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TECHNICAL SPECIFICATION

HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

CROSSINGS

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1. SCOPE

This specification covers the crossing of roads, railways, watercourses, streams, ravines, drains, pipes, cables etc with pipeline by boring or open cut method.
For the construction of these crossings, the requirements of the following, listed in order of precedence, shall be fulfilled:

- This specification.
- Relevant construction drawings.
- Standards drawings and typical details.
- Relevant requirements from authorities and utility Owners.

2. APPLICABLE STANDARDS, SPECIFICATION AND PRACTICES

edition of the following Standards, Specifications and Practices as applicable, except if specifically modified hereafter.

- ELOT EN 1594
- Presidential degree (Π.Δ. 1073/1981) for Greek regulations in safety (ΦΕΚ 260A).
- Greek State Regulation for Mining and Quarry Works (Υ.Α. ΙΙ – 5η/Φ/17402/84, ΦΕΚ 931/Β/31.12.1984)
- Requirements set out by Authorities and relevant utility Owner.

Note: For the referred Specs, Codes and Standards, the last valid version is applicable

3. EXTENT

The Contractor shall carry out all excavation, concrete and earth works in connection with the crossings. This includes, but not limited, the construction of boring pits, trenches, etc., dewatering of trenches and excavations, supply of materials, necessary backfilling, removal of excess material and reinstatement of surfaces unless otherwise stated.
Furthermore, the Contractor shall carry out all the construction works including the transportation, welding, insulation, and installation of carrier pipes, casing pipes, and where applicable, thrust boring or auger boring, saddles and end seals, the welding of cathodic protection measuring points, etc.
The Contractor shall take all necessary precautionary measures in connection with the construction of the crossings, i.e. closing of roads, adequate propping or shoring up of excavations, etc. All work shall be carried out in accordance with the safety regulations of relevant authorities. At all road crossings and at any other crossing requiring such steps for safety purposes, the Contractor shall install and operate appropriate warning signs and

lights, barricades, and safety railings. The Contractor shall plan and supply, where appropriate, all necessary services for transport diversions and the closure of roads.

It is the Contractor's responsibility to plan and implement all required safety measures relevant to the construction of pipeline crossings. All required safety measures shall be agreed with the Client Representative.

Around open excavations, in or near the road area, the Contractor shall install railings, e.g. wooden poles per 1.5 m, 0.8 m high, equipped with two rows of boards (approx. 18 x 100 mm).

Warning signs shall be erected as agreed with the Owner Representative or when requested by authorities, whenever inconvenience is caused to the public. If necessary speed limits shall be established in agreement with the police.

Additional working area at national road and railway crossings to the extent agreed with the Owner Representative, and shown on the cadastral drawings of **Job Specification No. DSF-SPC-CIV-002** will be placed at the Contractor's disposal free of charge. This area shall be treated in the same manner as the normal working width.

In case that additional space further to the space specified in the cadastral drawings showing the R.O.W. (Right Of Way) width, is required for the construction of crossings by boring and/or other crossings and/or river crossings, then Contractor is responsible to proceed with all the necessary actions (contacts with Landowners / Authorities, compensation etc), in order to secure the additional space at no extra cost to the Owner.

For works performed in proximity of high voltage power lines ref. is made to **Job Specification No.DSF-SPC-CPR-008.**

4. GENERAL CONSTRUCTION

The Contractor shall give the relevant authorities and/or landowners adequate notice of his intention to start work provided that the Contractor has got the relevant permit by the authorities.

Before the start of work, the exact location of any other installation in the working area shall be determined by referring to the landowner or installation Owner in question, by hand digging or by any other suitable method (e.g. electrical detectors, etc.).

A protocol shall be prepared as specified in **Job Specification No.DSF-SPC-CIV-002.**

Contractor shall undertake all necessary action to minimise the construction period of crossings, from start of excavation to completion of reinstatement.

