REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

PROJECT No

CONTRACT No

CONSTRUCTION OF PUMPING STATION IN RAM VILLAGE

VOLUME 4

PARTICULAR SPECIFICATIONS

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MINISTRY OF ENERGY AND WATER

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

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PART 1

GENERAL REQUIREMENTS

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PART 1

101. GENERAL REQUIREMENTS

101.1 APPLICATION OF PARTICULAR SPECIFICATION

This Particular Specification is to be read and construed together with the General Specification contained in Volume 3 of the Contract Documents for this Tender. In case of ambiguities or discrepancies between this Particular Specification and the General Specification, the Particular Specification shall prevail, except if and to the extent otherwise provided by the Contract or directed by the Engineer.

Whenever the term "Specification" without further qualification is used in the Contract Documents, it shall mean the General Specification together with the Particular Specification.

101.2 LOCATION OF WORKS

The work covers the equipping of the new borehole in Ram village with a submersible pump and connection to the existing reservoirs, with all related civil lift or gravity lines and electromechanical works to improve the water resources at Ram area due to the scarcity of rain in the last few years and consequently, the severe recession of all springs and wells.

101.3 THE SITE

For electromechanical works within Ram village, the limits of the Site (Conditions of Contract Sub-Clause 1.1) shall be the limits of land in public ownership which shall be taken to be any boundary fence or wall which is in our case the fence of the Ram wells and pumping stations.

The Contractor shall have inspected the Site (Conditions of Contract Sub-Clause 1.1) and shall have included for the provision of any additional working area that he may require outside the limits of the Site (Conditions of Contract Sub-Clause 58.2).

101.4 SCOPE OF WORK

The scope of work covered by this Contract includes the following:

- Drilling of boreholes.
- Supply and installation of well casings.
- Well development and testing.
- Excavation and backfilling.
- Supply and installation of steel pipes.
- Thrust and anchor blocks.
- Supply and installation of three submersible pumps.

- Supply and installation of rising steel pipes.
- Supply and installation of electrical control panels.
- Supply and installation of connecting pipes and hydraulic accessories (valves, air-release valves, check valves, etc…). to link the boreholes to the existing reservoirs.
- Supply and installation of electromagnetic flow meters.
- Supply and installation of one gas chlorinator units.
- Construction of new pumping station buildings.
- Construction of a well head concrete structures.
- Conduction of semi industrial and industrial testing.
- Operation of the wells for a couple of days prior to its commissioning.

101.5 CONDITIONS PREVAILING AT SITE OF WORKS

The Contractor's attention is drawn to his obligation to satisfy himself, before submitting his Tender, as to the conditions prevailing at the Site of Works and its surroundings (Clause 11 of Conditions of Contract) and relevant sections of the General Specification for Civil Engineering Works.

101.6 PRIVATE LANDS

The Contractor shall not enter upon or occupy with men, tools, or materials of any nature, any lands other than the working areas shown on the Drawings, except after consent shall have been received by him from the proper parties and a certified copy of such consent shall have been furnished to the Engineer. Any rentals or damages paid for occupying private lands shall be at the Contractor's expense.

101.7 EXISTING SERVICES

In the course of works, the Contractor will encounter within the limits of the working areas and in the vicinity, miscellaneous above ground and underground services such as drains, pipes, cables, telephone and electric poles and lines, water supply and similar existing services. The Contractor's attention is directed to the provisions of Clause 101.12.4 of the General Specification with regard to such existing services.

101.8 ACCESS ROADS

101.8.1 Temporary access roads

The necessity of construction of Access Roads and/or temporary roads may arise, in which case such temporary roads shall be subject to the provisions of Clause 101.12.3 of the General Specification for Civil Engineering Works, and shall be executed at the contractor responsibility and expenses in coordination with the concerned Authorities and according to the Engineer requirements.

101.9 PROGRAM AND MONITORING

It is a primary requirement of the Employer that a comprehensive knowledge of the status of progress to date, predicted progress, costs and cash flow forecasts is available at all times. The Contractor shall be responsible of the requisite information and shall be responsible for programming the Works, preparation of cash flow estimates and measuring and reporting the progress of the works in an approved format. In order that programming, progress measurements and reporting is executed in a timely and efficient manner, the Contractor shall program the Works, monitor progress and generate cost reports and cash flow projections by utilizing a recognized industry standard approved P.C. based Project Management software package.

