving license for the class of vehicle.
- Securing of the load shall be according to established and approved methods.
- All overhangs shall be made clearly visible and restricted to acceptable limits.
- Load shall be checked before moving off and after traveling a suitable distance.
- All vehicles used by Contractors shall be in worthy condition and in conformance to the Land Transport requirement.
- Effective communication should be done among all involved personals.
- Signaling shall be done by authorized foreman only.
- Ensure appropriate measures are taken for overhead hazards.
- Persons are not allowed towards trench side / under the boom at the time of lowering.
- Co-ordination of lowering in by a single man only.
- Inspection of equipment before use.
- All personnel should stay clear of moving equipment.
- Use of certified lifting tools and tackles.

### 6.10 Pressure / Leak Testing

#### Hydraulic and Pneumatic Test

Access to the test area shall be limited to essential personnel only before the test commences compliance is required with the following points:

- Persons supervising pressure or leak tests must have sufficient knowledge and experience of testing to fully understand the hazards of the activity and the precaution, which must be taken.



## Laying of PE Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

- Effective communication, including formal procedures, must be established between sites whenever the test envelope extends beyond one site, for example, pipelines.
- The area shall be cordoned off (using tape, shields or barriers, etc.) at an adequate distance from the equipment to be tested, as specified on the Permit to Work
- Warning signs shall be posted at access ways, at other strategic positions, and on the equipment to be tested (including the doors of test workshops or other designated areas
- Pressuring equipment shall be provided with suitably calibrated pressure control / regulator devices.
- Pressuring equipment shall not be left unattended at any time during the test.
- Pressuring equipment shall be isolated from the equipment under test and where practicable disconnected when the test pressure has been reached.
- Care must be taken to ensure that materials of construction have the required ductility at the test temperature to prevent brittle fracture.
- A safety valve should be fitted to the equipment/system being tested, set to relieve at a pressure that will prevent over pressurization.
- Sufficient venting / draining points shall be provided in order to prevent trapping of pressurizing medium behind non-return valves, check valves, between isolation valves, or within dead legs of the pressure envelope.
- The equipment/plant to be pressure tested must be subjected to thorough examination prior to testing. It may be necessary to 100% inspect all welds using visual, radiographic, or other NDT techniques.
- The gas supply must be isolated when test pressure has been achieved.
- The pressure envelope must contain sufficient vents, to a safe location.
- De-pressurization after pneumatic testing must be gradual.

### **6.11 Scaffolding and Ladder**

- All working platform must be constructed with the specific requirement of job.
- All portable ladders must be in good condition as per the site norms.
- If the working platform is not permanent, then safety belt must be used.
- There shall be firm foundation for all scaffoldings. All scaffolding shall be made of sound material.
- Scaffolding material shall be inspected and used, only if found in good condition.
- Provide metal base plate is used under all upright or standard scaffoldings. Correct type of couplers shall be used for all connections.
- Plumb and level scaffoldings as erection proceeds, so that braces will fit without forcing. Fasten all braces securely.
- Working platforms shall be provided with guards. This should consist of top rail, mid rail, and toe board. The toe board shall be of minimum height 100 mm, while the mid rail and top rail shall be at heights of 600 mm and 1200 mm respectively.
- Do not use ladders or makeshift devices on top of scaffoldings to increase the height.
- Shall be placed at least 75 deg. to the floor.
- Ladder shall extend 3' to 4' above the point of Landing and topmost 3 rungs shall not be used.
- Ladder is checked visually for defects before every use.
- Ladders shall not be used in a horizontal position as runways or scaffoldings.
- Ladders shall not be placed in front of a door that opens toward the ladder unless the door is locked, blocked, or guarded.



## Laying of PE Pipe at Cotonou, Benin of West Africa



Date: 10/08/2023

Tender Document No:  
A IIP/REPL/003/PEL

- Fall arrestor to be used wherever applicable.

### 6.12 Work Permit Procedure

- For working at more than 10' height the permission must be obtained from site in-charge.
- For doing any Hot work in the fire risk areas the permission must be obtained from site in charge or safety officer.
- For any Excavation work it must be ensured that there are no underground utilities like cables, Water pipeline etc.
- For any work inside confined space, entry permit must be obtained from site engineer.

### 6.13 Barricades and Warning Signs

- Area where work is being carried out above man height or below 1' ground depth must be barricaded.
- Follow the instruction of all types of warning signs like "NO SMOKING" "NO ENTRY" "DANGER" "Work at height."

### 6.14 Emergency Plan and Procedures

- All Contractor's employees should be aware of site Emergency control plan.
- Periodic drill to train employees for their awareness & information should be followed.

### 6.15 Road Safety Norms

- For roadside working site to be barricaded as per approved barricading norms given in drawing. Penalty clause for road safety & barricading shall be applicable as per relevant clause of commercial part of tender.
- Only eligible driver can drive required vehicle inside site.
- Speed limit norms of site must be followed.
- No riding or travelling on the back of open-ended vehicle, forklift or trailers should be done.

### 6.16 Labour Welfare & Legal Requirement

- All mandatory provisions with regard to safety as prescribed under contract Labour (Abolition & Regulation) Act of international Standard and Rules made there under are applicable.
- Workmen compensation insurance and registration under ESI should be maintained.
- Time to time, all rules and regulations suggested by safety committee of site must be followed and implemented.

**Note: Following Annexures Are to Be Duly Filled That Are Enclosed Herewith.**



**Laying of PE 100 MDPE Pipe at Cotonou, Benin of West Africa**



Tender Document No:  
**A IIP /REPL/003/PEL**

**Date: 10/08/2023**

**1.0 HEALTH, SAFETY & ENVIRONMENT (HSE) PLAN**

**ANNEXURE – A**  
**FORMAT - 1.0**

Project : .....

Contractor: .....

Date : .....

Owner: .....

(To be prepared & submitted by each Construction Agency)

Activity Description	Procedure/ W.I./ Guidelines	Code of Conformance	Performing Function			Audit Function
			Performance	Checker	Approver	Customer Review/ Audit Requirements

PREPARED BY

REVIEWED

APPROVED BY



**Laying of PE 100 MDPE Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

**ANNEXURE – B**

**2.0 : MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE**

Project: \_\_\_\_\_

Contractor : \_\_\_\_\_

Date: \_\_\_\_\_

Owner : \_\_\_\_\_

Inspection By : \_\_\_\_\_

**Note: write 'NC' (Not Concern) wherever any of the items are not applicable**

Item	Yes	No	Remarks	Action
<b>HOUSEKEEPING</b>				
Waste containers provided and used				
Sanitary facilities adequate and Clean				
Passageways and Walkways Clear				
General neatness of working areas				
Proper Material Storage				
Wooden Boards properly stacked, and nails removed				
Cords, leads out of walk and traffic ways				
Scraps removed from the work site				
Other				
<b>PERSONNEL PROTECTIVE EQUIPMENT</b>				
Goggles : Shields				
Face protection				
Hearing protection				
Safety Shoes				
Hand protection				
Respiratory Masks etc.				
Safety Belts				
Safety Helmets				
Other				
<b>EXCAVATIONS / OPENINGS</b>				
Excavation permit				
Excavated earth kept away from edge				
Dewatering pump kept away from edge				
Safe access into excavated area				
Opening properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				



**Laying of PE 100 MDPE Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

Item	Yes	No	Remark	Action
Welding Cutting				
Valid not work permit				
Flashback arrester provided for cylinders				
Power cable not crossing the welding cable				
Adequate earthing provided				
No combustible materials kept near welding & cutting works				
Gas cylinder chained upright & kept in trolleys				
Cables and hoses not obstructing				
Screens or shields used				
Flammable materials protected				
Fire extinguisher (s) accessible				
Other				
<b>SCAFFOLDING</b>				
Fully decked platform				
Guard and intermediate rails in place				
Toe boards in place & tied properly				
Adequate shoring				
Adequate access				
Other				
<b>LADDERS</b>				
Extension side rails 1'm above				
Top of landing				
Properly secured at top & bottom				
Angle $\pm 70^\circ$ from horizontal				
Other				
<b>HOISTS, CRANES AND DERRICKS</b>				
Condition of cables and sheaves OK				
Condition of slings, chains, hooks, and eyes OK				
Inspection and maintenance logs maintained				
Outriggers used				
Singh/ barricades provided				
Signals observed and understood				
Qualified operators				
Other				
Item	Yes	No	Remark	Action
<b>MACHINERY, TOOLS AND EQUIPMENT</b>				
Proper instruction				
Safety devices				
Proper cords				
Inspections and maintenance				
Other				
<b>VEHICLE AND TRAFFIC</b>				
Rules and regulations observed				



**Laying of PE 100 MDPE Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

Inspection and maintenance				
Licensed drivers				
Others				
<b>TEMPORARY FACILITIES</b>				
Emergency instruction posted				
Fire extinguishers provided				
Fire-aid equipment				
Secured against storm damage				
General nemeses				
In accordance with electrical requirements				
Other				
Fire Prevention				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas				
Hydrants clear				
Other				
<b>ELECTRICAL</b>				
Proper wiring & earthing				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Proper electrical cable joints				
Light poles secured				
Clear way to power distribution board				
Proper rating of fuses				
<b>HANDLING AND STORAGE OF MATERIALS</b>				
Properly stored or stacked				
Passageways clear				
Other				
<b>Item</b>	<b>Yes</b>	<b>No</b>	<b>Remark</b>	<b>Action</b>
<b>FLAMMABLE GASES AND LIQUIDS</b>				
Containers clearly identified				
Proper storage				
Fire extinguishers nearby				
Other				
<b>WORKING AT HEIGHT</b>				
Erection plan				
Safety nets				
Safety belts tied properly				
Illumination				
No loose material at height				





**Laying of PE 100 MDPE Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

No body under working area				
All openings covered				
Other				
<b>ENVIRONMENT</b>				
Chemical and other Effluents properly disposed				
Cleaning liquid of pipes disposed off properly				
Seawater used for hydrotesting disposed off as per agreed proceeding				
Lubricant Waste/ Engine oils properly disposed				
Waster from Canteen office, sanitation etc. disposed properly				
Disposal of surplus earth stripping materials, Oily rags and combustible materials done properly				
Green belt protection.				



**Laying of PE 100 MDPE Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

**3.0 MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE**

Item	Yes	No	Remark	Action
<b>HEALTH CHECK</b>				
Hygienic conditions at labour camps OL				
Availability of First Aid facilities				
Proper sanitation at site, office and labour camps				
Arrangements of medical facility				
Measures for dealing with illness				
Availability of potable drinking waters for workmen & staff				
Provision of cretches for children				
<b>ERECTION</b>				
Slings/ D'shakle checked				
Signal Man				
Tag line for guiding the load				
Protecting the slings from sharp edges				
No loose materials at height				
Ladder & platform welding inspected				
No one under the suspended load				
Stay rope				
SWL				

**Note: Write 'NC' (Not Concern) wherever any of the items are not applicable**

-----  
Signature of Resident  
Engineer with Seal



**Laying of PE 100 MDPE Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

**Monthly Health, Safety & Environmental (HSE) Report  
(To be submitted by each Contractor)**

Actual work start date: \_\_\_\_\_ For the month of: \_\_\_\_\_

Project: \_\_\_\_\_ Report No.: \_\_\_\_\_

Name of the Contractor: \_\_\_\_\_ Status as on: \_\_\_\_\_

Name of Work: \_\_\_\_\_ Name of Safety officer: \_\_\_\_\_

Item	This Month	Cumulative
Total strength (Staff – Workmen)		
Number of HSE meeting organized at site		
Number of HSE awareness programs conducted at site		
Whether workmen compensation policy taken	Y/N	
Whether workmen compensation policy valid	Y/N	
Whether workmen registered under ESI Act	Y/N	
Number of Fatal Accident		
Number of Loss Time Accident (Other than Fatal)		
Other accident (non-loss time)		
Total No. of accident		
Total man-hours worked		
Man-hour loss due to fire and accident		
Compensation cases raised with insurance		
Compensation cases resolved and paid to workmen		

**Note: write 'NC' (Not Concern) wherever any of the items are not applicable**

Remark:

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

Safety Officer/PMC  
(Signature and name)

To: OWNER..... 1 COPY  
/SITE-IN-CHARGE 1 COPY



Laying of PE 100 MDPE Pipe at Cotonou, Benin of West Africa



Tender Document No: A IIP/REPL/003/PEL

Date: 10/08/2023

SUPPLEMENTARY ACCIDENT, INCIDENT & NEAR MISS REPORT

Project: \_\_\_\_\_ Supplementary to Report No.: \_\_\_\_\_

(Copy enclosed)

Site: \_\_\_\_\_ Date: \_\_\_\_\_

Contractor: \_\_\_\_\_

NAME OF THE INJURED.....
FATHER'S NAME.....
SUB-CONTRACTOR M/S.....
DATE & TIME OF ACCIDENT.....
LOCATION.....

BRIEF DESCRIPTION & CAUSE OF AN ACCIDENT

NATURE OF INJURY / DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER WHO ATTENDED THE VICTIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION IF ANY

LOSS OF MANHOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER

Note: write 'NC' (Not Concern) wherever any of the items are not applicable

Date : \_\_\_\_/\_\_\_\_/\_\_\_\_/

SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER..... 1 COPY
: RCM/SITE-IN-CHARGE 1 COPY



Laying of PE 100 MDPE Pipe at Cotonou, Benin of West Africa



Tender Document No: A IIP/REPL/003/PEL

Date: 10/08/2023

ACCIDENT REPORT

(To be submitted by Contractor after every accident within 2 hours of accident)

Report No. \_\_\_\_\_

Date: \_\_\_\_\_

Name of Site: \_\_\_\_\_
COTRACTOR \_\_\_\_\_

NAME OF THE INJURED .....
FATHER'S NAME.....
SUB-CONTRACTOR M/S.....
DATE & TIME OF ACCIDENT.....
LOCATION.....

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY / DAMAGE

MEDICAL AID PROVIDED / ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES

Note: write 'NC' (Not Concern) wherever any of the items are not applicable

Date : \_\_\_\_/\_\_\_\_/\_\_\_\_/

SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER..... 1 COPY
: /SITE-IN-CHARGE 1 COPY



**Laying of PE 100 MDPE Pipe at Cotonou, Benin of West  
Africa**



Tender Document No:  
**A IIP /REPL/003/PEL**

**Date: 10/08/2023**

**5.0 PTS – WARNING MAT**



Laying of PE 100 MDPE Pipe at Cotonou, Benin of West Africa



Tender Document No: AIIP/REPL/003/PEL

Date: 10/08/2023

TABLE OF CONTENTS

1.0 INTRODUCTION & SCOPE .....

2.0 DEFINITIONS .....

3.0 REFERENCE CODE .....

4.0 FEATURES .....

5.0 QUALITY ASSURANCE (QA) .....

6.0 DEFECT LIABILITY .....

7.0 RECOMMENDED MANUFACTURER FOR RAW MATERIAL .....



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

### 1. INTRODUCTION & SCOPE

Owner plans to establish the PNG Network for natural gas supply to industrial consumers.

The present document covers the technical specifications for the procurement of Warning Mat. Warning Mats shall be laid in the ground above the gas main line in order to indicate their presence.

### 2. DEFINITIONS

Manufacturer Means the Manufacturer of the Warning Mat / Warning Tape.

Means the present <<Particular Technical Specification>> and its entire appendix, if any.

TPIA Means the Third-Party Inspection

### 3. REFERENCE CODE

EN 12613 – Plastics warning devices for underground cables and pipelines with visual characteristics

### 4. FEATURES

#### 4.1. Material

Warning Tape, Type 1 as per EN 12613 shall be used for the present project.

The material grade of Warning Mat shall be Virgin Low-density polyethylene (PE) material with warning sticker / stamp. The material shall have the density between 0.913 to 0.923 g/cc at 27 deg. Celsius.

The tape shall be uniform in colour, texture and finish and shall be free from holes and foreign materials. Rodent repellent chemicals to be added to the plastic master batch for protection against rodents.

The material and colour, if used, for printing shall have no detrimental effects on the environment.

#### 4.2. Mechanical properties

Mechanical properties of the Warning Mat (Type I) shall be in accordance with the code EN 12613.

Minimum tensile withstand load in longitudinal direction shall not be less than 200 N. The test piece shall not exhibit a reduction of more than 20% of its width after removal of the specified load.

#### 4.3. Colour

The Warning Mat shall be of bright golden yellow colour. This colour must not take any alteration in the course of time.

#### 4.4. Dimensions

Warning Mat shall have following dimensions:

Width 300 ± 2 mm

Thickness 1.0 mm (Minimum)

Negative tolerance on the thickness is not allowed.

#### 4.5. Marking

4.5.1. The warning mat shall be marked at intervals not exceeding 1 meter. Marking on the mat shall be approved by owner. The marking shall be legible and durable. The warning mat must be printed with "Caution: High Pressure Gas Pipeline Below" in both English and local language, Chainage marking along with OWNER's





## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

logo and OWNER's 24 Hours Emergency Number -----,at a frequency of every meter.

In addition, name or trademark of the manufacturer, year of manufacture and reference of code of manufacture of warning mat shall be included in the marking.

- 4.5.2. Vendor shall submit proposed Artwork to be marked on the Warning Mat for approval from OWNER / PMC. Vendor shall submit 02 Meters sample of Warning Mat meeting the tender requirements along with the Bid.

### 4.6. Tests

All the tests and test procedures for Warning Mats shall be as per EN 12613 or as per required International standards mentioned in EN 12613. In addition, all requirements pertaining to statutory requirements, if any, as specified from time to time shall be complied with.

The required tests are briefed as below:

#### 4.6.1. Colouring

Three separate tests shall be carried out in accordance with:

- As per normative annexure B of EN 12613, using 20% ammonium sulfide.
- As per EN ISO 175, using 10% nitric acid & 20% sodium carbonate solution. The tests shall be repeated for each colour (if Any).

There shall be no discoloration or change of the initial colour of the warning tape after the tests.

#### 4.6.2. Tensile Withstand Strength

The test sample shall be selected as per mentioned in EN 12613. The test samples shall be preconditioned for not less than 12 h at  $23\pm 2$  °C. Static loads shall be carried out to the samples over a period of 10 s.

After the test, the test piece shall withstand without starting to separate at weak points (if any) for not less than 5 minutes. Also it should not exhibit a reduction of more than 20% of its width after removal of specified load.

The minimum tensile withstand load for the warning mat in the longitudinal direction shall be not less than 200 N.

#### 4.6.3. Visual Warning Characteristics

The test shall be carried out in accordance with normative annexure A of EN 12613.

#### 4.6.4. Permanence of Printing

The test shall be performed as per CL 9.3 of IEC 60898:1995.

The test is made by rubbing the marking by hand for 15 sec with a piece of cotton soaked with water and again for 15 sec with a piece of cotton soaked with aliphatic solvent hexane with a content of aromatics of max. 0.1% by volume, a kauri butanol value of 29, an initial boiling point value of approx. 65 °C, a dry point of approx. 69 °C and a density of approx. 0.68 gm/cm<sup>3</sup>.

After the test, the marking shall be easily legible.