Pits on the sides of road and railway crossings may not be left open for more than 14 calendar days after completion of the crossing itself, unless otherwise agreed upon with the Owner Representative. If the time limit cannot be met the Owner Representative may order pits to be backfilled and subsequently re-excavated when the tie-ins are to be made at no extra cost to the Owner. Re-excavation may only be made under the supervision of the Owner Representative.

In general, crossings shall be constructed using one of the procedures described below.

4.1 OPEN TRENCH CROSSINGS

This procedure shall only be used where indicated on the drawings and approved by the relevant authority. These crossings shall be constructed as indicated either in specially approved drawings or, where no special information is available, according to DESFA standard drawings.

If the normal minimum cover cannot be achieved, the pipe may, with the permission of the Owner Representative, be protected with concrete saddles or slabs, without additional cost to the Owner.

Excavated materials, which are not suitable for backfilling, shall be driven away and replaced with suitable materials, without extra cost to the Owner. Any additional material required either by the relevant authorities or by the Owner Representative for the protection of the pipe will be paid separately in accordance with the Terms of Contract. The trench shall be backfilled immediately after the pipe has been lowered in.

Where for safety reasons propping or shoring up is required by the authorities during excavation work, this shall be done by the Contractor at no extra cost to the Owner.

Where it is necessary to provide mechanical protection or to prevent buoyancy of the pipe, concrete saddles, steel anchors, concrete slabs or coating shall be used as agreed upon with the Owner Representative.

Crossing of future major roads shall be made with casing pipe where it is shown on the drawings. In this case the requirements given in Section 4.2 are valid.

4.2 THRUST OR AUGER BORED CROSSINGS

The construction of the boring pit **(Section 3.0)** includes any supplementary trench required for the insertion of the carrier pipe, and the provision of suitable foundations for thrusting equipment.

When auger boring, the diameter of the auger may not exceed the external diameter of the casing pipe by more than 2%.

The pressure used for boring shall be continuously measured. This record shall be presented to the Owner Representative together with a certificate indicating the depth of each end of the pipe.

The coating of the pipes used for borings shall be shielded against high temperatures in accordance with the requirements for field bending of pipes in **Job Specification No.DSF-SPC-PIP-011.** Before the carrier pipe is placed in the casing pipe, the boring and the receiving pits shall be backfilled with well-compacted sand for at least 50 mm above the bottom of the casing pipe. The crossing construction will be regarded as complete when the coating control of carrier pipe has been approved and the Contractor's record and certificate have been accepted by the Owner Representative.

In rocky areas casing pipes without coating will be used as indicated on the drawings.

If a thrust or auger boring cannot be carried through due to boulders in the ground, the additional cost will be paid extra to Contractor through variation order, according to the Terms of the Contract.

Within the leading end of the pipe, a core of unbroken earth min 50 cm shall be maintained. The thickness of this core shall be such that material from outside the line of the pipe cannot fall in, or be washed in, leaving cavities outside the pipe.

Any additional requirements from authorities shall also be satisfied. Any cost arising from surface damages sustained during jacking or boring shall be paid by the Contractor.

If a crossing of road, channel or railway has to be performed within rocky terrain, casing pipes without coating shall be used. No boring shall be done using product or carrier pipes in rock. The size of the internal diameter of the casing pipe will be such as to allow working inside the pipe to remove the rock by hand-mining method. Blasting inside the casing needs the permission of the Owner Representative and/or the relevant authorities.

The Contractor has to use adequate equipment to remove the rock ahead the casing pipe, if a boring has to be performed within different types of rock. The auger has to fit to the geotechnical conditions. If possible the auger shall run approximately 0.5 m ahead the casing pipe. Rock has to be removed after completion of boring without any extra cost to the Owner. Backfilling has to be performed in the same way as described in this specification.

The edge of any earth removing equipment used within the pipe shall be of a material that will not damage the inside surface of the pipe.

All welding, welding inspection, and insulation shall be carried out as specified in the representative separate specifications.

Any break in boring (e.g. for the connection of a new pipe) shall be kept as short as possible.