The Contractor's master program and cash flow estimates and subsequent updates, submitted in accordance with Clause 14 of Conditions of Contract shall, as a minimum, detail the sequence of procurement, installing, testing and commissioning, and handing over for each of the works items including each item described in the Bill of Quantities.

At least 21 days prior to taking possession of any portion of the Site and starting of work, the Contractor shall submit a detailed construction program for that portion of the Site. The detailed construction program shall be to a level to adequately identify the intended sequence of working on each individual item of work. The minimum level of detail shall not be less than that needed to identify each individual payment item included in the Bill of Quantities.

The Engineer's obligation to measure the Works in accordance with Sub-Clause 56.1 of the Conditions of Contract shall be dependent on the Work being programmed and progress being monitored and reported in accordance with the requirements of the Contract.

101.10 LIST OF ABBREVIATIONS

In the Contract Documents, the following abbreviations have been employed:

uPVC	- Unplasticized Polyvinyl Chloride
D.I.	- Ductile Iron
R.C.	- Reinforced Concrete
C.I.	- Cast Iron
G.S.	- General Specification
C.O.C.	- Conditions of Contract
B.O.Q.	- Bill of Quantity
PN	- Nominal Pressure
DN	- Nominal Diameter
ID	- Inner Diameter
OD	- Outer Diameter

101.11 OR EQUAL CLAUSE

Wherever reference to Standard Specifications, such as British Standards, are made they shall not be construed to restrict materials to British products. Materials from other scheduled countries will be considered provided that the producer of the material certifies its conformity to the appropriate Standard Specification.

Similarly whenever a material or article required is specified or shown in the plans by using the name of the proprietary product or of a particular manufacturer or vendor; any material or article which will perform adequately the duties imposed by the general design will be considered equal and satisfactory provided the material or article so proposed is of equal substance and function in the Engineer's opinion. It shall not be purchased or installed without his written approval.

101.12 GOVERNMENT REGULATIONS

The Contractor shall comply with all provisions of the rules, regulations and orders of Government and Municipal agencies, such as the Public Works Department, Electricity of LEBANON, and Telecommunications Authority.

The Contractor shall co-operate with the Employer in promptly furnishing any information that may be required by such governmental agencies. It shall be the obligation of the Contractor to keep himself informed of these governmental rules, regulations, and orders and the Contractor shall make the requirements of this article a part of any sub-contract he may enter into.

101.13 FACILITIES FOR THE ENGINEER'S REPRESENTATIVE

Refer to text of Section 101.22 of Volume 3 – Technical Sepcifications – Part 1 – General Requirements.

In addition to the above, the Contractor shall provide any necessary protective clothing and safety equipment for the use of authorised visitors to the site including the Employer and his staff and Representatives and those of any relevant authority who have reason to visit the site.

101.14 ACCESS TO WORK

The Engineer and his duly appointed representatives and the Employer or his representatives or agents may at any time and for any purpose whatsoever enter into and upon the work and the premises used by the Contractor. The Contractor shall provide free, proper, and safe facilities therefore.

101.15 SURVEY AND SETTING OUT

All levels used for construction shall be referred to the National Height Datum.
The Contractor shall be responsible for obtaining the location and values of the permanent bench Marks. In cases where such bench Marks do not exist, a site datum shall be agreed with the Engineer.

Prior to the commencement of the work the Engineer shall approve all plans showing benchmarks, limits of plot and auxiliary baselines. The Contractor, under the supervision of the Engineer, shall set out on-site and erect appropriate permanent markers where instructed by the Engineer.

The Contractor shall employ an experienced licensed Surveyor for the duration of the Contract. He shall furnish the Engineer with a duly signed map showing the various centerlines, baselines, reference points permitting the renewal of markers and boundaries of parcels and blocks, if destroyed. Before starting and during earthwork on the site, the Contractor shall set out a net of square coordinates at distances not exceeding 10 m in each direction. A peg shall be driven at each intersection and at other relevant points and levels of peg tops and of ground at the same spot shall be measured.

The levels of the ground and the levels and dimensions of existing features shown on the Drawings are not guaranteed to be correct.

Wherever dimensions or levels are marked on the Drawings such dimensions or levels shall take precedence over dimensions scaled from the Drawings. Where no dimensions or levels are shown on the Drawings, instructions shall be obtained from the Engineer. Large scale drawings shall be taken in preference to drawings of smaller scale.