#### 4.6.5. Test of laying Characteristics

The test is for the assessment of transverse rigidity of the warning mats. The test shall be performed as per



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

EN 12613.

#### 4.6.6. Warning Mat Virginity Test

Differential Scanning Calorimeter (DSC) Scan test along with the temperature of melting ( $T_m$ ) shall be performed for the Warning Mat and its raw polymer i.e. virgin low density polyethylene (LDPE).

The Differential Scanning Calorimeter (DSC) Scan curve of the Warning Mat obtained from its DSC Scan test along with its Temperature of Melting ( $T_m$ ) shall then be compared with the DSC Scan curve and the Temperature of Melting ( $T_m$ ) of its raw polymer (i.e. virgin LDPE).

To ensure the virginity of the Warning mat, the DSC Scan curve and  $T_m$  of the Warning Mat (finished product manufactured from the raw polymer) shall match on overlapping with its corresponding raw polymer's DSC Scan curve and  $T_m$ .

#### 4.7. Packing

The warning mat shall be delivered in rolls of minimum 50 meters. Packing size to be mentioned to ensure uniformity in delivery conditions of the materials being procured. Bidder shall submit the packing details during offer and also compile them at the time of delivery. Packaging of the Warning Mat shall be such that there won't be any deterioration due to Ultraviolet (UV) effect during transportation and storage of the Warning Taps prior to use.

#### 5. QUALITY ASSURANCE (QA)

Manufacturer shall prepare detailed QAP and submit for the approval from OWNER / PMC.

#### 6. DEFECT LIABILITY

Defect liability period shall be as per commercial volume I of II.

#### 7. RECOMMENDED MANUFACTURER FOR RAW MATERIAL

1. SOLVAY
2. BOREALIS
3. TOTAL PETROCHEMICALS
4. DOW
5. ELENAC

However, any other reputed domestic or international Manufacturer may also be considered for supply of Raw material with approval of OWNER / PMC.



**Laying of PE 100 Pipe at Cotonou, Benin of West Africa**



Tender Document No:  
**A IIP /REPL/003/PEL**

**Date: 10/08/2023**

**6.0 GTS - PE ACCESSORIES  
FOR UNDERGROUND NETWORKS FOR NATURAL GAS  
DISTRIBUTION**



Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP /REPL/003/PEL

Date: 10/08/2023

TABLE OF CONTENTS

**1. SUBJECT AND AREA OF APPLICATION.....**

**2. REFERENCE STANDARDS AND SPECIFICATIONS.....**

**3. DEFINITIONS.....**

3.1. ELECTROFUSION ACCESSORY

3.2. ELECTROFUSION SADDLE

3.3. END TO END WELDING ACCESSORIES

**4. GENERAL SPECIFICATIONS.....**

**5. MATERIALS.....**

5.1. GENERAL INFORMATION

5.2. RAW MATERIAL SPECIFICATIONS

5.3. SPECIFICATIONS FOR COMPONENTS MADE OF MATERIALS OTHER THAN POLYETHYLENE

**6. GENERAL ACCESSORY CHARACTERISTICS.....**

6.1. TECHNICAL INFORMATION

6.2. APPEARANCE AND FINISH

6.3. COLOUR

6.4. JOIN APPEARANCE

6.5. ELECTROFUSION ACCESSORY ELECTRICAL CHARACTERISTICS

6.6. SUPPORT DRILLING EQUIPMENT

6.7. BRANCHING SUPPORT AND SADDLE LOAD LOSS UNDER LOW PRESSURE

6.8. ELECTROFUSION SLEEVE B LOCK

**7. GEOMETRICAL CHARACTERISTICS.....**

7.1. SIZE OF ELECTROFUSION SLEEVES

7.2. ELECTROFUSION SADDLE MEASUREMENTS



Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

7.3. MEASUREMENTS OF ACCESSORY ENDS TO BE WELDED

8. ACCESSORY MECHANICAL CHARACTERISTICS.....

9. PHYSICAL CHARACTERISTICS .....

10. PRODUCT APPROVAL .....

11. MARKING .....

11.1. ACCESSORY MARKING

11.2. COMPLEMENTARY INFORMATION

12. PACKAGING AND DELIVERY .....

13. QUALITY CONTROL.....

13.1. GENERAL RULINGS

13.2. CONTROLS

13.3. ACCEPTANCE OR REFUSAL

ANNEX 1.....

□ □ □



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

### 1. SUBJECT AND AREA OF APPLICATION

This specification has been established to define the requirements that must be met by injected moulded polyethylene accessories (PE) destined for the construction or the maintenance of underground networks for natural gas distribution where the maximum operating pressure (MOP) is equal to 5 bars.

It also defines some of the more general characteristics of materials used for accessory manufacturing and includes the appropriate classification model.

The specification also includes testing method parameters for the material in question. All accessories included in these specifications are listed as follows:

- Electrofusion welded accessories
- Electrofusion welded saddles
- Accessories are equipped with insertion connection for end-to-end welding and assembly using electrofusion-welded sleeve coupling.

This specification is limited to accessories with a nominal diameter of 225 mm and a working temperature between -20°C and +40°C.

PE and steel accessories with a tapered section and front section connections are not included in these specifications.

### 2. REFERENCE STANDARDS AND SPECIFICATIONS

<b>EN 682</b>	Air-tight rubber seals - specification for air-tight seal materials for gas and hydrocarbon fluid transfer piping
<b>EN 1555-1</b>	Plastic piping systems for combustible gas distribution. Polyethylene (PE). Part 1. General information
<b>EN 1555-3</b>	Plastic piping systems for combustible gas distribution. Polyethylene (PE). Part 3. Accessories
<b>EN 1555-7</b>	Plastic piping systems for combustible gas distribution. Polyethylene (PE). Part 7. Conformity evaluation.
<b>ISO DIS 11413</b>	Preparation of test assemblies between a polyethylene (PE) pipe and an electrofusion fitting.
<b>ISO DIS 11414</b>	Preparation of test assemblies between a pipe/pipe or pipe/fitting



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

polyethylene (PE) by butt fusion.

**ISO DIS 12093**

Format for a technical brochure for electrofusion joint characteristics.

**ISO TR 13950**

Electrofusion identification methods

**CEI 60335-1**

Safety standards for household appliances and similar equipment.

**CEI 364**

Electrical installations on buildings (including building sites and other temporary installations)

**CEI 449**

Voltage domains for building electrical installations.



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP /REPL/003/PEL

Date: 10/08/2023

### 3. DEFINITIONS

#### 3.1. ELECTROFUSION ACCESSORY

This term covers all injected moulded polyethylene accessories equipped with a heated element designed to transform electrical energy into heat to create self-welding.

In certain exceptional cases, an accessory can present one or more smooth ends. In this case the accessory will provide for the requirements of each connection end as regards shape, measurement, and technical characteristics.

#### 3.2. ELECTROFUSION SADDLE

This term covers a saddle shaped injection moulded PE accessory that is equipped with one or several heating elements that convert electrical energy into heat. The released heat provides a fusion surface sufficiently large to ensure correct saddle-pipe assembly.

Electrofusion saddles can be subdivided into two categories:

##### **Wrap around**

Electrofusion saddle whose upper shell is brought against the pipe during by welding using a fastening stirrup located on the lower part of the accessory to guarantee that the welding pressure is sufficient. Generally the stirrup is left in place after welding.

##### **Top load**

Electrofusion saddle where the welding pressure is obtained by pressing on the saddle head using a fixing system (clamp) that is removed after welding is completed.

*There are four different saddle types:*

##### **Support**

This is an accessory designed for joining branch pipes and is equipped with a drill bit made to pierce the wall of the pipe; this bit remains in the saddle body after installation.

##### **Branch piping saddle**

This accessory is designed for joining branch piping where an additional bit is necessary to pierce the wall of the main pipe next to the branch.

##### **Ballooning saddle**

This accessory provides the positioning of a sealing (or blocking)





## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

balloon and that can be filled again after work completion.

### Repair saddle

This accessory will seal/block any leaks on the pipe or will reinforce piping in the case of localized deterioration.

According to their leakage flow, the supports are divided into two model categories:

<b>Model 1</b>	Supports whose maximum immediate external leak flow is practically equal to zero at 5 bar pressure in the piping.
<b>Model 2</b>	Supports whose maximum immediate external leak flow never exceed 200 litres an hour at 5 bar pressure in the piping.

### 3.3. END TO END WELDING ACCESSORIES

This term describes injection moulded polyethylene accessories with smooth ends but not equipped with integrated heating elements. These are connected to the network by end-to-end welding using electrofusion sleeves.

In certain exceptional cases, an accessory can also present one or more electrofusion ends. In this case the accessory will provide for the requirements of each connection end in shape, measurement, and technical characteristics.

## 4. GENERAL SPECIFICATIONS

This specification is based on the series of EN 1555 standards, which standardize all the gas distribution network plastic piping systems.

The accessories described in this document comply with all prescriptions included in EN standard 1555-3, as well as all complementary requirements and/or options described in these Resonance energy specifications.

## 5. MATERIALS

### 5.1. GENERAL INFORMATION

The materials used for the manufacturing of the accessories must conform to the requirements demanded for components used in gas fuel distribution networks.

The accessory material that is in contact with the PE piping must not be composed of any material that will provoke a reduction in pipe performance, nor must it provoke cracking under stress.

All equipment will mark with inscription/description and specification in English language.



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

### 5.2. RAW MATERIAL SPECIFICATIONS

The raw material PE, used for accessory production, is in compliance with all prescriptions in EN 1555-1 standards.

The raw material belongs to class PE100. The following are strictly forbidden:

- use of recycled raw materials
- mixing of different raw materials
- The addition of supplementary additives to the raw material.

### 5.3. SPECIFICATIONS FOR COMPONENTS MADE OF MATERIALS OTHER THAN POLYETHYLENE

#### 5.3.1. Metal parts

All metal parts subject to corrosion must be protected in an adequate manner.

Metal parts must conform to prescribed standards of that particular material for gas distribution, for quality levels, size/gauge, and measurements.

Cast iron, aluminum and its alloys are not authorized for use.

#### 5.3.2. Elastomers

Elastomer air and watertight seals, like all other elements manufactured in this material, must comply with the prescriptions of EN 682 standards.

#### 5.3.3. Other materials

All other materials used are in compliance with the prescriptions described in paragraph 5.1. The accessories included in the paragraph comply with the requirements of this specification and are adapted for all general use for natural gas distribution.

## 6. GENERAL ACCESSORY CHARACTERISTICS

### 6.1. TECHNICAL INFORMATION

The manufacturer must supply a technical information dossier composed and including the same material and presented in the same manner, in compliance with the prescriptions of the ISO DIS standard 12093.

This dossier must mention all of the following information for each accessory:

- PE raw material used.
- Measurements and tolerances
- Domain of application (temperature and pressure limits, SDR and opalization)



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP /REPL/003/PEL**

**Date: 10/08/2023**

- Assembly instructions
- Welding instructions (welding parameters and limits)
- Test results attesting to the accessory conformity standard: c.f. EN standard 1555-3 for test descriptions.

For electrofusion accessories, the manufacturer must also supply the SDR series for the pipes, which will be used together with their accessory, according to their thickness.

In addition, for the saddles:

- The attaching method (tools necessary and/or lower shell)
- saddle category (refer to 3.2)
- Maximum saddle height (H in figure 2)
- the height of the branch pipe for supports (h in figure 2)

For all smooth ended accessories, the manufacturer must also supply the SDR series of connections; the accessory must be guaranteed for use on piping of the same class.

In the case of welding parameter modification, size or raw material changes, the manufacturer must include a new technical dossier providing proof that the accessory in question is still compliant with the specification prescriptions.

Testing assemblies will take into consideration manufacturing tolerance, assembly tolerance and the variations in environmental temperature corresponding with the conditions where the accessories will be in use. The manufacturer must observe all methods recommended for polyethylene accessory installation as shown in the Resonance energy specifications.

The assembly of piping and accessories manufactured and used in the tests must be in compliance with the manufacturer's technical instructions and the limits of use conditions. When the test assemblies are carried out, the manufacturing and assembly tolerances must be taken into consideration. Samples destined for assembly testing with electrofusion accessories must be prepared according to standard ISO DIS 11413. End-to-end welded samples must be prepared according to standard ISO DIS 11414.

### 6.2. APPEARANCE AND FINISH

The internal and external surfaces of the accessories must be smooth, clean and free of all scratching, pitting and other surface faults that can possibly reduce accessory and assembly performance.

No element of any accessory must show any signs of damage: scratching, scraping, piercing, blisters, bloating, denting, holes, cracks or other faults that can reduce required performance.

It must be possible to place the accessory on the pipe or on another accessory without moving the electric winding or the air/water tight seals etc. and this must respect the tolerance permitted for piping and accessories.

### 6.3. COLOUR



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

All accessories will be black. If agreed previously, they can also be coloured yellow or orange.

### 6.4. JOIN APPEARANCE

After welding, when examined visually without a magnifying glass, the internal and external surfaces of the pipes and accessories must appear free of welding exudation outside the accessory limits (unless identified by the accessory manufacturer as normal, or carried out deliberately as a welding test, but on condition that there is no wiring position change inside the electrofusion accessories that could provoke a short-circuit). Internal surfaces of all adjacent piping must remain identical to the previous condition before welding.

### 6.5. ELECTROFUSION ACCESSORY ELECTRICAL CHARACTERISTICS

#### 6.5.1. General information

The accessories include an electrical system as described in the standards CENELEC 60335-1, CEI 364 and CEI 449.

This system is equipped with appropriate electrical protection for the voltage and intensity of the current in use and adapted to the characteristics of the electrical supply line.

For voltage over 24 V protection is essential against direct contact with the active parts (conductors online). The type of protection in question depends on the local site conditions.

#### 6.5.2. Classification

Electrofusion accessories are divided into three classes according to the voltage and/or current characteristics.

- Class A** Electrical supply based on voltage set between 8V and 42 V
- Class B** Electrical supply based on voltage set between 42 V and 220 V
- Class C** Electrical supply based on power supply settings.

**All supplies, unless otherwise stipulated in the order, concern Class A accessories.**

The power required for electrofusion accessory welding must not exceed 3kW during welding operations.

Unless stipulated otherwise in the order, only “wrap-around” saddles can be supplied (refer to par. 3.2.)

Unless otherwise agreed between Resonance energy and the supplier, all electrofusion accessories must be “single wire” type.

#### 6.5.3. Connectors

Electrical connectors installed on electrofusion accessories must comply with the diagram included in Annexure 1 with these specifications, also including constant current supply where this is the case. The state of the connector terminal surface must offer the minimum possible contact resistance during



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

voltage cable joining.

#### 6.5.4. Protection against overheating

Electrofusion accessories that can only be welded once are equipped with a lock system which prevents re-welding.

Electrofusion accessories that cannot be re-welded immediately after initial welding are equipped with an incorporated security system in their welding program: that is they cannot weld while the wire is still hot.

If the welding program does not possess this lock system, the electrofusion accessory must absolutely be protected against a second or several welding cycles whatever the temperature of the winding wire.

#### 6.6. SUPPORT DRILLING EQUIPMENT

The support drilling equipment has been designed so that during drilling the maximum immediate leak flow will never exceed 200 liters per hour at 5 bar pressure, in the main pipe. According to this flow rate, the supports are divided into two categories- models 1 and 2 (refer to par. 3.2.) The required model will be specified when ordered.

The bell drill is equipped with a maneuvering opening for the insertion of a 17 mm hexagonal spanner.

The bell drill path is limited at the top and bottom by a limit block.

The drill mechanism is designed so that no additional tools (except the hexagonal spanner described above) are necessary for carrying out drilling operations.

#### 6.7. BRANCHING SUPPORT AND SADDLE LOAD LOSS UNDER LOW PRESSURE

The maximum load loss measured with natural gas at an inlet pressure of 20 mbar must not exceed the values listed below.

<b>Flow m<sup>3</sup> /hr</b>	<b>Saddle Type</b>	<b>Maximum load loss Mbar</b>
10	63 x 32	1.0
10	110 x 32	1.0
10	160 x 32	1.0
10	200 x 32	1.0
40	63 x 63	2.0
40	110 x 63	1.0

40	160 x 63	1.0
40	200 x 63	1.0

6.8. ELECTROFUSION SLEEVE BLOCK

All electrofusion sleeves are equipped with an immovable block in the centre of the sleeve.

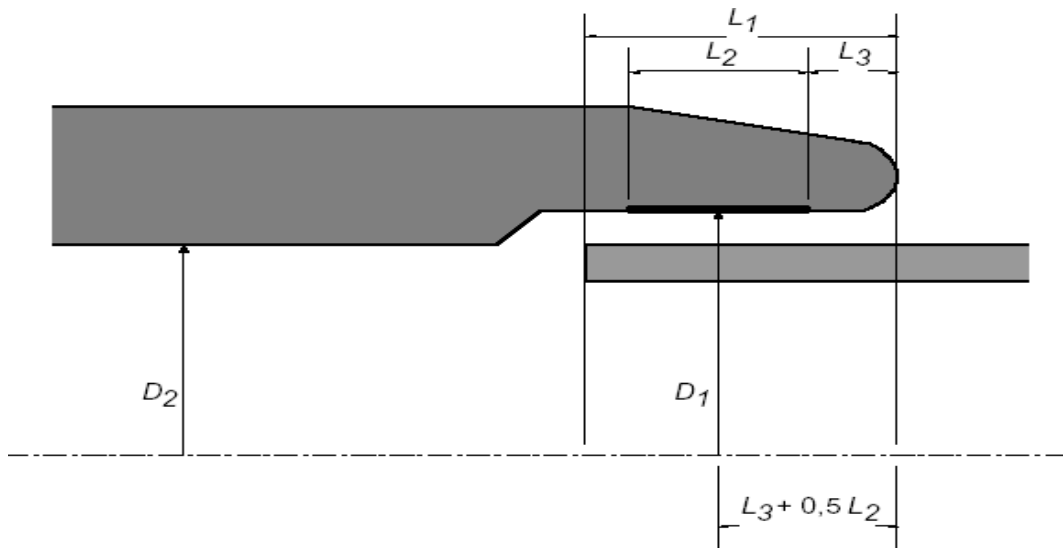
7. GEOMETRICAL CHARACTERISTICS

7.1. SIZE OF ELECTROFUSION SLEEVES

The sizes of the electrofusion accessory sleeves and their tolerance limits are described in chapter “Geometrical characteristics” of EN standard 1555-3.

They are controlled according to the method described in the specification standard. Any possible sealing plugs are removed from the sleeve 4 hours before the size control check. Measurements are controlled without the plugs inserted.

The main symbols are shown in figure 1 below:



- D<sub>1</sub>** The “average internal diameter in the welding zone” — that is: the average internal diameter measured in a parallel plane to the opening plane, at a distance of  $L_3 + L_2/2$  of the latter.
- D<sub>2</sub>** “Minimum drilling/boring” – that is the minimum diameter of the draining canal through the body of the accessory.