When required by the Owner Representative, the alignment of the pipe shall be surveyed during the boring every 4 m in order to adjust the boring equipment in due course, to obtain satisfactory alignment.

The deviation for the entire casing pipe may not prevent the prescribed route from being followed and the carrier pipe from being adequately supported.

For concrete casing pipes, the maximum deviation from the prescribed direction is 15mm for each 5m pipe.

All casing pipes shall be cleaned and dried internally before the carrier pipe is inserted. Any deviation of the pipe from the specified line shall be compensated for in the adjacent bends. The carrier pipe shall lie completely stress-free within the casing pipe.

Before the spacers attachment the pipe insulation shall be controlled as specified in **Job Specification No.DSF-SPC-PIP-013.**

Spacers shall be firmly attached to the carrier pipe for each 2-2.5 m within the casing pipe. A distance of 0.5 m shall be reserved at each end for the fitting of plastic pads.
With steel casing pipe, the Contractor shall ensure, before making the tie-ins to the crossing, that there is no contact between carrier and casing pipes.
If any contact is found at this time or later, the cost for repairing and re-installation will be born by the Contractor.
Watertight seals shall be fitted at each end of the casing pipe.
When backfilling, care shall be taken to ensure that the earth is adequately compacted around and beneath the adjacent piping. Special care shall be taken in compacting the soil underneath the end of casing and product pipes within boring and receiving pits, in order to avoid soil settlement and potential deformation of the carrier pipe. From 300 mm below and up to the middle of the carrier pipe, sand bedding in layers of 300 mm maximum shall be carried out. The compaction of the soil has to be documented and approved by the Owner Representative.
Cathodic protection measuring points shall be welded to the carrier and casing pipes as specified in **Job Specification No. DSF-SPC-CPR-005** at the positions indicated in the relevant drawings.

5. CROSSING OF ROADS

5.1 OPEN TRENCH CROSSINGS

Contractor shall satisfy any requirements issued by the relevant authorities.
The agreement with the owner of the road will specify whether the road shall be kept open for traffic during construction, or a temporary traffic deviation can be made.
In case the road must be kept open for traffic, this can be obtained either by making the crossing in two steps or by installing a temporary bridge over the trench, or by constructing a deviation road in accordance with the instructions of the relevant authorities. Where required, the Contractor shall construct or arrange for a temporary diversion in accordance with the instructions of the relevant authorities.
Warning signs, warning lights and protective barriers shall be erected and maintained by the Contractor at an adequate distance from the crossings. Open trenches shall be illuminated at night.
The Contractor is responsible for the correct illumination and for any cost arising from inadequate illumination. Where temporary traffic lights are required, these will also be provided and operated by the Contractor at no extra cost, to the Owner.
Trench bedding, padding and backfill materials in pipeline road crossings shall consist of quarry aggregates in compliance with the requirements as specified in **Job Specification No.DSF-SPC-CIV-005** and the details shown in the relevant project standard drawings.

Road levels shall be surveyed along the axis of the pipeline and recorded before construction and following completion of the crossing. Digital photographs of the pavement conditions shall also be taken prior and after the pipe installation. The relevant authority shall be notified prior to surveying measurements. The road levels shall be measured with 5mm accuracy at 2.5 m intervals for entire length of the crossing. Measurements shall include the edges and the centreline of each lane. Road level records, along with the digital photographs, shall be submitted to the relevant authority and the Client Representative to confirm that observed settlements are within acceptable limits and to approve the crossing works.

All road surfaces shall be reinstated as same as possible to their original condition. For public roads the reinstatement shall be made in accordance with the requirements of the relevant local road authority.

Warning tapes shall be laid along the crossing as well as the rest of the pipeline (**Job Specification No. -DSF-SPC-CIV-005).**

With open trench crossing with casing pipe, the applicable requirements of **paragraph 4.2** are valid.

In case where the route is running parallel to the axis of the road and on the road shoulder the requirements of **Job Specification No. DSF-SPC-CIV-005** for "Backfilling", apply.