101.16 NOTICE BOARDS

The Contractor shall provide and erect sign boards at the sites (No. 12, & refer to Annex 1 of this volume) where works are being executed, giving information to the public on the Project and the Employer and further details as will be prescribed by the Employer. The location and number of the sign boards at the sites will be indicated by the Engineer. The Contractor shall maintain, alter, move and adapt the sign boards from time to time as instructed by the Engineer. The display of any named Subcontractors or any other information associated with the Works shall be to the approval of the Engineer.

101.17 MANUFACTURE'S CERTIFICATES

The Contractor shall furnish the Engineer with a manufactures certificate confirming compliance to the specification in respect of all items of equipment.

The original and one copy of the manufacturer's certificate shall be delivered to the Engineer not later than 14 days prior to the intended date of delivery of the Item to site.

101.18 PRECAUTIONS AGAINST CONTAMINATION OF THE WORK

The Contractor shall at all times take every possible precaution against contamination of the works. The site and all permanent and temporary works shall be kept in a clean, tidy and sanitary condition. The Contractor shall at all times take measures to avoid contamination of the existing water courses and drains by petrol, oil or other harmful materials.

101.19 ACCESS TO PROPERTIES

The Contractor shall not disrupt any private or public access way without first providing alternative arrangements.

101.20 TOPOGRAPHIC SURVEY

Where the Contractor get the approval of the Engineer to execute topographical survey, mapping shall be at 1:200 with contour lines at an interval of 1 meter. A ground profile along the centerline of the pipe route shall be provided and shall be at the same scale of the construction drawings relatives to the contract.

The extent of mapping shall be the width of roads or dual carriage ways up to the property lines on either side of the public land, or one meter from the edge of road which ever is nearer to the road centerline.

In open areas and along water courses the mapping corridor shall be 20 meters. The mapping shall be supplied on film plotted from digital data.

All control points, and heights shall be related to the National Height Datum in meters. Station Descriptions with distances to reference objects and a list of coordinates and heights shall be submitted to the Engineer.

Permanent bench marks shall be constructed from steel pins, road nails or painted marks on existing stable features. A minimum of two site bench marks shall be established on existing stable features.

All man-made hand detail features, road edges, kerbs, existing manholes, inspection covers, culverts, and underground service pipeline shall be surveyed in their true position and shown by conventional symbols. The detection of the existing services will be paid separately and must be approved by the Engineer.

All surveyors which will subcontract the Contractor for the topographicals works shall be approved by the Engineer and the responsibility still on the Contractor to satisfy the Engineer by the accuracy of the survey.

101.21 DRAWINGS AND DOCUMENTS

All drawings and documents submitted by the Contractor shall have been checked, signed and be ready for issue and shall bear the title of the drawing, the scale, the date, the Contract number and name, the document number complying with an approved numbering system, the name and references of the Contractor, the name of the Employer and the Engineer, the date of approval by the Contractor and the signature of the person responsible for approval.

Unless otherwise specified the Contractor shall allow a minimum of 15 days for approval of drawings and documents by the Engineer.

101.22 MEASUREMENT AND PAYMENT

Unless otherwise provided for in the B.O.Q, all costs incurred in complying with the requirements of this Division 101 shall be deemed to be included by the Contractor in his unit rates in Bill of Quantities and shall not be paid for separately.

PART 2

CIVIL WORKS

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201. CONCRETE WORKS

201.1 GENERAL

201.1.1 Life Span of Concrete Structure

New works are to be designed for a life of 60 years.

201.1.2 Codes and Standards

Complementary or new design shall as far as possible be carried out in compliance with relevant International Standards such as:

– BS Standards.
– ACI and Uniform Building code.
– BAEL 1992
– AFPS 90
or equivalent standards

201.2 SOIL PARAMETERS

The Contractor shall carry out soil investigations to satisfy himself with the prevailing soil conditions for all sites.

201.3 MATERIALS

201.3.1 Grades of Concrete

The minimum grades of concrete for the various structures are given as follows:

Grade	Component
C30	Reinforced concrete for Reservoirs (400 Kg cement/cu.m)
C30	Reinforced concrete for Buildings and Structures (350 Kg cement/cu.m)
C25	Reinforced concrete for thrust blocks (350 Kg cement/cu.m)
C20	Mass concrete and Blinding concrete (250 Kg cement/cu.m)

Reinforced and mass concrete must be vibrated.

Admixtures and mix design of the different Grades of concrete shall be submitted for approval prior to commencing the work.