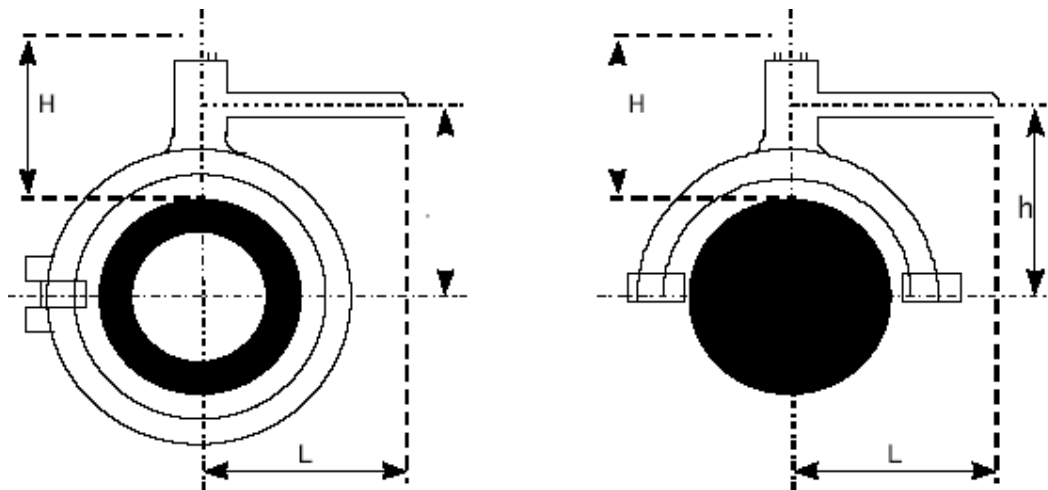
- L1 “penetration depth” of the pipe or the inserted (male) end of the accessory
- L2 “Nominal length of the welding zone” that corresponds with the length subject to heating.
- L3 “Nominal non-heated entry/inlet length of the sleeve”. This refers to the distance between the tip of the accessory and the beginning of the welding zone.

### 7.2. ELECTROFUSION SADDLE MEASUREMENTS

The measurements of the electrofusion saddles and their tolerance limits are described in EN standard 1555-3

They are controlled according to the method described in the specification standard. Any possible sealing plugs are removed from the sleeve 4 hours before the size control check. Measurements are controlled without the plugs inserted.

The main symbols are shown in the figure 2 below:



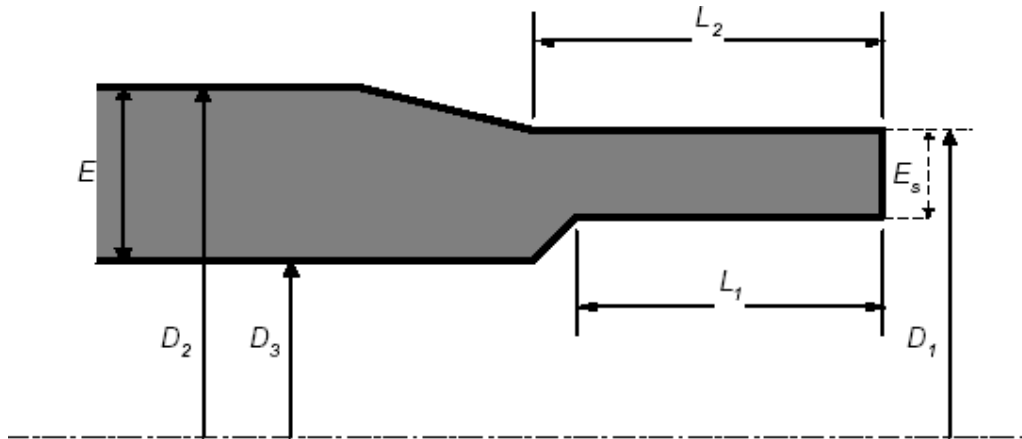
- H The “height of the saddle” — that is the distance between the upper generator of the main pipe and the top of the branch pipe saddle
- h the “height of the branch pipe” – that is the distance between the axis of the main pipe and the axis of the branch pipe
- L The “width of the branch pipe saddle” – that is the distance between the axis of the pipe and the surface plane of the branch pipe opening

### 7.3. MEASUREMENTS OF ACCESSORY ENDS TO BE WELDED

The measurements of the ends and their tolerance limits are described in EN standard 1555-3.

They are controlled according to the method described in these specification standards. Any possible sealing plugs are removed from the sleeve 4 hours before the size control check. Measurements are controlled without the plugs inserted.

The measurements and main symbols used in this specification are shown in the figure 3 below:



- D1** The “average external diameter of the end to be welded measured on any plane parallel to the inlet/entry plane at a distance where this plane does not exceed  $L_2$ (tubular section).
- D2** The “average external diameter of the body” of the tip of the accessory.
- D3** “Minimum drilling/boring” – that is the minimum diameter of the passage through the body of the accessory. Measuring of the diameter must not include any ribbing due to welding.
- E** “Thickness of the accessory body wall” – that is: the thickness measured at any point of the accessory wall.
- Es** “Thickness of the end to be welded” measured at any point but where the distance does not exceed  $L_1$  (length that can be cut) compared to the inlet/ entry plane, must be equal to the thickness of the nominal pipe wall.
- L1** The “cuttable section” of the end to be welded — that is the initial depth of the tip of the insertion section, necessary for end-to-end welding or for starting an end-to-end weld again.
- L2** The “tubular section” of the end to be welded — that is the initial length of this section. This tubular section permits the following in all types of combination:
  - Use of the clamp stirrups, as is essential for end-to-end welding, or for electrofusion.
  - Assembly using electrofusion sleeves.

## 8. ACCESSORY MECHANICAL CHARACTERISTICS

All accessories must obey the requirements and tests described in the chapter concerning the mechanical characteristics of EN standard 1555-3. They must also comply with the hydrostatic test conditions described in the same standard.





## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP /REPL/003/PEL

Date: 10/08/2023

They must be controlled as described in the same standard.

### 9. PHYSICAL CHARACTERISTICS

All accessories must obey the requirements and tests described in the chapter concerning the mechanical characteristics of EN standard 1555-3

They must be controlled as described in the same standard.

### 10. PRODUCT APPROVAL

The product will be approved by the Owner if all results of the tests, controls and checking prescribed by this specification are satisfying.

The manufacturer will provide a complete approval dossier including all the product characteristics specified in 6.1. (Technical dossier) and the results of tests prescribed in these specifications. The number of tests run on the product must comply with EN standard 1555-7. The results of these tests described in the approval dossier must be confirmed by the Owner authorized laboratory. Hydraulic testing must be continued until the rupture of at least two test samples for each set of tests. (max. 2000 hours).

All changes made to the approved product must be communicated to the Owner, and this entails further control checks for approval.

Any requirement not observed or test missing from this specification will result in the withdrawal of the product approval and can even result on annulment of contract.

### 11. MARKING

#### 11.1. ACCESSORY MARKING

11.1.1. Identification marking will be made directly on the accessory. The system used to make the product must not provoke cracking or other faults. All marking must be permanently legible for the product life under standard stocking conditions, exposure to external weather conditions, treatment, installation, and use.

11.1.2. Where the products are printed, the colour of the printed identification mark must be different from that of the basic product colour.

11.1.3. Marking quality and size must be of a standard that can be read with the naked eye without magnification.

No marking must be printed on the minimum length of the insertion section of accessories.

11.1.4. Each accessory must be marked with at least the obligatory details required by EN standard 1555-3. The marking must be printed on the accessory itself or on a label as shown in the standard described above.

The SDR pipe range that are to be fitted with these accessories must be clearly marked on the fitting. Details must include: each SDR value, or the upper and lower value of the permitted SDR range.

#### 11.2. COMPLEMENTARY INFORMATION



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

All complementary information on welding conditions (welding time and cooling time) can also be described on a label affixed to the accessory or delivered with the accessory.

### 12. PACKAGING AND DELIVERY

Normally all accessories are packed separately in plastic sheeting and/or cardboard boxes.

Sometimes they can be loosely packed together where there is no danger of damage or deterioration or loss of loose parts.

All boxes and plastic sheeting must be marked with at least one label showing the manufacturer's name, the product type, part measurements, and number of single parts contained in the box or bag, plus all details necessary for stocking and stock expiry dates.

All electrofusion accessories must be printed with a bar code and an individual magnetic card. The magnetic card contains the welding parameters that have been encoded in the magnetic track, as well as the bar code printed on the card. Coding must be carried out according to prescriptions included in ISO TR 13950 standards.

With regard to stocking guarantee, accessories must correspond with the prescriptions of the local laws & regulations if any. If the guarantee period decided by the manufacturer is shorter than that in these documents, the Owner must be informed in writing at the time of the offer.

### 13. QUALITY CONTROL

#### 13.1. GENERAL RULINGS

##### 13.1.1. Manufacturer's responsibility

The manufacturer is entirely responsible for the quality of the PE accessories manufactured by his firm.

All control checks prescribed above do not relieve him of this responsibility.

To ensure that all PE accessories are in compliance with the specification in all aspects, they must be controlled by the plant control service, which must be independent from the manufacturing department.

All PE accessories supplied are guaranteed for a one-year period after application for use, that is a maximum of three years after the date of production.

##### 13.1.2. Quality assurance

The manufacturer must have some form of quality control to ensure that products comply with EN standards 29001 or 29002. The quality assurance manual must be made available to the Owner Control Service or an external Control laboratory appointed by him.

The system of quality assurance must be certified by an authorized body.

#### 13.2. CONTROLS



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

### 13.2.1. Control testing by the manufacturer

#### 13.2.1.1. *By material batch.*

The manufacturer demands a certificate from the raw material manufacturer including the following:

- Fluid index
- Water content
- Volume mass
- Carbon black or yellow stabilizing agent content
- Carbon black or yellow stabilizing agent quality
- OIT value (thermal stability)

#### 13.2.1.2. *By accessory batch*

The manufacturer must run control checks as follows :

- Appearance / colour
- Measurements
- Hydraulic testing
- Electrical resistance
- Printing/markings.

Control checks and the number of tests must be carried out according to the prescriptions of the EN standard 1555-3

Also refer to table No. 8, paragraph 4.2.3. "Lot release tests" of EN standard 1555-7.

The results must be written out in documents that contain the complete identification of the accessory batch.

These documents must be made immediately available for the Owner representative.

### 13.2.2. Plant Reception by the Owner Control Service representative

#### 13.2.2.1. *General information*

All quality controls must be run in the presence of the Owner Control Service representative.

All tests and control checks must comply with appropriate standard prescriptions and with the specific specifications established with the order.

At each visit by the Owner representative, the manufacturer must provide, free of charge, all means and personnel necessary for running the established control checks.



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

While the order is under production, the Owner representative must have access to stocking installations of all raw materials before manufacturing, manufacturing and control installations, as well as the accessory stocking areas for any control checks he is responsible for.

During his visits, the Owner representative will receive a certificate as soon as he reaches the plant for each batch of accessories presented for reception.

Each time this is requested by the Owner representative, the manufacturer must provide recent reports of all control checks and measuring instrument results and testing results.

### *13.2.2.2. Convocation for reception*

Convocation instructions for reception are to be defined with the order.

### *13.2.2.3. Reception control checks*

For each accessory batch or any fractions of the batch, minimal batch sampling is established in annexed enclosure 3. These control checks and tests are to be run according to the prescriptions of EN standard 1555-3

## 13.3. ACCEPTANCE OR REFUSAL

### 13.3.1. Appearance, measurements and marking.

Any requirements not supplied will lead to the refusal of the complete batch. However in the case where a batch is refused, it can be presented for approval again after a control check, on agreement with the Owner Control Service.

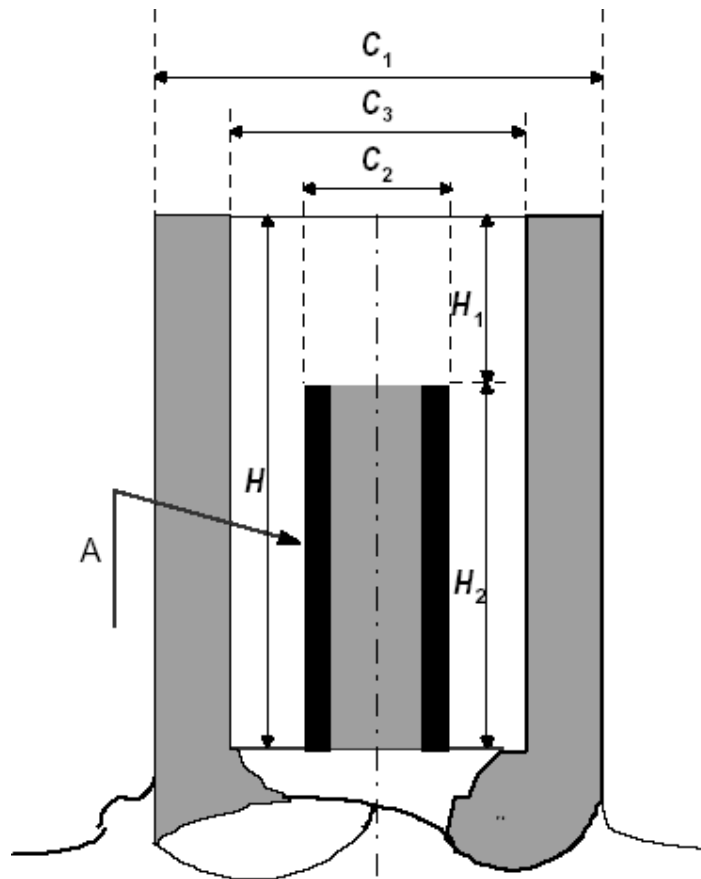
### 13.3.2. Control check on characteristics

All results that do not comply with the specification prescriptions and the particular specifications requested with the order, demand counter-testing on at least double the number of the samples previously tested. If the undesirable result is confirmed, then the batch is refused permanently. If the result is positive, then the batch will be accepted.

As a complementary control check, other analyses and/or tests can be run after common agreement, and at the manufacturer's cost.

ANNEXURE 1

**CONNECTOR FOR ELECTROFUSION ACCESSORIES**



**Symbols**

<b>C<sub>1</sub></b>	External diameter of connector	$C_1 \geq 11,8 \text{ mm}$
<b>C<sub>2</sub></b>	Diameter of active part of connector	$C_2 = 4.0 \pm 0.03 \text{ mm}$
<b>C<sub>3</sub></b>	Internal diameter of connector	$C_3 = 9,5 \pm 1,0 \text{ mm}$
<b>C<sub>4</sub></b>	Max. Diameter of active part foot	$C_4 \geq 6,0$



**Laying of PE 100 Pipe at Cotonou, Benin of West Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

- H** Connector internal depth  $H \geq 12,0$
- H<sub>1</sub>** Distance between upper part of connector and activepart  $H \geq H_1 + H_2$
- H<sub>2</sub>** Height of active part  $H_2 \geq 7,0 \text{ mm}$
- A** Active zone.  $H_1 = 3,2 \pm 0,5$

**RECEPTION AT MANUFACTURER'S PLANT.**

<b>Characteristics</b>	<b>Reference EN 1555-3</b>	<b>Minimum drill tests / frequency</b>	<b>No. of samples</b>	<b>No. of measure/samples</b>
Appearance /colour	5.2 /5.3	1 x /size / product type / internal space	10	1
Measurements	6	1 x /size / product type / internal space	10	1
Thermal stability (OIT)	8.2	1 x batch	1	1
Melt mass/flow rate(MFR)	8.2	1 x batch	1	1
Electrical resistance	5.6	1 x /size / product type / internal Space	5	1
Cohesion resistance	7.2	1 x /size / product type	2	1
End-to-end seam resistance to traction (Cohesion resistance)	7.2	1 x /size / product type	2	1
Shock resistance	7.2	1 x /size / product type	1	1
Load loss	7.2	1 x /size / product type	1	1
Marking	10.2	1 x /size / product type	1	1

□ □ □



**Laying of PE 100 Pipe at Cotonou, Benin of West Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

**7.0 GTS - POLYETHYLENE COMPOUNDS FOR MANUFACTURE OF PIPES  
AND FITTINGS FOR UNDERGROUND NETWORKS FOR NATURAL GAS  
DISTRIBUTION**

**ACCEPTANCE PROCEDURE**



Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

TABLE OF CONTENTS

**1. SUBJECT ..... 99**

**2. REFERENCES: STANDARDS AND SPECIFICATIONS ..... 99**

**3. DEFINITIONS AND SYMBOLS ..... 101**

3.1. LOWER CONFIDENCE LIMIT (LCL)

3.2. MINIMUM REQUIRED STRENGTH (MRS 10)

3.3. PE 100

3.4. BATCH OF COMPOUND

3.5. BATCH OF PIPES

**4. GENERAL SPECIFICATIONS ..... 101**

**5. SUMMARY OF THE PROCEDURE ..... 102**

5.1. GENERAL

5.2. APPLICATION FOR APPROVAL

**6. TECHNICAL FILE ..... 102**

6.1. EVALUATION

6.2. ADDITIONAL TESTS

**7. CONFIRMATION TESTS ..... 104**

**8. FOLLOW-UP..... 105**

8.1. TECHNICAL DATA SHEET

8.2. CONTINUITY OF THE COMPOUND

**APPENDIX 1 ..... 107**

□ □ □





## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

### 1. SUBJECT

This specification describes the procedure to be followed for acceptance of a polyethylene (PE) compound for manufacture of natural gas underground distribution systems.

This specification also gives the minimum requirements which have to be met by PE compounds for manufacture of pipes, fittings and valves and for the construction of underground distribution systems for natural gas.

The compounds that meet this specification must at the minimum be PE 100. The colour shall be black or orange in accordance with the local requirements.

### 2. REFERENCES: STANDARDS AND SPECIFICATIONS

This section contains the list of standards and specifications referred to in this specification.

<b>EN 728: 1997</b>	Plastics piping and ducting systems – Polyolefin pipes and fittings - Determination of oxidation induction time.
<b>EN 1555-1</b>	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 1: General
<b>EN 1555-3 EN 1555-7</b>	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 7: Assessment of conformity.
<b>EN 12099</b>	Plastics piping systems - Polyethylene piping materials and components - Determination of volatile content.
<b>EN 12118</b>	Plastics piping systems - Determination of moisture content in plastics by coulometry.
<b>EN ISO 12162: 1995</b>	Thermoplastics materials for pipes and fittings for pressure applications - Classification and designation - Overall service (design) coefficient.
<b>EN ISO 13478: 1997</b>	Thermoplastics pipes for the conveyance of fluids -Determination of resistance to rapid crack propagation (RCP) - Full-scale test (FST).
<b>EN ISO 13479: 1997</b>	Thermoplastics pipes for the conveyance of fluids -Determination of resistance to crack propagation (RCP) - Test method for slow crack growth on notched pipes (notch test).
<b>EN 45001: 1990</b>	General criteria for the operation of testing laboratories.



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

**ISO 1133: 1997**

Determination of the melt mass-flow rate (MFR)  
And the melt volume-flow rate (MVR) of thermoplastics.

**ISO 6964: 1996**

Polyolefin pipes and fittings  
- Determination of carbon black content by calcination and  
pyrolysis -Test method and basic specification.