5.2 THRUST OR AUGER BORED CROSSINGS

The boring pits shall never be less than 2m from the edge of the road shoulder and never less than 1 m from the roadside ditch or otherwise shown in the relevant drawing.

6. CROSSING OF RAILWAYS

All railway crossings shall be constructed with casing pipes.

These crossings shall be constructed in accordance to the requirements, which shall be given to Contractor by the OSE (Railway Company), as indicated in specially approved drawings. The railway company and the Owner Representative shall be notified at least 3 weeks before crossing work is commenced. Any imposed requirements and specifications of the railway authority relevant to the design and construction of the casing shall be adhered to (design train loading, allowable casing deformations, etc.).

Before construction works are commenced, the levels of the rails shall be taken at 2 m intervals over a length extending 25m to either side of the crossing, with an accuracy of 5 mm. These levels shall be taken again on completion of the work and the results shall be presented to the Owner Representative and the railway company.

Notification shall be given to the railway company prior to level takings.

All excavations shall be outside the load-influenced zone. If the sides of any pit are furnished with props and struts, the Contractor shall be in a position to provide evidence to

show that the materials and structures construction are stiff enough to bearing the load and to ensure excavation stability against all acting loads.

7. CROSSINGS OF WATERCOURSES. CURRENTS, STREAMS, RAVINES, CHANNELS, DITCHES AND DAMS

7.1 DAMS

The crossings of dams (and dikes) shall be constructed by thrust or auger boring, as specified in **paragraph 4.2** and indicated on the longitudinal sections.

7.2 WATERCOURSES, CURRENTS, STREAMS, RAVINES

The Contractor shall comply with the requirements of any specially approved drawings for the crossing, or where these do not exist, the requirements of the DESFA standard drawings. In cases of watercourses or streams with rocky banks the use of gabions is compulsory.

The water flow shall not be interrupted at any time. Any pumping required in connection with the construction of the crossings which are shown on drawings available at the time of contract, will not be separately paid.

The Contractor is liable for any cost arising from damages to fish farms or any other business that depends upon the quantity and purity of the water.

The over bends at each end of the crossing shall be placed at a sufficient distance from the watercourse to ensure that there is no danger of erosion to the pipe.

Where required, the Contractor shall establish the necessary propping or shoring up of the trench to reduce excavations at watercourse crossings. The trench shall be excavated to such a depth that the specified cover can be achieved, even if some material is washed into the trench before the pipe can be lowered.

The Contractor shall ensure that excavated material washed away is causing no inconvenience to the landowner.

Immediately after lowering-in, the depth of the pipe shall be measured. If necessary, a diver shall inspect the crossing before and after pipe lowering.

This shall be carried out in the presence of the Owner Representative or a representative of the relevant authority, as required.

The pipe shall be insulated as described in **Job Specification No. DSF-SPC-PIP-013 .**

The pipe shall be secured against buoyancy by loading with concrete saddles or concrete coating or steel anchors as shown in the drawings

Unless otherwise indicated on the drawings the weight of pipe and concrete in water shall provide a safety factor of at least 1.2 against uplifting. Concrete saddles shall conform to DESFA Standard Drawings and shall be supplied by the Contractor. Where concrete coating is used this shall be of a construction approved by the Owner Representative and with steel reinforcement or appropriate synthetic reinforcing material. When concrete saddles are used the pipeline shall be covered in its

part attached to the saddle with geotextile of following description 100% polyester of 2kg/m^2 with cover of 100% polyethylene net on both sides, satisfying the following minimum requirements:

Chemical resistance	Acid resistance and resistance to lime cement and concrete.
Biological resistance	Able to resist all microorganisms present in soil.
Stock duration	When it remains in stock to be able to resist temperatures up to 80°C without changing its properties with time.

Thickness when pressure = 2 KN/m2	15mm
Thickness when pressure = 20 KM/ m2	13mm
Thickness when pressure = 200 KM/ m2	8,5mm

The values of thickness are according to ELOT EN ISO 9863. Where steel anchors are used, these shall be of a construction approved by the Owner Representative.