201.3.2 Reinforcement

All reinforcing steels shall be Type 2 High Yield Bars and comply with the requirement of BS 8110 and shall have a specified characteristic strength of 420 N/mm^2.

Dowel bars and stirrups shall be Mild Steel grade 25, fy = 250 N/mm^2.

Lap lengths shall be 50 diameters. Mechanical bending for $\phi \geq 12$ mm is required.

201.3.3 Minimum Cover of Reinforcement

The concrete cover for all steel bars including stirrups shall not be less than 40 mm in structures where concrete surfaces are in contact with water.

Where concrete surfaces are in contact with soil, the cover of reinforcement shall not be less than 35 mm.

The cover of reinforcement in external surfaces of structures, and all elements of buildings shall not be less than 30 mm.

Formwork for all concrete surfaces in contact with water and/or soil and internal surface (walls and ceilings) of technical rooms shall be of form panels (marine plywood or metallic formwork) in order to obtain a regular and smooth finish.

201.3.4 Classes of Exposure and Crack Width

External and internal walls, columns and beams are to be considered as subject to severe exposure as defined in Sub-Clasuse 3.3.4 of BS 8110.

The faces of structures in contact with ground shall also be considered as subject to severe exposure.

Concrete surfaces in contact with water are designed for a maximum crack width of 0.2 mm.

201.3.5 Admixtures

Admixtures (retarders, mass waterproofing, silica fume…) are to be added to concrete in contact with liquid. Technical sheets and the mix design of concrete shall be submitted for approval.

202. COMMON REQUIREMENTS

All metal sheets shall be 3mm thick minimum. All metal works shall be epoxy painted over a primer. Openings for ventilation or other shall be taken into consideration.

All hardware shall be water resistant.

Buried walls shall receive a bituminous coating for protection.

203. PIPELINES AND PIPEWORK

203.1 TRENCH EXCAVATION

Excavation for pipelines shall be carried out in accordance with Sub-Section 201.3.2 of the General Specifications. During the pipelaying, jointing, testing of pipes and backfilling, the trench shall be completely dry.

The Contractor shall excavate the trenches without damaging existing pipes, cables and any other structure. In this respect, the Contractor shall excavate the necessary depth or change the route in order to avoid damaging the pipes, cables and culverts that cross the roads.

In case the modification of the pipe depth or route is impossible, the Contractor shall, after the approval of the Engineer, undertake all the necessary works including excavation, fill and concrete works, etc... to modify the culvert in a way to maintain the passing section of the culvert, the cost of these works, after getting the approval of the Engineer should be measured as a concrete works (according to concrete works item).

The Contractor shall clear away within the same day, all excavated material arising from trenches and headings on asphalted roads as the work proceeds, and shall keep these roads free from any accumulations and clear in a good condition, to the satisfaction of the Engineer.

In addition to Sub-Section 201.3.2 of the General Specifications, Earthwork shall not be classified in accordance with the hardness of the excavated material, all excavation should be classified as common excavation and the Contractor shall take the sole responsibility for his assessment of excavated material and conditions. He should also use all suitable materials in the permanent construction required under the contract.

203.2 BACKFILLING OF PIPE TRENCHES

Backfilling shall be carried out in accordance with the Ministry of Public Works decree No. 13495 dated 5/11/98 (Refer to Annex 1 of this volume) and in accordance with related general specifications of Volume 3.

In case of ambiguities or discrepancies between the content of the above mentioned decree and the general specifications, the decree shall prevail.

All pipes shall be placed in granular material (fine course) bedding and surround if the pipeline is above water table, and in gravel bedding and surround if the pipeline is below water table.

203.3 PIPELINES AND MATERIALS

As specified in the BOQ, ductile iron pipes shall be used.

Moreover, the materials used shall comply with the requirements of Section 101.9 of the General Specifications. Any unsuitable material not satisfying the specifications shall be rejected by the Engineer, removed from the Site and replaced by the Contractor at his own expense.

203.3.1 SPECIAL REQUIREMENTS

203.3.1.1 Manufacturer's Certificate

Materials shall be supplied with certificates, in respect of each delivery, stating that products comply with and have been factory tested in accordance with the specified Standards.

203.3.1.2 Special Tests

Whenever required by the Engineer, the Contractor shall supply and transport to an approved testing laboratory samples of materials selected by the Engineer. The number of samples shall not be less than 0.5% of total supplied, with at least one from each class, diameter and manufacturer. Failure of any sample shall be followed by a second and if necessary a third test from the same batch. A third test failure will result in all material from that manufacturer being rejected and replaced by material from a different manufacturer, subject to approval by the Engineer, after satisfactory testing. Laboratory test reports in an approved form shall be provided.