**ISO/DIS 9080**

Plastics piping and ducting systems  
-Determination of the long-term hydrostatic strength of  
thermoplastics materials in pipe from by extrapolation.

**ISO 11420: 1996**

Method for the assessment of the degree of  
carbon black dispersion in polyolefin pipes, fittings and  
compounds.

**ISO 13477: 1997**

Thermoplastics pipes for the conveyance of fluids  
- Determination of resistance to rapid crack propagation (RCP)  
- Small-scale-steady-state test (S4 test).



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

### 3. DEFINITIONS AND SYMBOLS

#### 3.1. LOWER CONFIDENCE LIMIT (LCL)

A quantity with the dimensions of stress, in mega pascal, which can be considered as a property of the material under consideration and represents the 97.5% lower confidence limit of the predicted long-term hydrostatic strength at a temperature of 20°C for 50 years with internal water pressure.

#### 3.2. MINIMUM REQUIRED STRENGTH (MRS 10)

Standardized class of compounds for which the LCL is equal to 10.

#### 3.3. PE 100

Standard designation for PE compounds in class MRS 10.

For such PE compounds, the long-term hydrostatic strength – calculated and classified according to the standardized method (ISO 9080 and ISO 12162) for a temperature of 20°C, a period of 50 years and a reliability of 97.5 % – must be at least 10 MPa.

#### 3.4. BATCH OF COMPOUND

By batch of compound means a homogeneous quantity of PE compound of the same origin and of a particular brand.

The batch must be registered under a single identification number (batch number) which leaves no doubt as to the origin, identity, and date of manufacture of the compound.

#### 3.5. BATCH OF PIPES

By batch of pipes means a homogenous lot of pipes with identical dimensions, made in a continuous process by the same extrusion machine and from the same batch of compound.

### 4. GENERAL SPECIFICATIONS

The PE compounds that are acceptable according to the requirements of this specification must conform to the requirements for PE 100 described in prEN1555-1.

If the proposed compound is destined for manufacture of pipes, then the acceptance procedure is carried out as described in this specification.

If the proposed compound is destined for manufacture of fittings, then the first stage (section 6) of this acceptance procedure is carried out, after which type tests are carried out on the fittings manufactured from the material concerned. An independent laboratory appointed by Owner will then evaluate whether conformity with the characteristics mentioned in the technical file has been proved, on the basis of the provisions of prEN 1555-7.



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

### 5. SUMMARY OF THE PROCEDURE

#### 5.1. GENERAL

The acceptance procedure for PE compounds comprises two stages, namely the evaluation of the technical file and the confirmation tests. The different steps are carried out in the order described below.

The tests which form part of the technical file are carried out on pipes or samples supplied by the compounds manufacturer. In principle, all tests mentioned in the technical file are carried out on pipes from the same batch.

The tests mentioned in chapter 7 are carried out on pipes manufactured by a pipe manufacturer chosen by Owner.

The tests mentioned in chapter 6.1 (table 1), 6.2 and 7 are carried out in a laboratory appointed by Owner.

#### 5.2. APPLICATION FOR APPROVAL

A manufacturer that wishes to have a certain PE compound classified for the manufacture of PE gas components must submit a written application to Owner.

This application must be accompanied by a clear description of the compound concerned, including the technical characteristics.

All correspondence must be in English.

### 6. TECHNICAL FILE

#### 6.1. EVALUATION

If the application is taken into consideration by Owner, the compound manufacturer must submit a technical file to a laboratory appointed by Owner.

This technical file must include the following information:

- name and class of the PE compound;
- technical characteristics of the compound, with reference to the standard;
- a dossier with test results, from an independent laboratory, showing that the proposed compound meets the requirements of prEN 1555-1 for a PE 100 compound. The dossier must also state which tests have been carried out on the same batch of pipes or test samples, including the identification of their origin.

The laboratory chosen by Owner will also evaluate the conformity of this dossier, taking the following rules into account:

- a) If the tests mentioned in the technical file have been carried out by a laboratory accredited according to EN 45001, and if the tests have been carried out on the same batch of pipes for the required diameter and wall thickness, then the evaluation will be limited to an examination of the dossier in accordance with the provisions of prEN 1555-1 and the quantity of test samples laid down in prEN 1555-7.
- b) If the tests mentioned in the technical file have been carried out by a laboratory that is not accredited



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

according to EN 45001 and/or on different batches of pipes for the same diameters/wall thickness, then the evaluation will be done on the basis of further tests in order to confirm the characteristics mentioned in the technical file.

- c) The characteristics for rapid crack propagation (RCP) and slow crack propagation (SCG), as mentioned in the technical file, must comply with the requirements of the standard. Furthermore, the requirements of table 1 must be met:

**Table 1**

Characteristic	Requirement	Standard
Pc S4	DN 250 – SDR 11 0°C - > 3,5 BAR	ISO 13477
Pc FS	DN 250 – SDR 11 0°C - > 15 BAR	EN ISO 13478
SCG	DN 250 – SDR 11 80°C – $\sigma_{4,6}$ - > 500 h	EN ISO 13479

The tests mentioned in table 1 must be carried out by an independent laboratory appointed by Owner. The three series of tests must be carried out on the same batch of pipes.

If it emerges from the evaluation of the technical file that conformity with prEN 1555-1 is guaranteed, then the next stage of the procedure can commence, as described in section 7.

### 6.2. ADDITIONAL TESTS

#### 6.2.1. General

If from the evaluation it emerges that the dossier submitted is incomplete or does not offer the necessary guarantees of conformity with the standard, then additional tests will be carried out by the laboratory appointed by Owner, at the cost of the compound manufacturer.

The same procedure will be followed if the technical file has been drawn up by a laboratory that is not accredited and/or if several batches of pipes have been used for each diameter/wall thickness in carrying out the tests.

#### 6.2.2. Delivery of the pipes

The required batch of pipes must be delivered by the compound manufacturer, the pipes having been produced by a pipe manufacturer who at that moment is a Owner supplier.

The number of pipes must be based on the numbers and frequencies mentioned in prEN 1555-7.



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP /REPL/003/PEL

Date: 10/08/2023

If the technical file is based on tests carried out by a non-accredited laboratory and/or carried out on several batches of pipes per diameter/wall thickness, then the tests will be repeated on at least half of the required test samples; if the number thus calculated is not a whole number, the number of test samples taken will be equal to the next whole number.

### 6.2.3. Test results

If from the additional tests it appears that conformity with prEN 1555-1 is guaranteed, then the next phase of the procedure can commence, as described in section 7.

If despite the additional tests no unambiguous decision can be taken regarding the conformity of the compound, then further additional tests will be carried out, until the number of test samples is at maximum equal to the number specified in the standard concerned. For this purpose, the manufacturer must keep sufficient pipes of the same batch in reserve.

If the evaluation is still not positive after the maximum number of samples has been tested, then the compound will be considered as not accepted.

## 7. CONFIRMATION TESTS

The second stage of the acceptance covers the industrial production of pipes, the verification of the characteristics, the laying of the pipes and the fusion to existing PE systems.

This second stage of the acceptance is carried out by Owner.

Before this stage can commence, the manufacturer must provide Owner with a technical data sheet (see appendix 1) showing the limit values for the characteristics of the compound concerned.

For the purpose of carrying out this part of the procedure, Owner will order a batch of pipes from one of its pipe manufacturers. After verification of the characteristics in the factory and confirmation by an independent laboratory, the pipes will be installed in the Owner gas distribution network, taking into account the following aspects:

- Any problems with delivery and with extrusion of the compound will be noted.
- The limits of the characteristics mentioned in the technical data sheet.
- For characteristics not included in the technical data sheet, the measured value may
- deviate by max. 30% from the average values mentioned in the technical file, to the extent that these are relevant and not in conflict with the requirements of the standard.
- Any problems with laying or welding or connecting the pipes; these will be noted.

If from the test results it appears that the characteristics of the compound and/or pipes do not comply with the requirements, or if anomalies are found in laying and/or welding of the pipes, then the acceptance procedure will be provisionally suspended. The problems found will be analyzed in consultation with the compound



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP /REPL/003/PEL**

**Date: 10/08/2023**

manufacturer, and an attempt will be made to find solutions which are acceptable to both parties. If this turns out to be impossible, then the compound will be considered as not accepted.

In such a case, the costs of the second stage could be charged to the compound manufacturer.

If the second stage of the procedure is successfully completed, then the compound is accepted.

### **8. FOLLOW-UP**

#### **8.1. TECHNICAL DATA SHEET**

The manufacturer must supply Owner with a technical data sheet, as described in Appendix 1, with permission for Owner to publish this technical data sheet in the specifications for PE pipes and fittings, for as long as the compound is included in the list of approved compounds.

The data entered on this data sheet apply as limit values for the compound concerned. Whenever one or more characteristics of a batch of compounds falls outside these limits, then the batch will be automatically refused for production of components destined for our gas network.

#### **8.2. CONTINUITY OF THE COMPOUND**

No alterations may be made to the compound without prior permission from Owner.

As mentioned in 8.1, the limits mentioned in the technical data sheet must be respected. Furthermore, in the case of characteristics not included in the technical data sheet, the measured values may not deviate by more than 30% from the average value mentioned in the technical file, to the extent that these are relevant and not in conflict with the requirements of the standard.

Each change that affects the final characteristics of the compound can result in additional tests being carried out by the compound manufacturer in accordance with the provisions of prEN 1555-7 appendix A. The procedures for the test shall correspond to those described in section 6.1 of this specification.



Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

APPENDIX 1

Technical Data Sheet

Characteristics of (name of PE compound) as  
per prEN 1555-1

Characteristics	Standard	Specification
MRS	EN ISO 12162	> .... MPa
Density	Method D of ISO 1183	
min.		.... kg/m <sup>3</sup>
max.		.... kg/m <sup>3</sup>
MFR 190/5	ISO 1133	
min.		.... g/ 10 min
max.		.... g/ 10 min
Volatile content	prEN 12099	
max.		.... mg/kg
Water content	prEN 12118	
max.		.... mg/kg
Carbon black content	ISO 6964	
min.		.... %
max.		.... %
Carbon black dispersion	ISO 11420	
max.		≤ grade ...
OIT at 210°C	EN 728	
min.		... min

Company .....

Person responsible .....

Position .....

Signature .....





**Laying of PE 100 Pipe at Cotonou, Benin of West Africa**



Tender Document No:  
**A IIP /REPL/003/PEL**

**Date: 10/08/2023**

**8.0 GTS - POLYETHYLENE VALVES FOR NATURAL GAS  
DISTRIBUTION UNDERGROUND NETWORK**



Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

TABLE OF CONTENTS

**1. SCOPE AND FIELD OF APPLICATION..... 112**

**2. NORMATIVE REFERENCES..... 112**

**3. DEFINITIONS..... 113**

3.1. NOMINAL SIZE DN/OD

3.2. NOMINAL OUTSIDE DIAMETER (D<sub>N</sub>)

3.3. NOMINAL WALL THICKNESS (E<sub>N</sub>)

3.4. COMPOUND

3.5. MAXIMUM OPERATING PRESSURE (MOP)

3.6. VALVES

3.7. BASE PLATE

3.8. SPINDLE PROTECTION SLEEVE

3.9. EXTERNAL LEAK-TIGHTNESS

3.10. INTERNAL LEAK-TIGHTNESS

3.11. LEAK-TIGHTNESS TEST

3.12. INITIATING TORQUE

3.13. RUNNING TORQUE

3.14. LEAKAGE

**4. GENERAL SPECIFICATION..... 115**

**5. MATERIAL PARTICULARITIES ..... 115**

5.1. GENERAL

5.2. PE COMPOUND FOR POLYETHYLENE VALVES BODIES

5.3. SEALS

5.4. LUBRICANTS



Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

5.5. OPERATING CAP

**6. VALVES GENERAL PARTICULARITIES..... 116**

6.1. TECHNICAL FILE

6.2. DESIGN

6.3. APPEARANCE AND COLOUR

6.4. DIMENSIONS

**7. MECHANICAL CHARACTERISTICS FOR ASSEMBLED VALVES ..... 118**

7.1. GENERAL

7.2. RUNNING TORQUE

7.3. INDIVIDUAL TEST (BATCH RELEASE TEST)

7.4. PRESSURE DROP AT LOW PRESSURE

**8. MARKING ..... 119**

**9. PACKAGING AND DELIVERY ..... 120**

**10. GUARANTEE..... 120**

**11. QUALITY CONTROL..... 120**

11.1. GENERAL RULINGS

11.1.1. Manufacturer’s responsibility

11.1.2. Quality assurance

11.2. CONTROLS

11.2.1. Control testing by the manufacturer.

11.3. ACCEPTANCE OR REFUSAL

11.3.1. Appearance, measurements and marking

11.3.2. Control check on characteristics

**ANNEXE A ..... 123**

**DIMENSIONS OF THE EXTENSION SPINDLE**



**Laying of PE 100 Pipe at Cotonou, Benin of West Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**

**ANNEX B ..... 124**

**DIMENSIONS OF THE OPERATING CAP TYPE A**

**ANNEX C ..... 125**

**DIMENSIONS OF THE OPERATING CAP TYPE B**

**ANNEX D ..... 126**

**DIMENSIONS OF THE OPERATING CAP TYPE C**

□ □ □



**Laying of PE 100 Pipe at Cotonou, Benin of West Africa**



Tender Document No:  
**A IIP/REPL/003/PEL**

**Date: 10/08/2023**



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

### 1. SCOPE AND FIELD OF APPLICATION

This General Technical Specification specifies the requirements for valves and its component made from extruded or injected moulded polyethylene (PE) and which are intended to be used for the Natural gas distribution systems where the maximum operating pressure (MOP) is equal to 10 bar.

In addition, it specifies some general properties of the materials from which these valves are made.

It applies to bi-directional valves with spigot ends or electrofusion sockets intended to be fused with polyethylene pipes.

This specification is limited to valves with a nominal diameter ( $d_n$ ) up to and including 225mm.

### 2. REFERENCES

prEN 1555-1	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 1 : General
prEN 1555-4	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 4 : Valves
prEN 1555-7	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - part 7 : Guidance for assessment of conformity
ISO CD 12176-4	Plastics pipes and fittings - Equipment for fusion Joining polyethylene system - part 4 : traceability coding
ISO TR 13950	Plastics pipes and fittings - Automatic recognition systems for electrofusion



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

### 3. DEFINITIONS

#### 3.1. NOMINAL SIZE DN/OD

Nominal size, related to the outside diameter.

#### 3.2. NOMINAL OUTSIDE DIAMETER ( $d_n$ )

Specified outside diameter, in millimeters, assigned to a nominal size DN/OD.

#### 3.3. NOMINAL WALL THICKNESS ( $e_n$ )

Numerical designation of the wall thickness of a component, which is a convenient round number, approximately equal to the manufacturing dimension in millimeter (mm).

Note : For thermoplastics components conforming to prEN 1555, the value of the nominal wall thickness  $e_n$  is identical to the specified minimum wall thickness at any point,  $E_{min}$ .

#### 3.4. COMPOUND

Homogenous mixture of base polymer (PE) and additives, i.e. antioxidants, pigments, UV-stabilizer's and others, at a dosage level necessary for the processing and use of components conforming to the requirements of this standard.

#### 3.5. MAXIMUM OPERATING PRESSURE (MOP)

Maximum effective pressure of the fluid in the piping system, expressed in bar, which is allowed in continuous use. It takes into account the physical and the mechanical characteristics of the components of a piping system.

Note : It is calculated using the following equation :

$$MOP = \frac{(20 \times MRS)}{Cx(SDR - 1)}$$

#### 3.6. VALVES

An obturating device designed to stop or restore the gas flow by operating the opening and closing mechanisms.

#### 3.7. BASE PLATE

The valves are split into two models.

MODEL 1	Valve supply without base plate
MODEL 2	Valve supply with a base plate fixed or integrated



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

### 3.8. SPINDLE PROTECTION SLEEVE

A sleeve tube that protect the valve spindle. The protection sleeve exists in two models.

VENTILATED	The sleeve is provided with opening and wrapped with textile fabricin order to let the gas escape and prevent the soil to go in.
NON-VENTILATED	A normal sleeve tube without textile fabric.

### 3.9. EXTERNAL LEAK-TIGHTNESS

The tightness of the body enveloping the space containing the gas, with respect to the atmosphere.

### 3.10. INTERNAL LEAK-TIGHTNESS

The tightness between the inlet and the outlet of the valve, obtained by closing the operating mechanism.

### 3.11. LEAK-TIGHTNESS TEST

Test to determine.

- the internal leak-tightness of the valve's closing seat when closed and pressurized from either side.
- the external leak-tightness of the valve when half open.

### 3.12. INITIATING TORQUE

Torque required to initiate movement of the obturator.

### 3.13. RUNNING TORQUE

Torque is required to achieve full opening or closing of the valve at maximum allowable operating pressure.

### 3.14. LEAKAGE

Emission of gas through the body, sealing membrane or any other component of the valve.

## 4. GENERAL SPECIFICATION

The present specification is based on the European Standards EN 1555 series prepared by technical committee CEN/TC 155 plastic technical and ducting system.

The requirements of this General technical specification are chosen in order to guarantee a high quality gas system which will respond to the European Standards for gas supply systems.

- the valves described in this General technical specification comply with the standard prEN1555-4 and the complementary particular requirements or options of the present GTS.





## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

- the valves are intended to be use in gas distribution networks made of PE pipes and accessories.

### 5. MATERIAL PARTICULARITIES

#### 5.1. GENERAL

All parts of the valve in contact with the gas stream shall be resistant to the gas, its condensates and other occurring substances such as dust.

All metallic parts of the PE valve shall resist to both internal and external corrosion.

#### 5.2. PE COMPOUND FOR POLYETHYLENE VALVES BODIES

- The PE compound from which the valve body, with spigot end or electrofusion socket is made out, shall conform to prEN1555-1 "acceptance procedure".
- The PE valves bodies are PE 100 class made from approved material.
  - use of recycled materials,
  - mixture of different materials,
  - addition of complementary materials.

#### 5.3. SEALS

- The seals shall be homogeneous, without any inner crack, inclusion or impurities and cannot contain any component that can alter the properties of the materials they are in contact with, and prevent the non-conformity of those materials with the present specification.
- additives shall be distributed evenly.
- The rubber seal rings shall comply with standard EN 682.
- Other seals shall comply with the relevant standard and be suitable for gas service.

#### 5.4. LUBRICANTS

Lubricants cannot have any adverse effects on the long-term performance of the valve parts.

#### 5.5. OPERATING CAP

Operating cap are in plastic material or in metal, protected against corrosion.

### 6. VALVES GENERAL PARTICULARITIES

#### 6.1. TECHNICAL FILE



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP /REPL/003/PEL

Date: 10/08/2023

The manufactures of the valves shall deliver for each type of valve a technical file which includes:

- Raw materiel used,
- drawings, dimensions and tolerances, including for the accessories,
- application range (temperature and pressure limits),
- running torque and initiating torque,
- pressure drop and flow diagram,
- test results and data proving the conformity of the valve in accordance with prEN1555-4 and prEN1555-7,
- the assembly pipes/valves realized during testing shall be in conformity with the manufactures instructions and the extreme installation conditions.
- For the test assembly due consideration should be taken regarding the fabrication tolerances and the variation of the outside ambient temperature.