If a separate hydrostatic test is necessary for the crossing, this will be requested by the Owner Representative. Any such test shall be performed before the pipe is cast in concrete.

Backfilling in watercourses shall be made in agreement with Job Specification No. DSF-SPC-CIV-005 and the relevant authority

The trench through the crossing shall be completely backfilled before the section is tied-in. The tie-in bell hole shall be constructed as described in Job Specification No. DSF-SPC-CIV-003 and shall be kept free of water.

After backfilling has been completed, the intersection between the trench and large or swift-flowing watercourses shall be protected from erosion at the sides with fascines or wattle-work or other suitable material to be approved by the Owner's Representative. All stone-faced banks shall be reinstated to their original condition. Earth banks shall be replanted and tender for such time as it takes for vegetation to be re-established.

Where required, bank and bed protection will be made by gabions, according Std Drawings No STD-1-41-09 and No STD-0-41-11.

The riverbed and the banks downstream of the crossing shall be cleaned of any respectively material washed down from the crossing.

8. CROSSING OF DRAINAGE AND IRRIGATION CHANNELS

The channels (e.g. for irrigation purpose) to be crossed either by open cut method, (provided that the relevant approval by the authorities shall be granted to the Contractor), or by boring / horizontal drilling method.

A separation of at least 1 m shall be achieved between the pipeline and a concrete channel and 1.20 m between the pipeline and an earth channel.

9. CROSSING WITH PIPES AND CABLES

Any authorization necessary for the commencement of this work shall be obtained from the pipe or cable owners by the Contractor, who shall comply with all requirements from these owners. The owners shall be given at least 2 weeks notice of the Contractor's intention to start this work.

The Contractor shall obtain all necessary information concerning the exact location of cables and pipes from their respective owners. At the same time the Contractor shall acquaint himself with any new pipe or cable, which may have been laid since the preparation of the tender documents. These shall be recorded by the surveyor in the as-built plans.

Prior to commencement of the work Contractor shall establish the exact location of any existing underground installations within the working area by contacting the landowners or relevant utility operators to collect relevant information, by hand excavation, or any other suitable method. (e.g.detectors, etc.).

The exact location of each pipe or cable shall be defined by hand-digging without extra cost to the Owner. Any pipe or cable crossing the trench shall be adequately supported so that it will not fail due to bending deformation because of its self loading (dead load).

This support shall comply with all requirements of the pipe or cable owner. Any damage to pipes or cable shall be reported immediately to the Owner Representative and the respective owner.

Repairs, as specified by the pipe or cable owner shall be made by the Contractor without extra cost to the Owner. Furthermore the Contractor shall be responsible for any loss due to the damage.

A separation of at least 0.30 m (or greater if required by pipe or cable owners) shall be achieved between the pipeline and other pipes or cables. The crossing line shall be double-wrapped in accordance with Job Specification No.DSF-SPC-PIP-013, over that length which is within 1.5 m of the gas line. The separation shall be achieved with elastic bands, as possible.

If this separation is not possible, a 10 mm thick sheet of insulating material shall be laid between the crossing pipelines. This sheet shall have a side length at least as long as the diameter of the larger pipe. At no point may the pipeline and any other line contact each other.

If any contact is ascertained during or after completion of the work, all cost arising from the elimination of this shall be paid by the Contractor.

On completion of the crossing works, the Contractor shall obtain from the respective pipe or

cable owner a certificate stating that the pipe or cable in question is functioning correctly and safely.

Cost for these crossings is included in Contractors Lump-sum price and there will be no extra payment by the Owner.

Where required by either the pipe or cable owner or any involved authority, the Contractor shall establish interference measuring points on the pipe or cable.

10. SPECIAL CROSSING METHODS

If crossing of any areas cannot be performed using the above described methods, e.g. areas with shallow water, special methods may be specified on the drawings or in requisitions.

Furthermore, the Contractor may propose alternative crossing methods e.g. directional drilling.

Such methods shall be described in detail by the Contractor and shall be approved by the Owner Representative in time, before start of the construction work.