203.3.1.3 Manufacturer’s Instructions

The Contractor shall observe the manufacturer’s written instructions and recommendation in respect of handling, protection, stacking, storage, laying, fitting, cutting, repair of the products and materials as applicable.

203.3.1.4 Marking

Unless otherwise specified in the relevant Standard, products shall have legibly cast, stamped or indelibly painted on, the following marks, as appropriate:

- The manufacturer's name, initials and identification mark.
- Nominal diameter.
- Class designation.
- Initials and number of relevant Standard.
- Length of pipe if shorter than the standard length.
- Angle of bends in degrees.
- The date of manufacture.

203.3.1.5 Samples and storage of materials

Where required by the Engineer, the Contractor shall submit to the Engineer for approval samples of pipes, fittings and materials prior to procurement.

The Contractor shall store pipes, fittings and other materials only at places approved by the Engineer and shall at all times provide adequate supervision and watchmen to prevent theft or damage. Any loss or damage incurred will be the Contractor’s responsibility.

Pipes shall not be stacked higher than recommended by the manufacturer. The area on which the pipes are to be stacked shall be free draining, the grass or other vegetation shall be kept cut and suitable timber or cradles shall be provided on which the pipes shall be laid. End stops to all stacks shall be provided.

Fittings and valves shall not be stacked more than one tier high and they shall be supported off the ground by suitable timbers.

Air valves, rubber joint rings, gaskets, bolts and similar fittings and materials shall be kept in approved locked premises and such fittings and materials shall not be distributed to the trench side until immediately prior to laying, fitting, jointing or assembly thereof. All rubber joint rings and gaskets must be stored in a cool damp location and all fittings and materials shall at all times be stored in the shade under cover and protected from the weather to the satisfaction of the Engineer.

203.3.1.6 Flanges

Unless otherwise specified, flanges shall be faced and drilled to conform to the dimensions specified in BS 4504. Flanges shall be compatible with the pressure rating of the adjacent pipework but not less than 16 bars. Bolts, nuts, and washers (two washers per bolt) shall be to BS 4504 Clause 5. No bolt shall project more than two full threads beyond its nut after tightening. In no circumstances shall be shortening of excessively long bolts but cutting be allowed.

Gaskets shall comply with BS 4865 and BS 2494 Type W.

Flanges shall be painted with two coats of epoxy resin paint.

203.3.1.7 Mechanical Couplings

Unless otherwise specified or shown on the Drawings pipes and fittings shall be supplied with flexible joints.
Mechanical couplings shall be of the Dresser, Viking Johnson type without a center register.

203.3.1.8 Materials for the assembly of flexible joints

Lubricant shall be of a kind not conductive to the growth of bacteria and shall have no deleterious effects on either the joint rings or pipes. Lubricants for water supply shall not impart to water taste, colour, or any effect known to be injurious to health.

203.3.2 WORKMANSHIP: OPERATIONS

1) Manufacturer's recommendations on handling, repairing, laying, jointing, anchoring, testing and other works for pipes and fittings shall be strictly followed.
2) The Contractor shall use cranes, hoists or forklifts as directed by the Engineer. The Contractor shall use hooks, spreader beams, ropes, band or wire slings etc. as recommended by the manufacturer for each type of pipe and as approved by the Engineer.

3) The Contractor shall stack pipes on a level surface. Pipes shall not rest on sockets or flanges and end pipes in the bottom row shall be securely chocked. Heights of stacks shall be in accordance with the manufacturer's instructions.

4) The Contractor shall handle material with care to avoid damage whenever moved by hand, forklifts or hoists.

5) The Contractor shall provide safe storage for all material. The interior of pipes, fittings etc. shall be kept free from dirt and foreign matter. The Contractor shall provide shade for materials as required by manufacturers' instructions and recommendations and to the Engineer's approval.

6) Pipe Cutting: The Contractor shall use hacksaws, manually operated wheel cutter or pipe cutting machine in accordance with manufacturers' instructions. If, in the opinion of the Engineer, special precautions are required to eliminate airborne particles, the Contractor shall use methods and equipment as directed by the Engineer. The Contractor shall prepare ends according to type of joint used and follow manufacturers' recommendations. The Contractor shall take care not to damage linings. The Contractor shall repair on site minor damage if so permitted by the Engineer.