### 6.2. DESIGN

- The valves will be designed for a maximum operating pressure (MOP) equal to 10 bar.
- The wall thickness of the PE valve body shall be equal or greater than the minimum wall thickness of the corresponding SDR 11 series pipes.
- Valves body and valves ends form an indivisible whole.
- Except otherwise stated in the Owner purchase order, all valves will be "ball valve" type.
- The operating cap shall be designed in a way that it cannot be ejected "non blow out" type.
- The design of the extension spindle and the spindle protection sleeve will be such that they will never, in any case, even due to soil settlement, lay on the non-reinforced part of the valve body or the valve ends. The spindle protection sleeve cannot turn during valve turning operation.
- The owner will specify if the spindle protection sleeve is a ventilated or non-ventilated type.
- The spindle protection sleeve ventilated type will have holes (min. diameter 10 mm) or slot type holes (min. width 1 mm) all around the sleeve in sufficient number in order to assure a maximum permeability for the gas.
- The sleeve will be covered by a non-waved geo-textile fabric (90 µm). The geo-textile fabric with a 50 mm overlap will be well secured on the sleeve.
- The valves should be equipped with a base plate. In order to achieve this, the valve body will be designed



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

with a flat base (model 1) or with an attached base plate or an integrated one (model 2). The Owner or his representative will specify the model.

- The operating mechanism and the stop wedges will be protected against water intrusion.
- The valve body is completely sealed except for a passage for the spindle mechanism.

### 6.3. APPEARANCE AND COLOUR

- The internal and external surfaces of valves shall be smooth clean and shall have no scoring, cavities or other defects to an extent that would prevent non-conformity to the present GTS or to the standard prEN 1555-4.
- The colour of the PE valves shall be either yellow, black or orange.
- The colour of the valve shall be specify by the Owner or his representative in the purchase order;

### 6.4. DIMENSIONS

- The dimensions will be in conformity with the standard prEN1555-3 and prEN1555-4.
- The dimensions of the extensions spindle are detailed in appendix A.
- The operating cap will be designed as per appendix B, C or D.
- The type of the operating cap will be specified by the Owner or his representative in the purchase order.
- The design of the extension spindle is such that the extension can be turn easily at any time to suit the site conditions.

## 7. MECHANICAL CHARACTERISTICS FOR ASSEMBLED VALVES

### 7.1. GENERAL

The valve shall have mechanical characteristics and be tested as specified in standard prEN 1555-4.

### 7.2. RUNNING TORQUE

The running torque and the concept of the valve shall prevent the valve from being easily operated (by hand) without an operating key. To operate the valve designed with running torque as specified I the standard prEN 1555-4, the use of an operating key is requested. Neither the operating cap nor the spindle shall be damaged when operating at maximum operating torque as specified in the standard prEN 1555-4.

### 7.3. INDIVIDUAL TEST (BATCH RELEASE TEST)

Before delivery each valve will be individually tested for mechanical strength and leak tightness as per standard prEN1555-4.

A combined mechanical resistance and leak-tightness test shall be performed inconformity with the prEN1555-4.

By batch of valves a supplementary leak-tightness test (25 mbar) shall be performed inconformity with the



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

prEN 1555-4 on 3 valves taken at random.

### 7.4. PRESSURE DROP AT LOW PRESSURE

The drop of pressure is measured with natural gas as a medium and according to the diagram specified in the standard EN 12117 (fig.1).

The maximum drop of pressure measured with natural gas (inlet pressure 25 mbar) will be limited to 0.2 mbar for a nominal gas flow as per table below.

<b>d<sub>n</sub></b>	<b>Flow m<sup>3</sup>/h</b>
32	10
40	15
63	60
90	180
110	250
160	600
200	1000

### 8. MARKING

At least the information given below shall be printed or formed directly on the valve :

- a) Manufacturer's name and/or trademark.
- b) Material and designation (e.g. PE 100).
- c) Design application series (e.g. SDR 11).
- d) Nominal diameter.
- e) Internal fluid "gas";
- f) Traceability code (valve and component) as per standard ISO/FDIS 12176-4.
- g) Number of the system standard (e.g. prEN 1555-4) this information can be printed/formed directly on the valve or on a label associated with the valve or on an individual bag.
- h) Production period, year and month;

The marking shall stay legible during normal manipulation, storage and installation.

The marking shall not adversely influence the performance of the valve and prevent the non-conformity of the valve.



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

No marking will be accepted at the valve spigot ends.

### 9. PACKAGING AND DELIVERY

The valve and its accessories shall be packaged individually in plastic bags in order to prevent them from deterioration. The valves ends shall be protected with external caps.

The cartons and/or individual bags shall bear at least one label with the manufacturer's name, type and dimensions of the part number, number of units in the box and, any special storage conditions and storage time limits.

### 10. GUARANTEE

The manufacturer will extend his guarantee for each part for 10 years after production. This guarantee period is valid if the parts are kept in proper conditions and in the original packaging.

The valves equipped with electrofusion sockets will be supplied with a magnetic card and a code bar tag containing the welding parameters. The coding of the parameters shall be in conformity with the standard ISO TR 13950.

The operating manual (in English) will be inserted in the individual part package.

### 11. QUALITY CONTROL

#### 11.1. GENERAL RULINGS

##### 11.1.1. Manufacturer's responsibility

The manufacturer is entirely responsible for the quality of the PE valves manufactured by his firm.

All control checks prescribed above do not relieve him of this responsibility.

To ensure that all PE valves are in compliance with the specification in all aspects, they must be controlled by the plant control service, which must be independent from the manufacturing department.

All PE valves supplied are guaranteed for 10 years after the date of production.

##### 11.1.2. Quality assurance

The manufacturer must have some form of quality control to ensure that products comply with EN standards 29001 or 29002. The quality assurance manual must be made available to the Owner Control Service or an external Control laboratory appointed by him.

The system of quality assurance must be certified by an authorised body.

#### 11.2. CONTROLS

##### 11.2.1. Control testing by the manufacturer

###### 11.2.1.1. By material batch.



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023

The manufacturer demands a certificate from the raw material manufacturer including the following :

- Fluid index
- Water content
- Volume mass
- Carbon black or yellow stabilising agent content
- Carbon black or yellow stabilising agent quality
- OIT value (thermal stability)

### 11.2.1.2. *By accessory batch*

The manufacturer must run control checks as specified in the standard prEN 1555-4 and prEN 1555-7:

Control checks and the number of tests must be carried out according to the prescriptions of the EN standard 1555-4.

Also refer to table N° 8, paragraph 4.2.3. “Lot release tests” of standard prEN 1555-7.

The results must be written out in documents that contain the complete identification of the accessory batch.

These documents must be made immediately available for the Owner representative.

### 11.2.2. Plant Reception by the Owner Control Service representative

#### 11.2.2.1. *General information*

All quality controls must be run in the presence of the Owner Control Service representative.

All tests and control checks must comply with appropriate standard prescriptions and with the specific specifications established with the order.

At each visit by the Owner representative, the manufacturer must provide, free of charge, all means and personnel necessary for running the established control checks.

While the order is under production, the Owner representative must have access to stocking installations of all raw materials before manufacturing, manufacturing and control installations, as well as the accessory stocking areas for any control checks he is responsible for.

During his visits, the Owner representative will receive a certificate as soon as he reaches the plant for each batch of accessories presented for reception.

Each time this is requested by the Owner representative, the manufacturer must provide recent reports of all control checks and measuring instrument results and testing results.

#### 11.2.2.2. *Convocation for reception*



## Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Tender Document No:  
**A IIP /REPL/003/PEL**

**Date: 10/08/2023**

Convocation instructions for reception are to be defined with the order.

### 11.2.2.3. *Reception control checks*

For each accessory batch or any fractions of the batch, minimal batch sampling is established in annexed enclosure 3. These control checks and tests are to be run according to the prescriptions of standard prEN 1555-4.

## 11.3. ACCEPTANCE OR REFUSAL

### 11.3.1. Appearance, measurements and marking.

Any requirements not supplied will lead to the refusal of the complete batch. However in the case where a batch is refused, it can be presented for approval again after a control check, on agreement with the Owner Control Service.

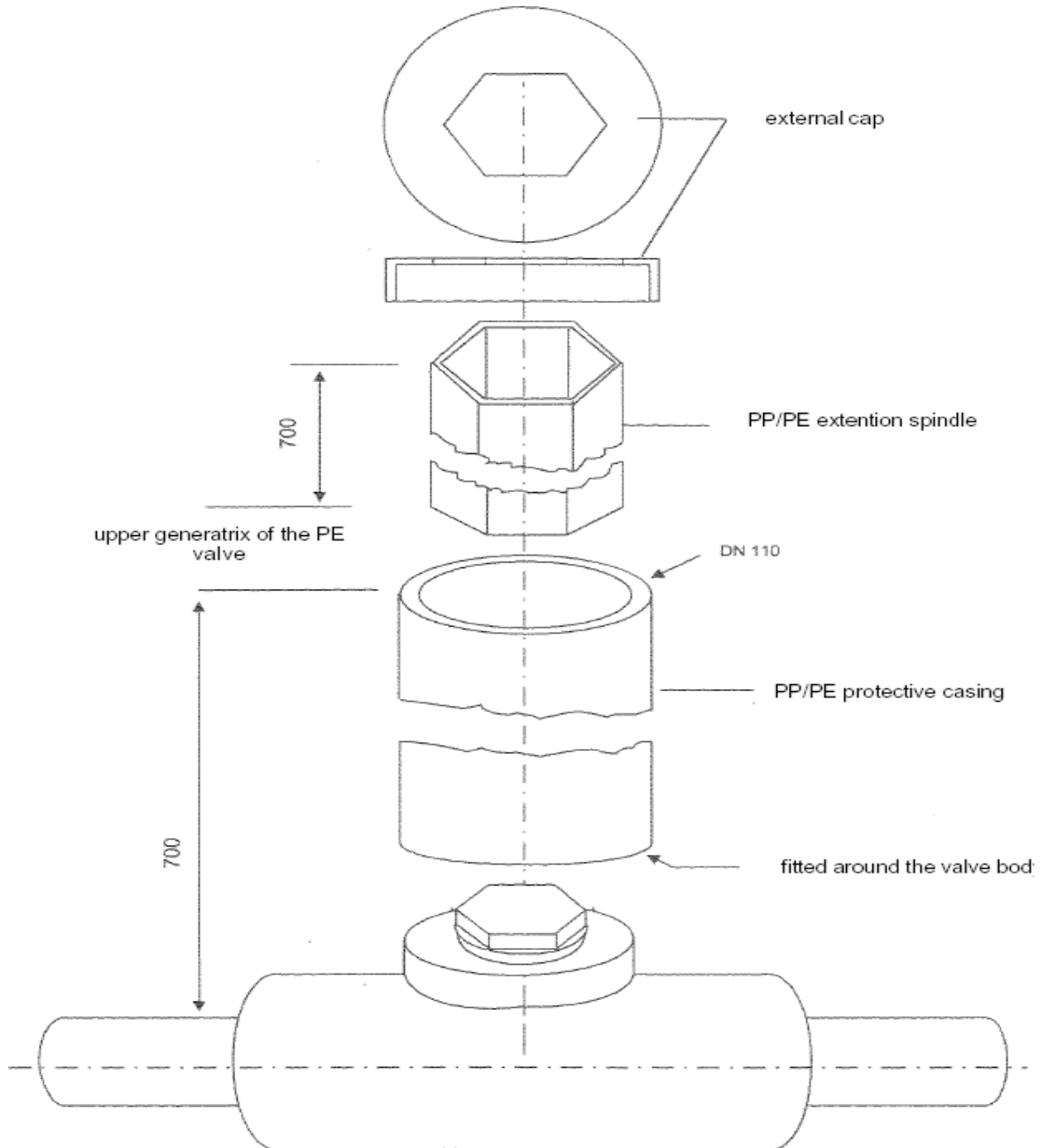
### 11.3.2. Control check on characteristics

All results that do not comply with the specification prescriptions and the particular specifications requested with the order, demand counter-testing on at least double the number of the samples previously tested. If the undesirable result is confirmed, then the batch is refused permanently. If the result is positive, then the batch will be accepted.

As a complementary control check, other analyses and/or tests can be run after common agreement, and at the manufacturer's cost.

**ANNEXURE - A**

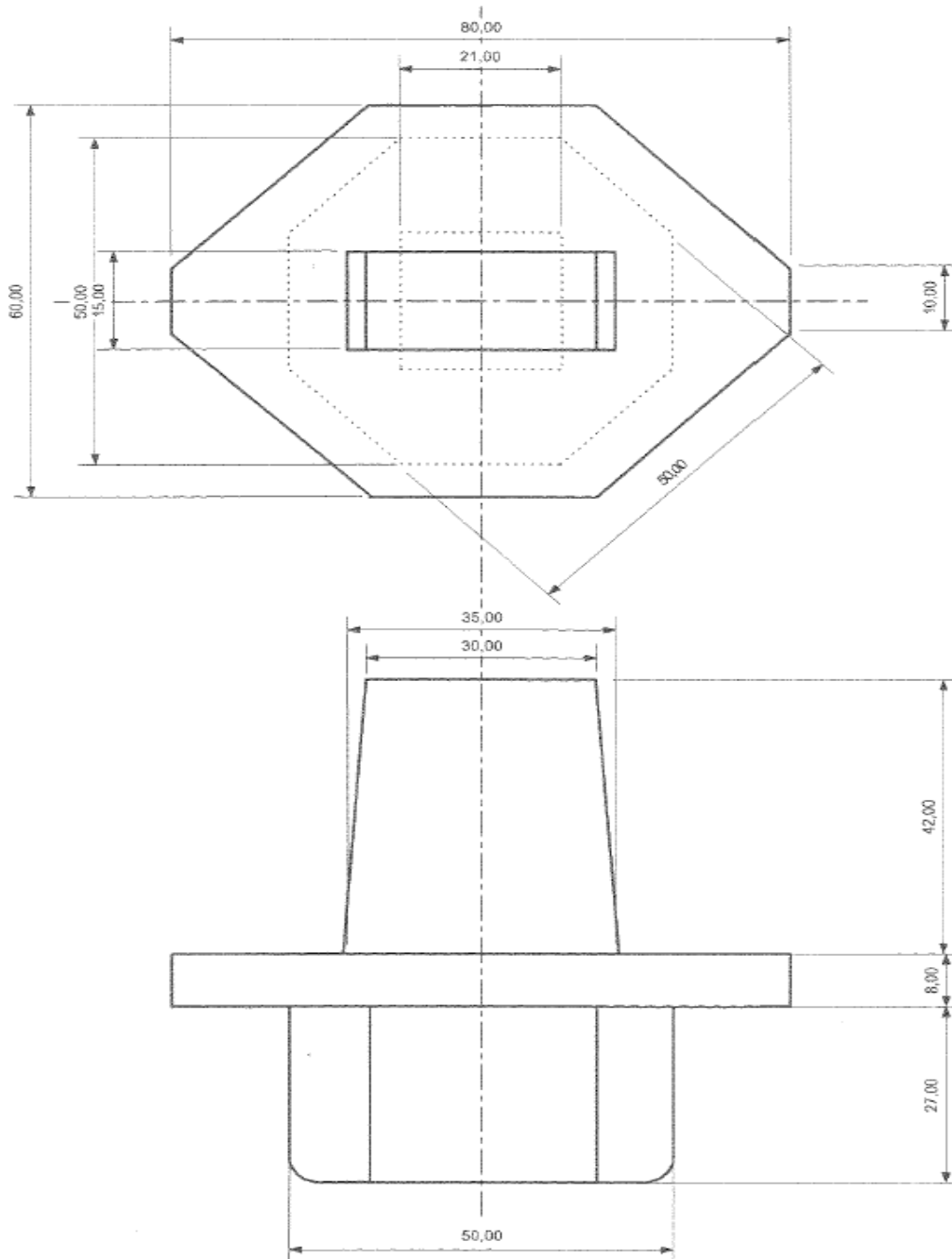
Dimensions of the extension spindle





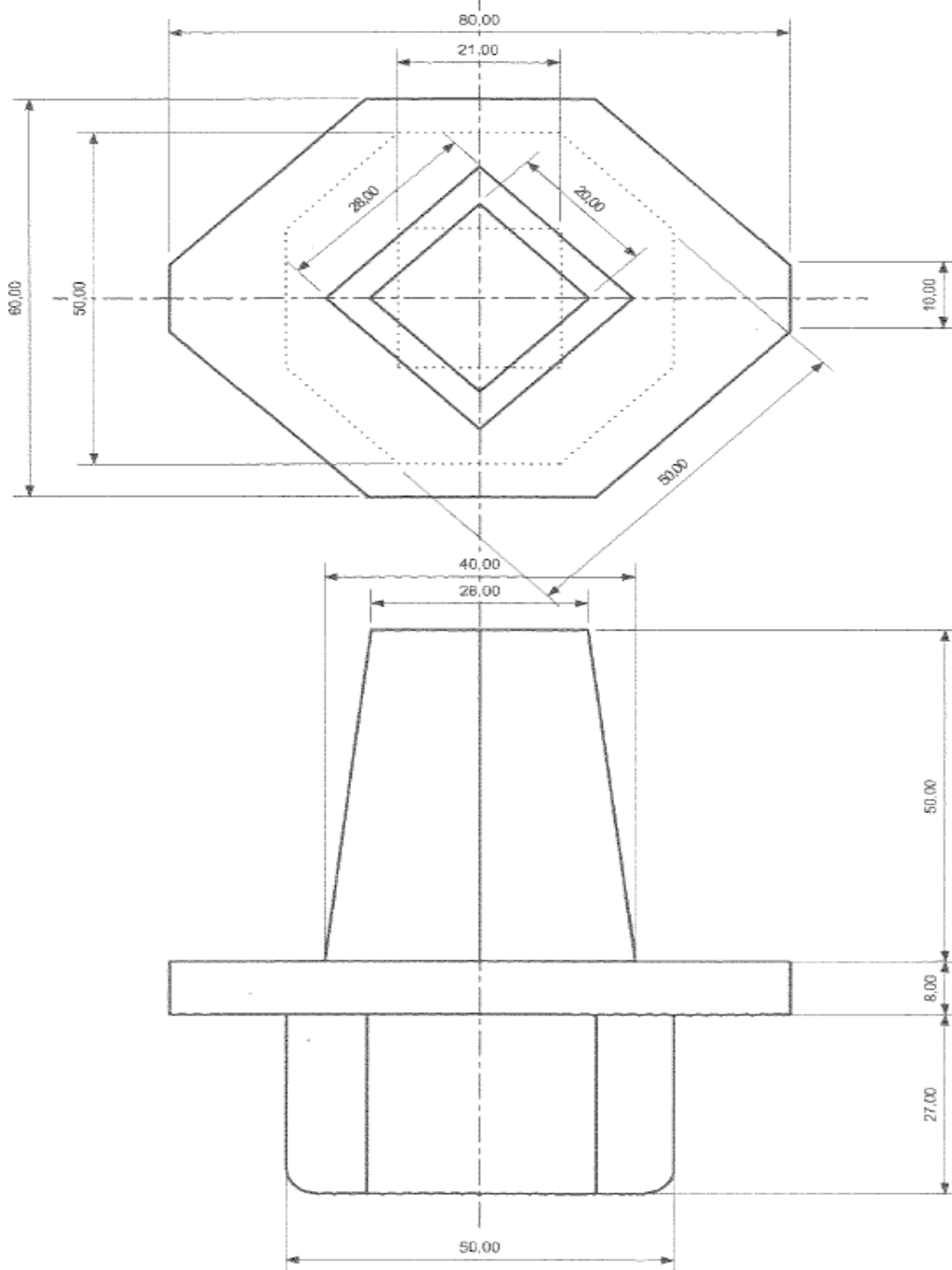
### ANNEXURE - B

#### Dimensions of the operating cap Type A



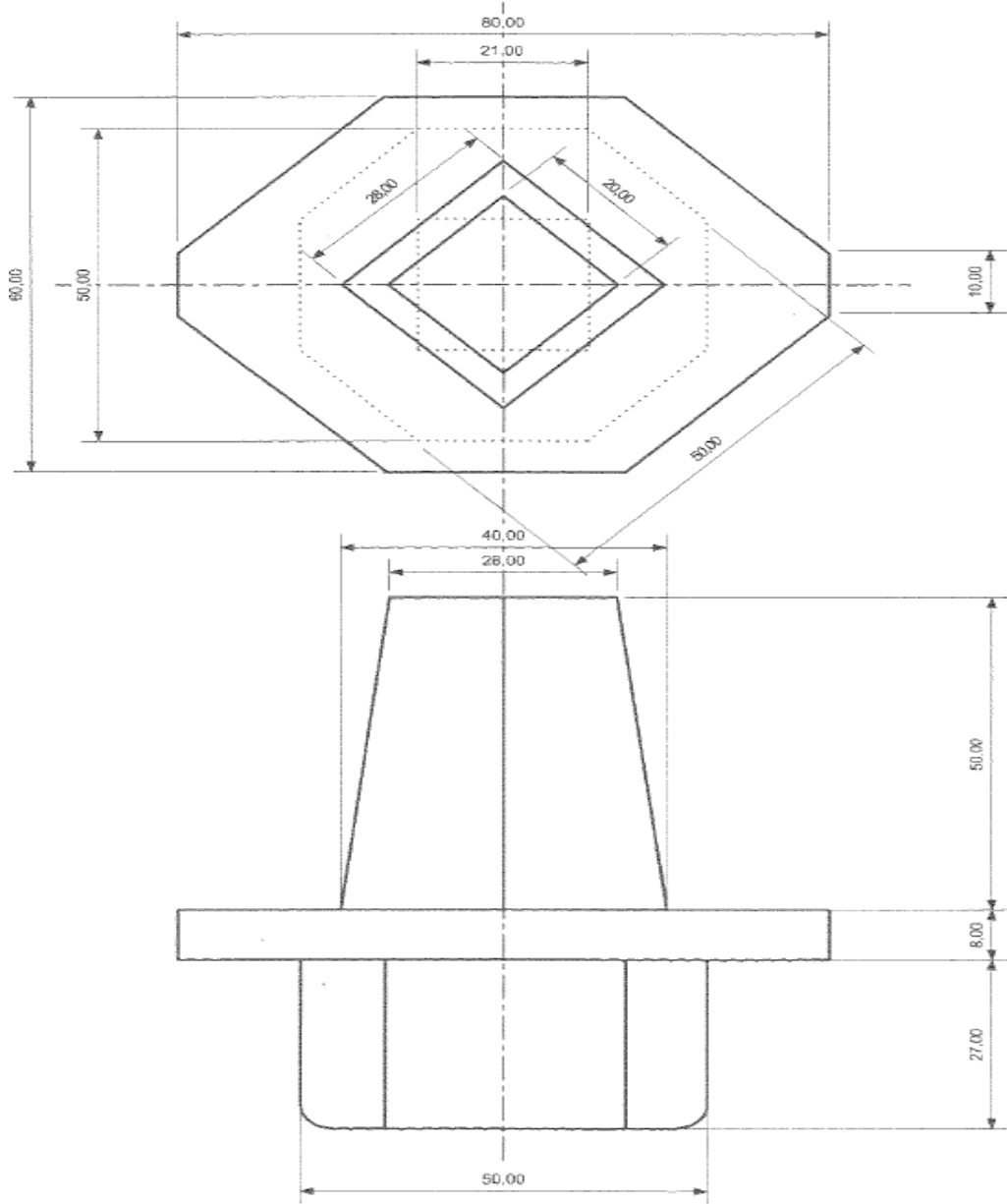
### ANNEXURE - C

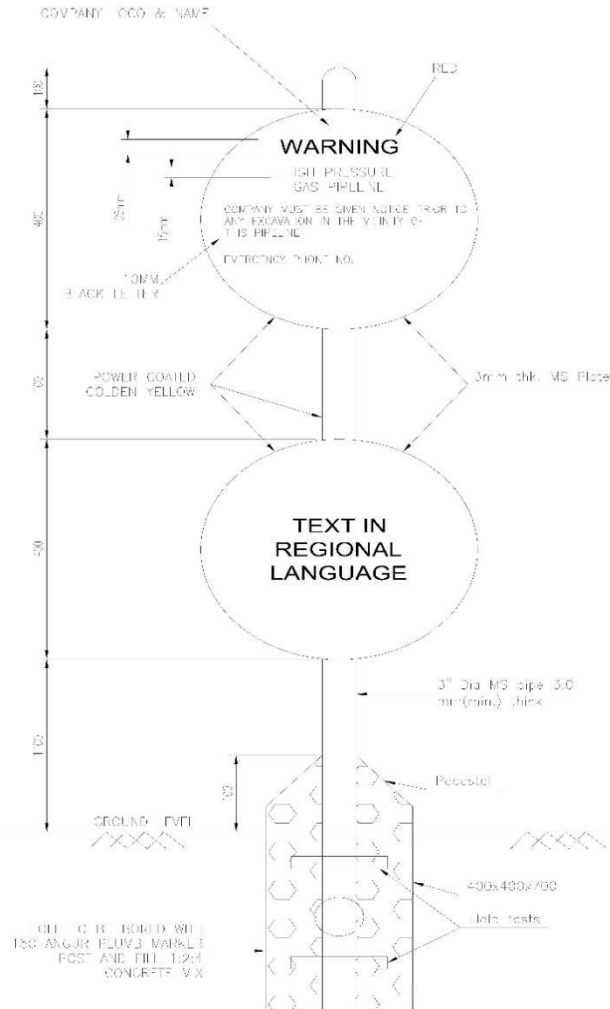
Dimensions of the operating cap Type B



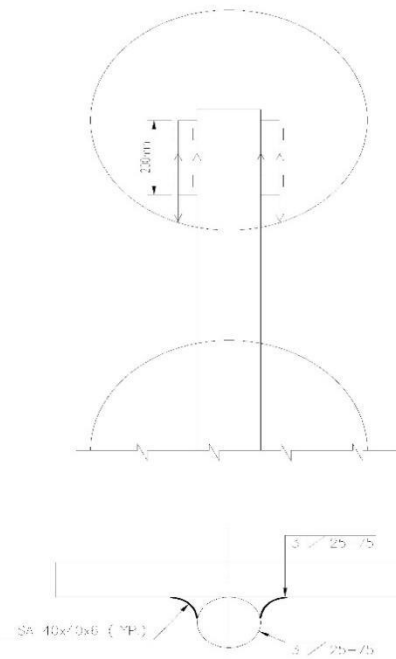
## Annexure - D

### Dimensions of the operating cap Type C





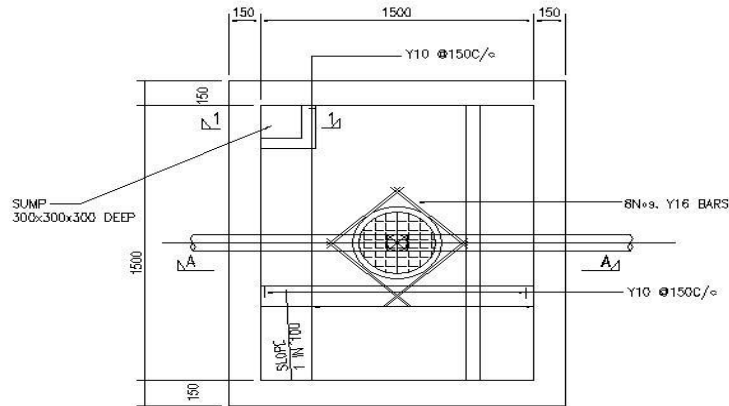
FIXING DETAILS



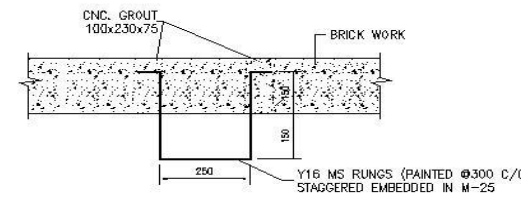
NOTES:

1. ALL DIMENSIONS ARE ONLY INDICATIVE AND ARE SUBJECT TO THE APPROVAL BY OWNER/PMC OR LOCAL AGENCIES.
2. SCHEME FOR POWDER COATING AND COLORING, ONE COAT OF PRIMER & TWO COATS OF SPECIFIED PAINTS. ALL LETTERS EXCEPT "WARNING" TO BE PAINTED BLACK.
3. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
4. APPROVAL OF WARNING MARKER DESIGN SHALL BE OBTAINED BEFORE THE COMMENCEMENT OF WORK.

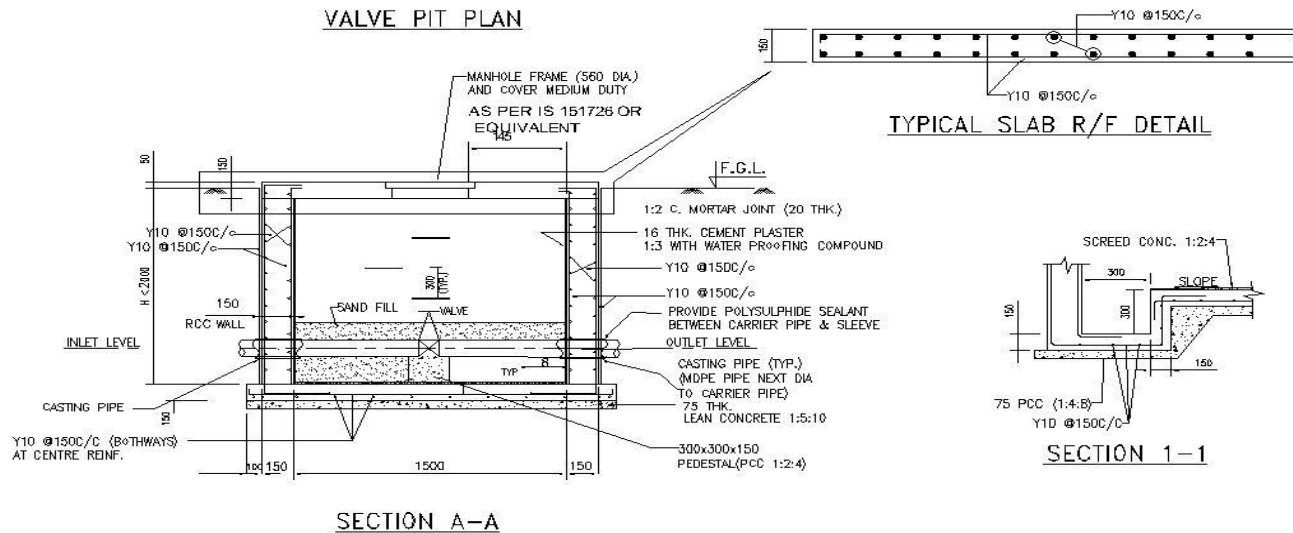
0	26/07/2023	Issued for tender	AS	PA	1/BS
Rev.	01	modification	Drawn by	Checked by	Approved by
		PROJECT: LAYING OF PE 100 PIPE			
		SUBJECT:			
		POLE MARKER WITH FOUNDATION DETAILS			
		Scale:	Sheet:	Total	
		A3	NTS	01 of 01	0
		Drawing No: ICP/003/STD/PE-001			
		  RESONANCE ENERGY PVT. LTD.			



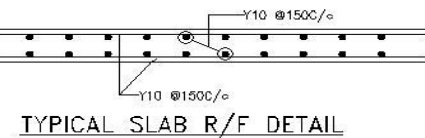
VALVE PIT PLAN



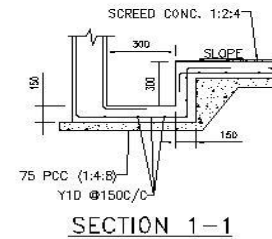
TYPICAL DETAILS OF MS RUNGS



SECTION A-A






TYPICAL SLAB R/F DETAIL

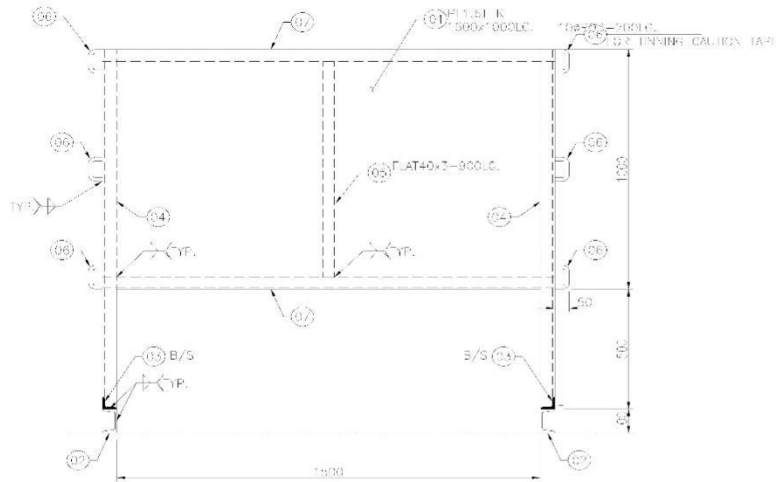


SECTION 1-1

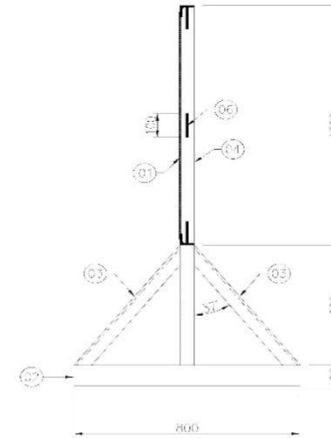
NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3. CLEAR COVER TO MAIN REINFORCEMENT SHALL BE: SLAB = 20mm.
4. GRADE OF CONCRETE SHALL BE C-25.
5. REINFORCEMENT SHALL BE OF HYSD ( Fe 415) CONFIRMING TO 151786 OR EQUIVALENT.

Rev.	Date	Description	AS	KM	VBS
D	20.07.2023	Issued for Bid			
Rev.	D M Y	modification	Drawn by	Checked by	Approved by
					
PROJECT: LAYING OF PE 100 MDPE PIPELINE SUBJECT: RCC VALVE CHAMBER (1.5M X 1.5M)					
 RESONANCE ENERGY P.T.I LTD.		Size	Scale	Sheet	Rev.
		A3	NTS	01 of 01	0
		Drawing No: REPL/CGG/STD/PE-01B			

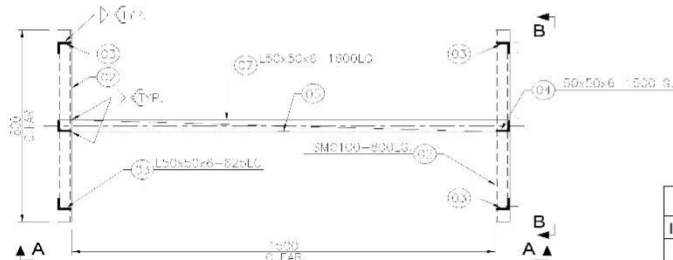


ELEVATION A-A  
(SCALE: 1:100)



ELEVATION B-B  
(SCALE: 1:100)

- NOTES:
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
  2. FOLLOW WRITTEN DIMENSIONS ONLY, DO NOT SCALE.







PLAN VIEW  
(SCALE: 1:100)

**CAUTION**  
WORK IN PROGRESS

LAYING OF NATURAL GAS PIPE IN-  
CLIENT : OWNER'S NAME  
CONTRACTOR NAME :  
DATE OF COMMENCEMENT :  
DATE OF COMPLETION :  
EMERGENCY PHONE NOS :

(TO BE PRINTED ON BOTH SIDE  
OF ITEM NO. 01)

BILL OF MATERIAL						
Item Mkd.	Section	Width	length	Item Qty. (All Marks)	Weight Kgs/M,M2	In Kgs Total Weight
1	PL 1.6 Thk.	1600	1000	1	12.56	20.1
2	ISMC 100	-----	8000	2	9.2	14.72
3	L50 x 50 x 6	-----	625	4	4.5	11.25
4	L50 x 50 x 6	-----	1500	2	4.5	13.5
5	Flat 3 thk.	40	900	1	0.94	0.03
6	10 dia rod	-----	200	6	0.62	0.74
7	L50 x 50 x 6	-----	1600	2	4.5	14.4
Grand Total (Kg)						74.74

26/07/2023		20/07/2023	
Rev	D V Y	Rev	D V Y
PROJECT: LAYING OF PE 100 PIPE IN-BENIN		PROJECT: LAYING OF PE 100 PIPE IN-BENIN	
SUBJECT: TYPICAL DETAIL OF CAUTION BOARD		SUBJECT: TYPICAL DETAIL OF CAUTION BOARD	
			
			
Size	Scale	Sheet	Rev
A3	NTS	01 of 01	0
RESONANCE ENERGY PVT. LTD.		DRAWING NO. RZTL/003/STD/PE-001	



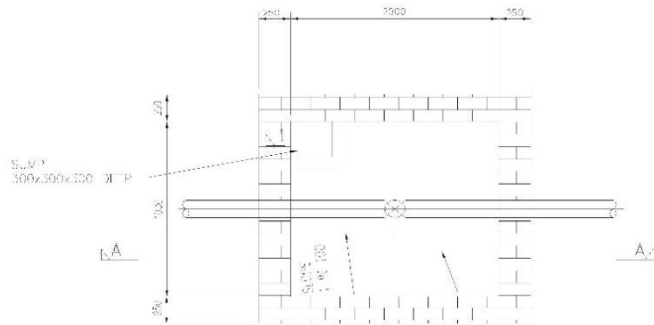
# Laying of PE 100 Pipe at Cotonou, Benin of West Africa



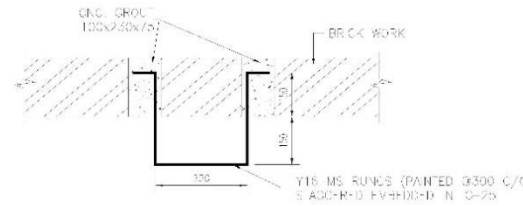
Resonance Energy

Tender Document No:  
**A IIP/REPL/003/PEL**

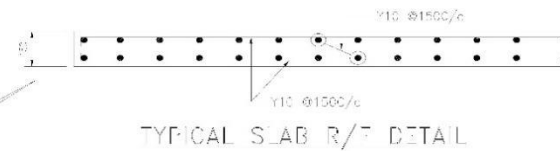
Date: 10/08/2023



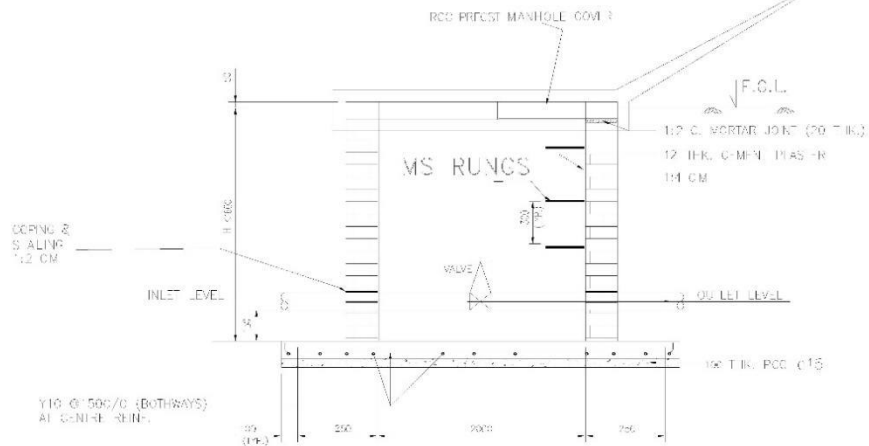
VALVE PIT PLAN



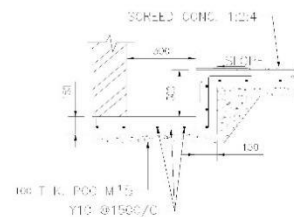
TYPICAL DETAILS OF MS RUNGS



TYPICAL SLAB R/T DETAIL



SECTION A-A



SECTION

- NOTES:
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
  2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE SCALE THE DIMENSIONS.
  3. CLEAR COVER TO MAIN REINFORCEMENT SHALL BE SLAB = 25mm.
  4. BRICK SHALL BE OF 750 C ASS RCC OF C-25 @ 1000 OF C-15.
  5. REINFORCEMENT SHALL BE OF 1 YSD (GRADE 1 & 16) CONFORMING TO S.1786 OR EQUIVALENT.