7) The Contractor shall repair damaged coatings, sheathings or linings in accordance with the Specification and the manufacturer's instructions. The Contractor shall use material compatible with that originally used. Repairs shall be approved by the Engineer before incorporating the materials into the works.

203.3.3 SEQUENCE OF CONSTRUCTION

The Contractor shall adhere to the sequence of construction as set out below unless a justified request for modification is approved by the Engineer at least two weeks prior to commencement of work on the affected section of the network:

1) Stake out pipe alignments

2) Clear and grade the right of way (wherever required)

3) Carry out surveys, including trial pits if necessary, along the alignments to verify the location, depth, size and type of existing utilities.

4) Prepare and submit for approval composite Shop Drawings for all utilities showing alignment, ground elevation, trench invert elevation, pipe size, class and length, station and size of fittings, valves as applicable manholes, inlets, appurtenances and structures to be demolished and reinstated (kerbstone, rails, culverts, etc.). Cross sections showing location and inverts of existing pipes and those proposed shall be prepared. Pipes, structures and other utilities to be removed or relocated shall be indicated on the Shop Drawings.

5) Relocate, demolish and reinstate existing services and utilities interfering with pipeline alignments.

6) Remove pavement layers, excavate trenches and place bedding as required

7) Lay and join pipes, fittings, appurtenances, manholes, etc.

8) Place primary backfill material

9) Perform hydrostatic testing

10) Complete connections to existing services and curb/gutter inlets as required

11) Place final backfill

12) Restore or reinstate surfaces and structures as required

13) Carry out final surface works road surfacing curb stone, backing walls, sidewalk paving, etc.

14) Dispose of surplus materials.

203.3.4 DUCTILE IRON PIPES

203.3.4.1 General

1) Ductile iron pipes for raw and potable water pipelines shall be of Class C (preferred pressure class) pipes in conformance to BS EN 545-2010 or ISO2531-2009. Pipes shall be to pressure rating suitable for the condition of service as denoted on the drawings and not inferior to the preferred pressure class. All ductile iron pipes and fittings to be supplied under this Specification shall be obtained from an approved manufacturer having an ISO9001-2000 TOTAL QUALITY ASSURANCE system based on the latest version of the ISO9001 standard.

2) Spigot and socket ended pipe joints shall be used for straight runs and adjacent to elbows or fittings. These joints shall be provided with rubber gaskets, and external thrust blocks at elbows or fittings. Anchored joints shall be the push-in, self anchored type. Concrete thrust blocks are not required for anchored joints. The Contractor shall submit calculations verifying the number of restrained joints required noting that pipe pressure testing will be made when pipes are partially backfilled.

3) Prior to the ordering of pipe and fittings materials, the Contractor shall carry out his own calculations of the surge, the maximum allowable pressure and the Test Pressures, using approved parameters to ensure safety of the proposed system under worst working conditions, all to the approval of the Engineer. If the Contractor's approved calculations show that the resulting pipe classes needed are higher than the original Contract Documents, then the Engineer shall instruct the Contractor to adopt them; but if lower classes are needed, then the Contract classes shall prevail.

4) Flanges shall be provided in accordance with BS EN 1092-1:2002.

5) Factory protection for pipes shall be as follows:

- Internally: cement lined to BS EN 545:2002 with ordinary Portland cement to BS EN 197-1:2000.
- Externally: metallic zinc shall be applied in accordance with BS EN 545:2002 either hot applied coal tar material to BS 4164:2002 or bitumen to BS 3416:1991, minimum thickness 150 microns.

6) Factory protection for fittings shall be as follows:

Coated internally and externally by dipping, or other method, using hot applied coal tar based material to BS 4164:2002 or hot applied bitumen to BS 3416:1991, Type 1, grade D, minimum thickness 250 microns.

203.3.4.2 Joints

Joints of Ductile Iron Pipes and Fittings shall be of the Push in automatic standard type and any axial forces shall be taken by thrust and anchor blocks, where necessary and as shown on drawings.

203.3.4.3 Lubricant paste

The lubricant paste shall be a mixing of Vaseline, non soluble in accordance with French standard AFNOR T90 M DOC8. The quantities used in the assembly joints shall be as per manufacturer recommendation. The pipes and fittings manufacturer shall supply it.

203.3.4.4 Connecting pieces

All connecting pieces i.e. flexible coupling, flange adaptors, dismantling joint shall be made of ductile iron and shall be supplied from the same pipes and fittings manufacturer.