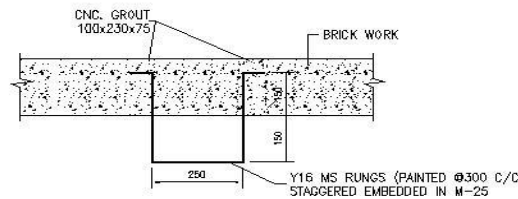
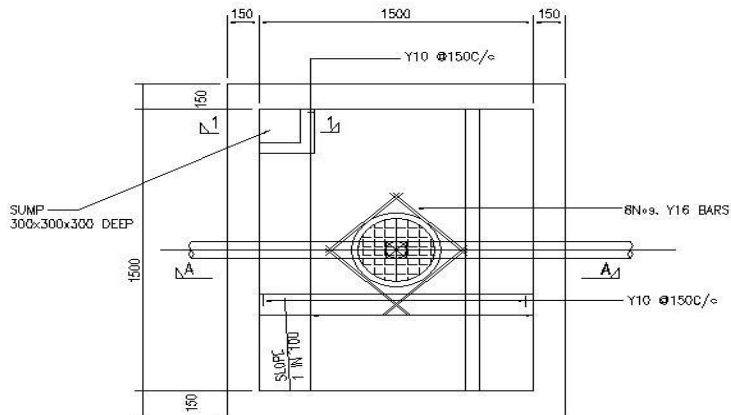
Rev.	1907/2023	Issued for tender	AS	KM	VBS
	D.M.V.	modification	drawn by	checked by	approved by

SIPI  
 PROJECT: LAYING OF PE 100 PIPE  
 SUBJECT: BRICK VALVE CHAMBER (2.0M X 1.0M)  
 GDIZ  
 GENERAL INVESTMENT  
 BENIN

Drawn	Scale	Sheet	Rev.
A3	NTS	01 of 01	0

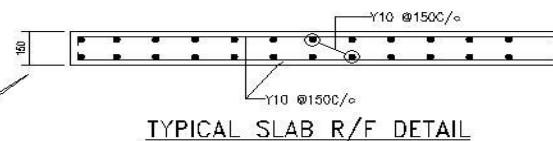
Resonance Energy  
 Resonance Energy PVT. LTD.  
 Drawing No: REPL/2023/STD/PEL-018

This document is the property of RESONANCE ENERGY. Any reproduction or transmission in any form without the prior written consent of Resonance Energy is strictly prohibited.

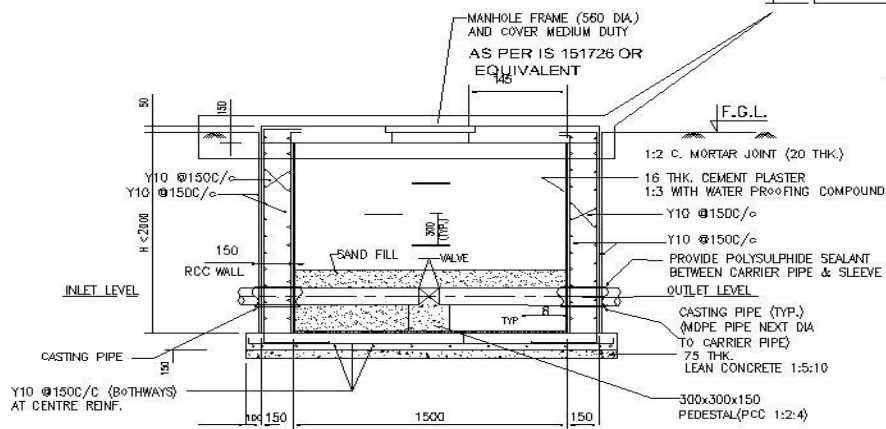


TYPICAL DETAILS OF MS RUNGS

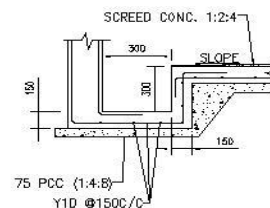
VALVE PIT PLAN



TYPICAL SLAB R/F DETAIL






SECTION A-A



SECTION 1-1

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3. CLEAR COVER TO MAIN REINFORCEMENT SHALL BE: SLAB = 20mm.
4. GRADE OF CONCRETE SHALL BE C-25.
5. REINFORCEMENT SHALL BE OF HYSD ( Fe 415) CONFIRMING TO 151786 OR EQUIVALENT.

D	20.07.2023	Issued for Bid	AS	KM	V95
Rev.	D M Y	modification	Drawn by	Checked by	Approved by
					
PROJECT:-LAYING OF PE 100 MDPE PIPELINE SUBJECT: RCC VALVE CHAMBER (1.5M X 1.5M)					
		Size	Scale	Sheet	Rev.
RESONANCE ENERGY PVT. LTD.		A3	NTS	01 of 01	0
		Drawing No: REPL/CGD/STD/PE-018			





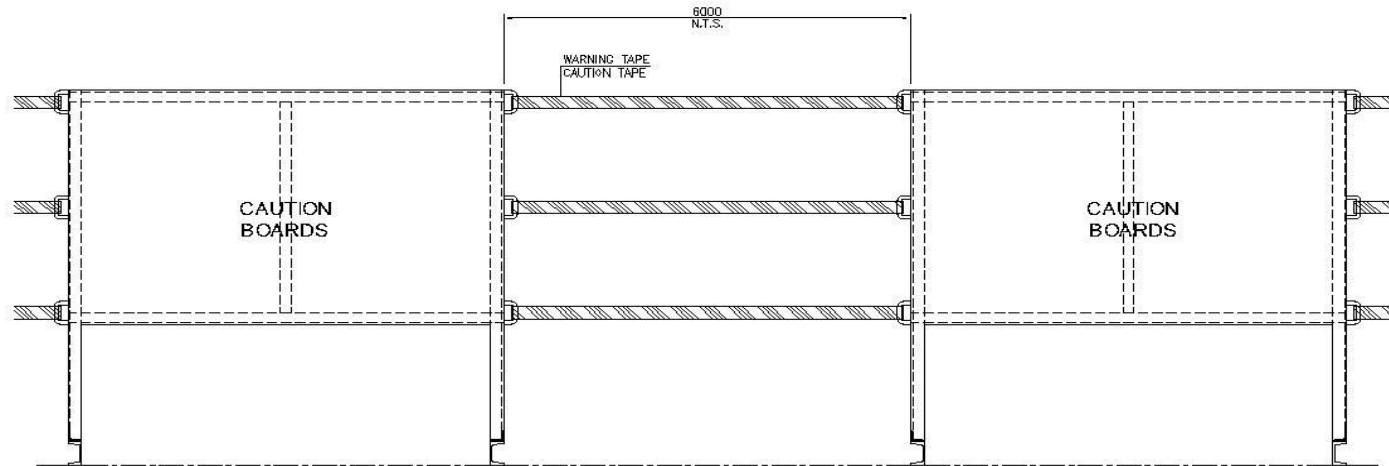
Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Resonance Energy

Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023



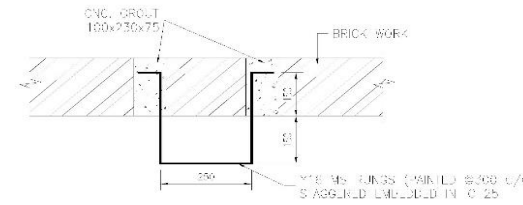
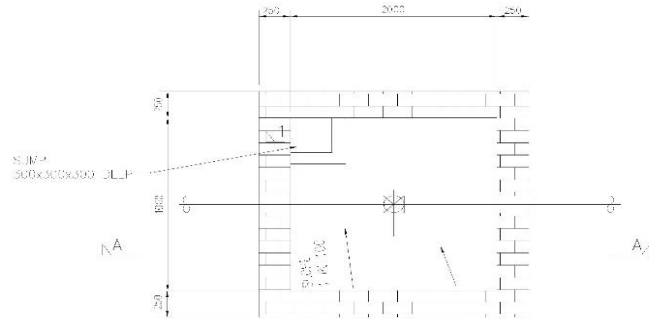
SCHMATIC LAYOUT OF CAUTION BOARDS AND BARRICADING

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.

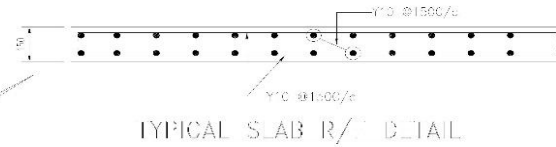
No reproduction or copying of any part of this drawing is permitted without the prior written approval of the Engineer.

0	20/07/2023	Issued for tender	AS	KM	VBS
Rev.	D. M. Y.	modification	Drawn by	Checked by	Approved by
				PROJECT: LAYING OF PE 100 PE PIPELINE SUBJECT: TYPICAL DETAIL OF BARRICADING	
		Size	Scale	Sheet	Rev.
RESONANCE ENERGY P.T.I LTD. Drawing No. REPL/CGD/STD/PE-002		A3	NTS	01 of 01	0

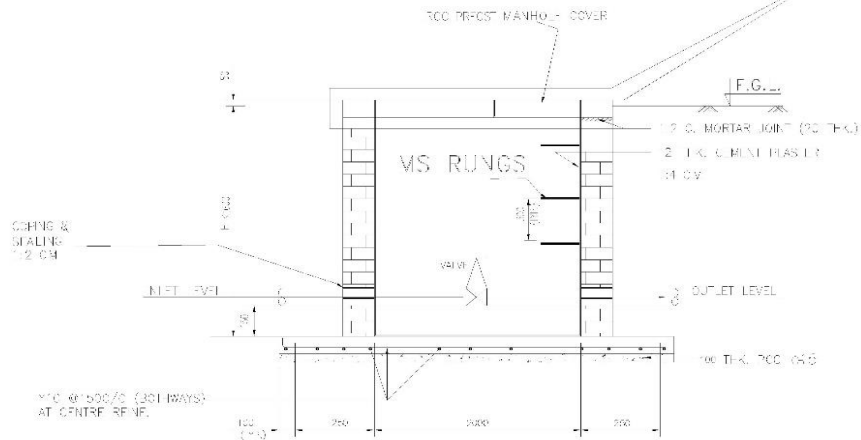


TYPICAL DETAILS OF MS RUNGS

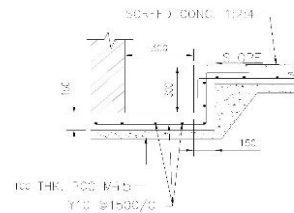
VALVE PIT PLAN



TYPICAL SLAB R/F DETAIL





SECTION A-A



SECTION 1-1

- NOTES:
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
  2. FOLLOW WRITTEN DIMENSIONS ONLY DO NOT SCALE DIMENSIONS.
  3. CLEAR COVER TO MAIN REINFORCEMENT SHALL BE 20mm.
  4. BRICK SHALL BE OF 75 CLASS R/O OF C-25 & R/O OF G-15.
  5. REINFORCEMENT SHALL BE OF HYSD (GRADE Fe 415) CONFORMING TO S1785 OR EQUIVALENT.

This document is the property of RESONANCE ENERGY. Any duplication or transmission without the written permission is strictly prohibited.

0	19/07/2023	Issued for tender	AS	KM	VBS
Rev	2.0	modification	drawn by	checked by	approved by
					
PROJECT: LAYING OF PE 100 PIPE					
SUBJECT: BRICK VALVE CHAMBER (2.0M X 1.0M)					
Scale	Scale	Sheet	Total		
A3	NTS	01 of 01	0		
DRAWING NO: REPL/003/PEL-018					
RESONANCE ENERGY PVT. LTD.					



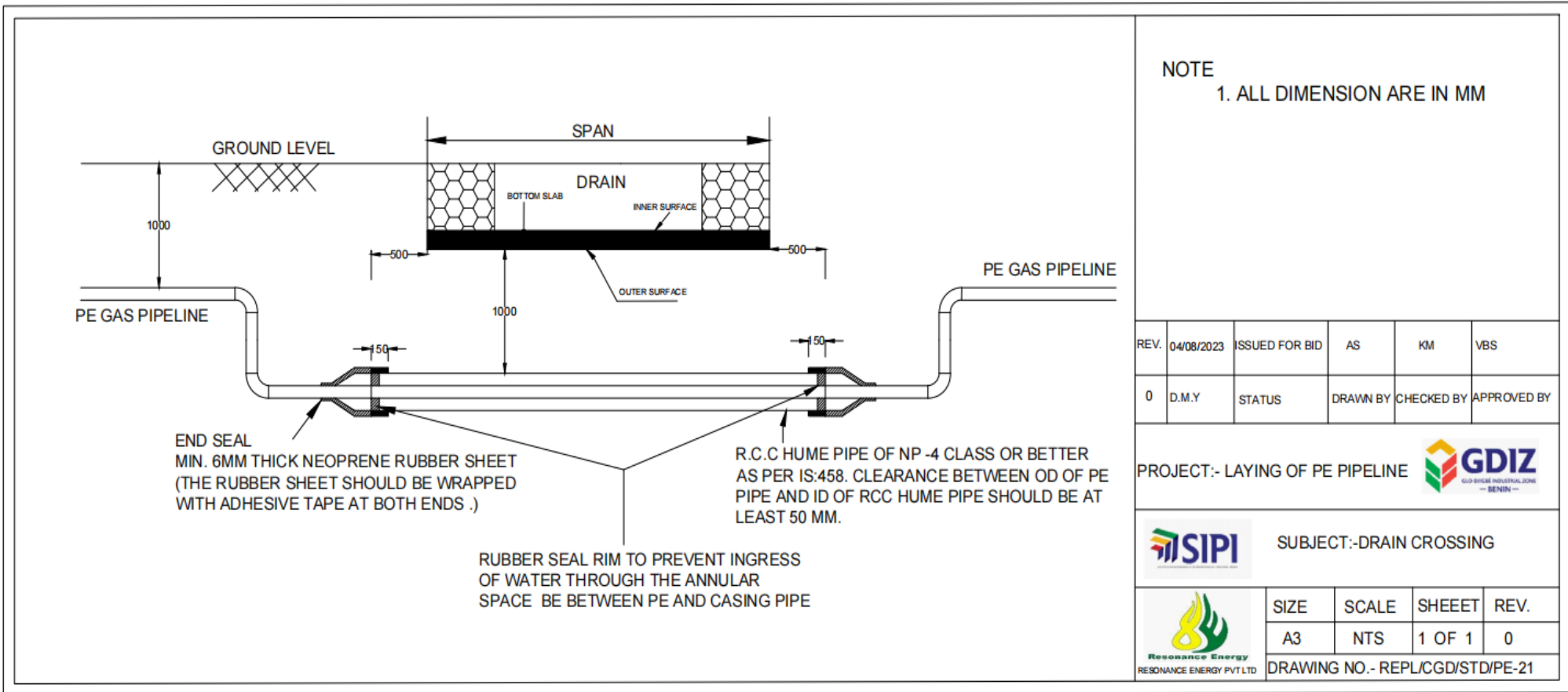
Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Resonance Energy

Tender Document No:  
A IIP/REPL/003/PEL

Date: 10/08/2023





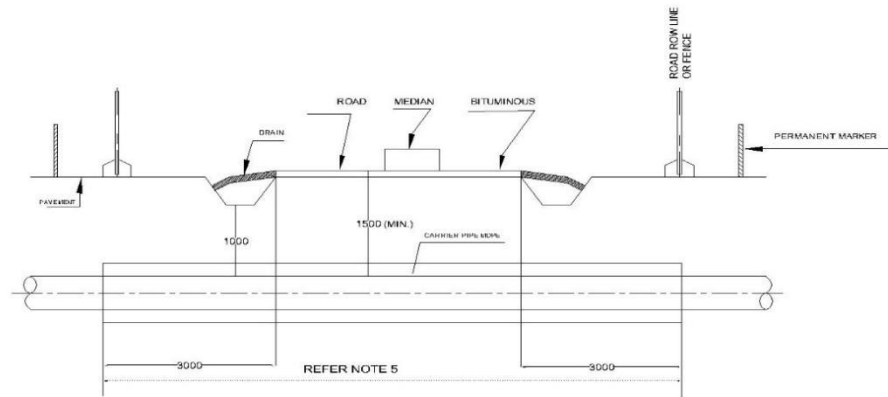
# Laying of PE 100 Pipe at Cotonou, Benin of West Africa



Resonance Energy

Tender Document No:  
A IIP /REPL/003/PEL

Date: 10/08/2023



PE-100 CARRIER PIPE DIA SIZE (MM)	MIN.DIA OF HDPE CASING PIPE (MM)
32	90
63	160
90	180
125	250
180	315

**NOTE**

1. ALL DIMENSION ARE IN UNLESS OTHERWISE SPECIFIED .
2. ROAD HIGHWAY CROSSING SHALL BE RESTORED YO ORIGINA CONDITION TO THE ENTIRE SATISFACTION OF OWNER AND CONCERNED AUTHORITIES HAVING JURISDICTION. REFER API RP 1102 FOR OTHER DESING AND INTALLATION REQUIREMENTS.
3. ANGLE OF INTERSECTION BETWEEN PIPELINE AND THE ROAD HIGHWAY SHALL BE AS CLOSE TO 90° AS POSSIBLE BUT IN NO CASE LESS THAN 30°
4. CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSION WITH RESPECT TO SURVEY DETAIL FOR EACH ROAD HIGHWAY CROSSING AND PREPARE DETAILED DRAWING FOR INDIVIDUAL CROSSING FOR ENGINEER- IN CHARGE APPROVAL BEFORE COMMENCEMENT OF CONTRUCTION .