203.3.4.5 Pipes internal protection (including welded flanged pipes)

Pipes shall be internally lined with sulphate resisting blast furnace slag cement applied by a centrifugal process. The cement mortar lining shall be in accordance with the European Standard EN 545-2002 & with the International Standard ISO 4179-1985 with the thickness given in the following table:

	Thickness of mortar	
	Nominal mean value (mm)	Tolerance (mm)
80 – 300	3.5	-1.5
350 – 600	5	-2
700 – 1200	6	-2.5
1400 – 2000	9	-3

203.3.4.6 Pipes external protection (including welded flanged pipes)

Pipes shall be externally coated with:

- A metallic zinc coating in accordance with the European Standard EN545 – 2002 and the International Standard ISO 8179 Part 1-1995. The quantity of zinc shall not be less than 200 g/m2.
- A bituminous varnish or equivalent anticorrosive paint which shall be applied over the zinc coating in accordance with the European Standard EN545-2002 and the International Standard ISO 8179 Part 1-1995, with a minimum thickness of 100 microns.

203.3.4.7 Connecting pieces internal and external protection

The connecting pieces (flexible couplings, flange adaptors, dismantling joint) shall be internally and externally protected with a powder epoxy coating having a minimum thickness of 150 microns or with a Rilsan nylon coating having a minimum thickness of 200 microns.

203.4 WARNING TAPES

Warning tapes shall be placed on well compacted Backfill at 450mm below the finished level and directly above the center-line of the pipeline.

Warning tapes shall be made of pigmented low density polyethylene and aluminium foil in a bright colour or other approved material not less than 250 mm wide and 0.15 mm thick. When laid, the tapes shall provide a continuous band detectable with a metal detector if the pipe itself is not detectable. The tapes shall be continuously and alternatively labeled in Arabic and English.

Where possible, tapes shall also be laid above ducts and concrete protection slabs as directed by the Engineer.

203.5 MANHOLES

Manholes shall be constructed as specified in Sub-Sections 202.11.2, 202.14.2 and 202.14.5 of the General Specifications and according to the dimensions specified in the BOQ and the related drawings.

Steel Ladders shall be manufactured in accordance with BS 4211:2005, mild steel, galvanized to BS EN ISO 1461:1999 with 200 grams of zinc per square metre.

All concrete faces in contact with the soil shall receive a waterproofing treatment consisting of two layers of brush-applied bituminous paint, in accordance with Sub-Section 213.2.1 of the General Specifications

203.6 CHAMBER COVERS AND SURFACE BOXES

Covers and frames shall be manufactured from ductile iron in accordance with BS EN 124:1994, non-rock, locking and solid tops. The wording on covers shall indicate the nature of the network (water supply). Grades of covers shall be Grade A, heavy duty test load 40 tons

Manhole covers shall be of a circular pattern unless otherwise indicated on the Drawings. Frames shall be provided with openings for fixing bolts for solid frame embedment into manhole concrete necks. Covers and frames shall be coated with a bitumen based compound to BS 3416:1991 with a minimum thickness of 200 microns.

203.7 IRONS STEP FOR VALVE CHAMBERS

Irons Step shall be manufactured in accordance with BS EN 13101: 2002.

203.8 TEMPORARY RESTORATION OF PAVED ROADS

In all paved roads, trenches shall be refilled and compacted to the underside of the original road surface.

A sub-base and base layers shall be laid and compacted as described in technical specifications.

The road surface shall be temporarily surfaced with finished thickness of 50mm bitumen.

203.9 PERMANENT RESTORATION OF PAVED ROADS

The permanent restoration shall comprise two layers of bitumen to a total compacted thickness of 100mm.

203.10 REMARKS

The Contractor shall lay pipes on one side of the streams and on one side of the roads (even if this is not shown of the drawings) and if possible outside the carriageway in order to avoid damaging the roads. The Contractor shall coordinate with the Administration and the Engineer and the relevant Authorities in order to obtain official authorization prior to any construction work.

204. HYDRAULIC ACCESSORIES

204.1 AIR RELEASE VALVES

For all transmission pipelines, air release valves should be exclusively double air release valves three functions, type anti shock type.

204.2 CHECK VALVES

For all transmission pipelines, check valves should be anti slam and in accordance with AWWA C508, iron body, bronze trim, 45 or 22 degree swing disc, renewable disc and seat, flanged ends.