0	19/07/2023	issued for tender	AS	KM	VBS
Rev. D	M Y	MODIFICATION	drawn by	checked by	approved by

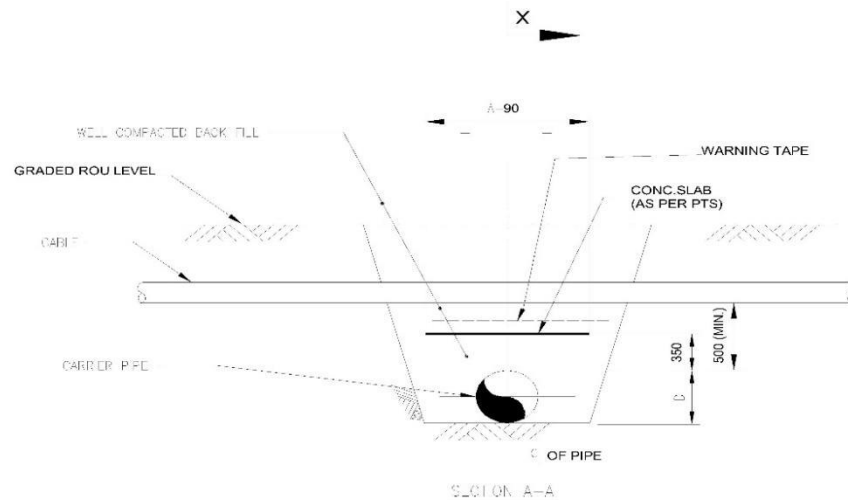
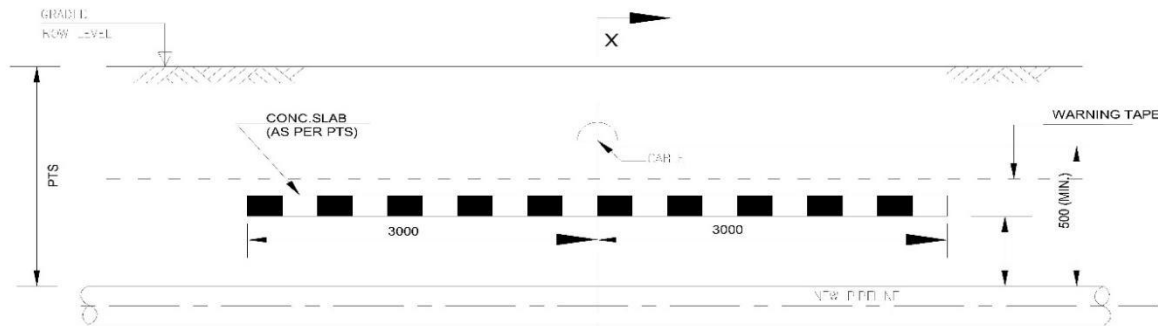
PROJECT: CITY: -LAYING OF PE 100 PE PIPELINE

SUBJECT- ROAD / HIGHWAY CASED CROSSING FOR PE PIPE






SIZE	SCALE	SHEET	REV.
A1	NTS	01 OF 01	0
DRAWING NO REPL/003/PEL/001			

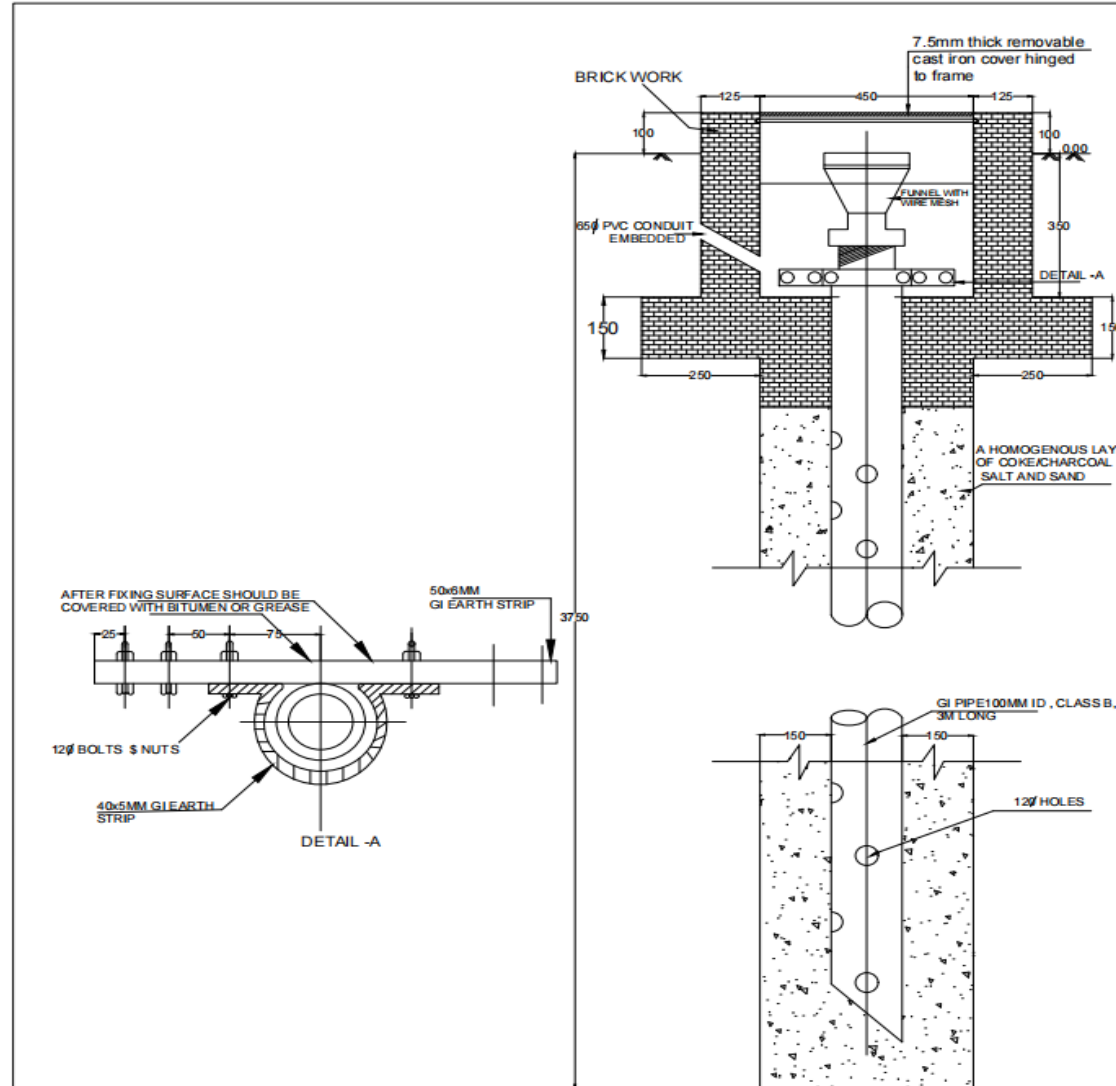
UNDERGROUND CABLE CROSSING



NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. A MODEL PIPE WITH WARNING STRIP SHALL BE INSTALLED OVER THE CABLE CROSSING.
3. APPROVAL OF THE CROSSING SHALL BE OBTAINED FROM CONCERNED AUTHORITIES.

Issue No.	20.07.2023	Issued for	AS	RM	VSS
Rev.	J. M. Y.	Status	Drawn by	Checked by	Approved by
				PROJECT - LAYING OF PE 100 PIPE (PART 02)	
SUBJECT: TYPICAL UNDERGROUND CABLE CROSSING DETAILS					
Scale	Scale	Sheet	Rev.		
A3	NTS	01 of 01	0		
 RESONANCE ENERGY PVT. LTD.		Drawing No. PE-L/003/STD/02-008			



NOTE

1. ALL DIMENSION ARE IN MM
2. EARTH PIT SYSTEM CONFIRM TO IS 3043 (87.)
3. AFTER LAYING THE EARTH STRIP TO THE ELECTRODE THROUGH PVC CONDUIT AT PIT ENTRY, THE PVC CONDUIT SHALL BE SEALED WITH BITUMIN COMPOUND.
4. NO. OF EARTH PIT SHALL BE MADE TO ACHIEVE THE DESIRED EARTH RESISTANCE.

REV.	03/08/2023	ISSUED FOR BID	AS	KM	VBS
0	D.M.Y	STATUS	DRAWN BY	CHECKED BY	APPROVED BY

PROJECT-GLO DJIGBE INDUSTRIAL ZONE BENIN

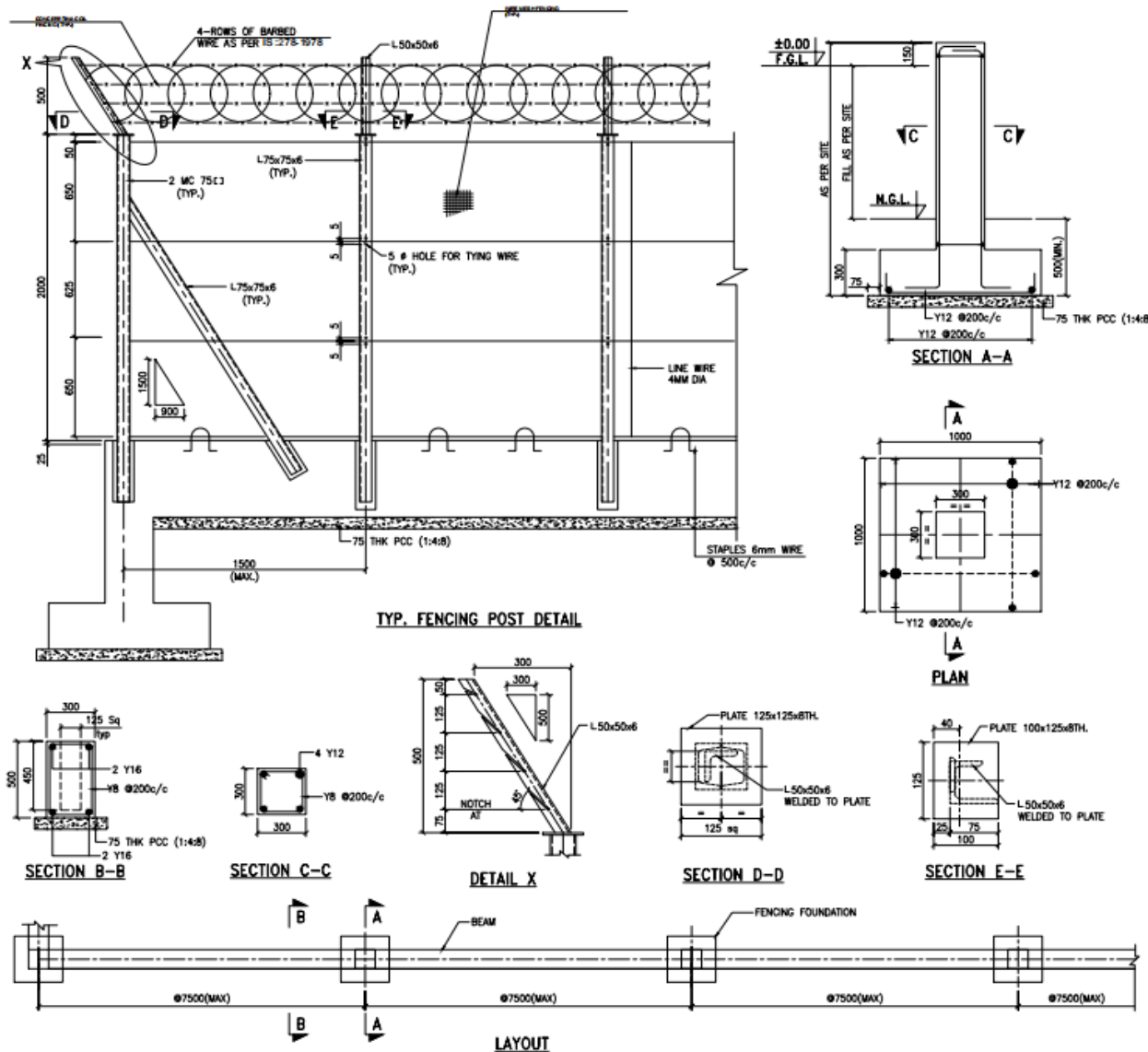


SUBJECT- TYPICAL ELECTRICAL EARTH PIT



SIZE	SCALE	SHEET	REV.
A3	NTS	1 OF 1	0

Drawing No: -REPL/CGD/STD/CSP-046

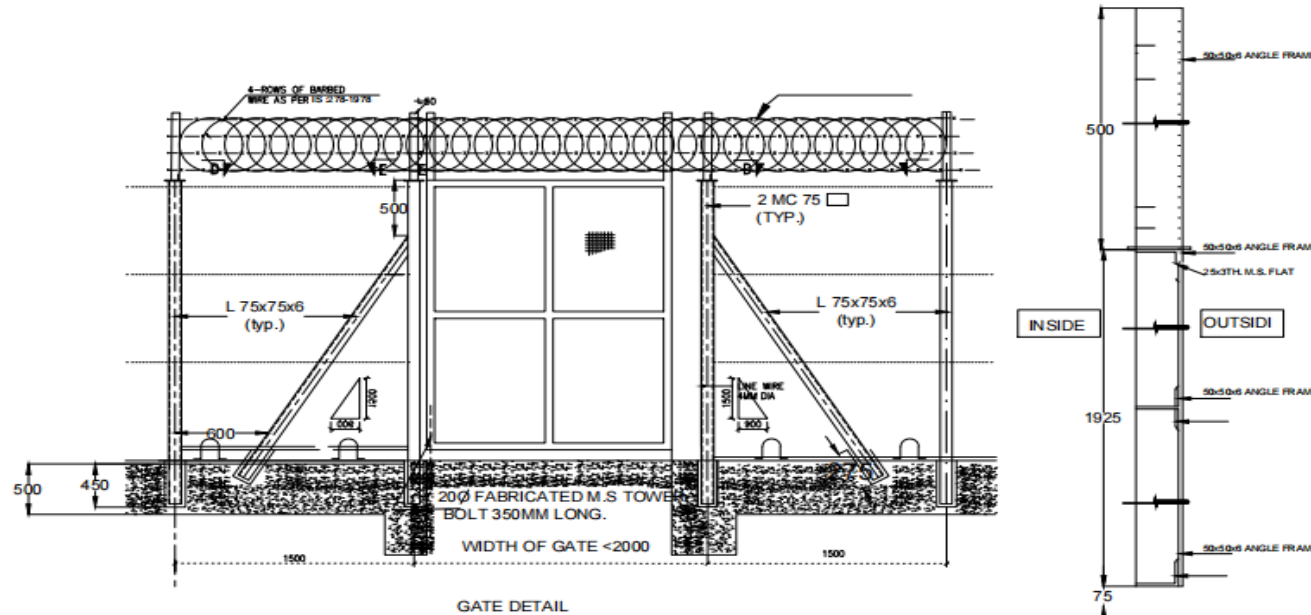
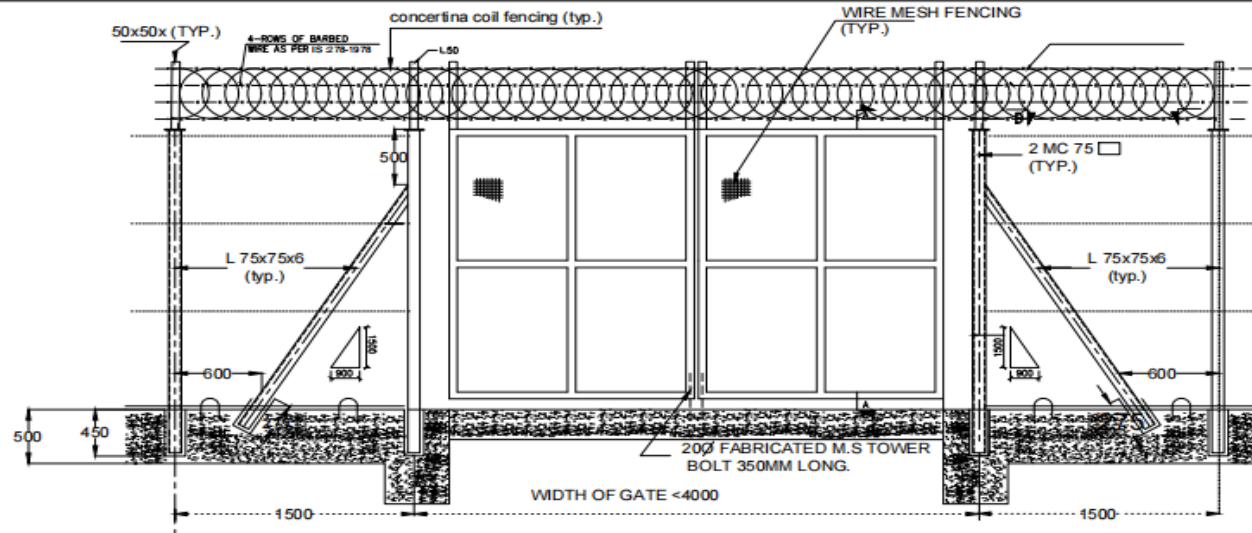


NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE THE.

0	12.06.2023	Issued for Bid	AS	KM	VBS
Rev.	D M Y	Drawn by	Checked by	Approved by	
PROJECT: LAYING OF PE PIPELINE					
SIPI		GDIZ			
SUBJECT: TYPICAL DETAILS OF FENCING WITH WIRE MESH FENCING					
Size	Scale	Sheet	Rev.		
A3	NTS	01 of 01	0		
Drawing No: REPL/CGD/STD/PE-018					
RESONANCE ENERGY PVT. LTD.					





- NOTES:  
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.  
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE THE DIMENSIONS

0	26.07.2023	Issued for Bid	AS	SM	VBS
Rev.	D M Y	Drawn by	Checked by	Approved by	
PROJECT: LAYING OF PE PIPELINE					
SUBJECT: TYPICAL DETAILS OF GATE					
SIPI		GDIZ			
Resonance Energy		Size	Scale	Sheet	Rev.
RESONANCE ENERGY PVT. LTD.		A3	NTS	01 of 01	0
Drawing No. REPL/C00/STD/PE-020					