204.3 PRESSURE GAGES

1. Description: ASME B40.1, Grade A phosphor bronze Bourdon tube pressure gage, with bottom connection.
2. Case: Drawn steel, brass, or aluminum with (115 mm) diameter glass lens. C. Connector: Brass, (DN 8).
3. Scale: White coated aluminum, with permanently etched markings. E. Accuracy: Plus or minus 1 percent of range span.
4. Range: Conform to the following:
   - Vacuum: 100 kPa of vacuum to 103 kPa of pressure.
   - Fluids Under Pressure: 2 times operating pressure.
5. G. Accessories:
   - Valves: (DN 8) brass or stainless steel needle type.
   - Siphons: (DN 8) straight coil of brass tubing with threads on each end.
   - Snubbers: ASME B40.5 (DN 8) brass bushing with corrosion resistant

204.4 NEEDLE VALVES

Needle valves shall be made of ductile iron material and shall include a cylindrical shutter that axially moves inside special hydrodynamic shaped valve body.

The water flows through the annular cavity between the body and the shutter; this cavity has a cross section continuously decreasing up to the valve seat, where reaches its minimum value. Downstream the valve seat the flow is oriented to the center of the valve.

By axially moving the shutter, the minimum flow area can be regulated until it became zero when the valve is completely closed.

The disk ring shall be made of a water seal material in order to guarantee the valve a tight closing and to reduce the service demand even if the valve operates under high pressure heads.

The valve shutter should be axially moved by a shaft – link-block - connecting rod operated by a gearbox (motor or manual operated), by a hydraulic cylinder, by a counterweight, by a floater or, by a combination of the above.

The valve shutter should be equipped with a stainless steel ring in order to symmetrically divide the flow in several radial jets colliding at the valve axis and to modulate the dissipation of the flow energy.

204.5 ELECTROMAGNETIC FLOW METER

1. Electro-magnetic flow meter shall comprise a detector head and converter. They shall be suitable for operation under the prevailing ambient temperature and site conditions. External weatherproofing paint of the equipment shall be executed by the application of epoxy resin.

2. The material used in the construction of the detection head shall comprise carbon steel for the flanges drilled to BS 4504 and suitable for the pressure rating of the pipework system. Flange adaptors shall be incorporated in the pipework adjacent to the flow meters to ensure ease of removal for maintenance or replacement. Specially double flanged pipe, insert pieces of ductile iron to the same specifications as the installed pipe shall be provided on each size of magnetic flow meter so that these can be inserted in the pipeline in the event of the removal of the unit. Face to face dimensions shall be in accordance with ISO or BS standards. Internal insulating lining shall be in accordance with manufacturer's recommendations. Electrodes in AISI 316 L or Nickel alloy C22.
3. The converter used shall have power supply, ON/OFF impulse/frequency, and load (in Ohm) suitable for the pipework system. A 24 Vdc alarm shall be incorporated. Digital inputs (reset totaliser, stop totaliser via internal or external, external calibration system, scale exchange, dosage, etc.) Grade of protection shall be IP 67.
4. The Contractor shall provide adequate portable testing equipment in order to demonstrate the proper performance of each element of the magnetic flow meter without dismantling its main parts and/or without interrupting the flow.

204.6 SURGE VESSEL

1. 1 unit of surge vessel, bladder type, it has to be installed at summit as shown on drawing 428W-P01.
2. Vertical or horizontal installation with minimum capacity of 1000 liters, the factory pressure test shall be performed at a minimum of 25 bar, the vessel has a single flanged connection in/out fitted with isolating valve PN16 DN 150 mm.
3. Particular requirements: adjust pre-charge pressure to 3.4 bar prior to opening to network.

205. SHOP DRAWINGS, AS-BUILT DRAWINGS

Shop Drawings and all necessary material technical specification shall be submitted to the Engineer for approval at least 21 days before starting of the work.

As-built drawings shall be prepared and submitted successively during the execution of works and shall be also submitted completely to the Engineer for approval one month maximum after the completion of the work.

It is the duty of the Contractor to undertake all the Engineer's recommendations, modifications and corrections at his own expense until complete satisfaction of the Engineer.

PART 3

MECHANICAL WORKS

TABLE OF CONTENT

300. MECHANICAL WORKS: COMMON PARTICULAR SPECIFICATIONS - PUMPING STATIONS

300.1 PUMPING SYSTEM

300.1.1 Surface Motopumpset (Not Applicable)

- Motopumpsets shall be horizontal axis, above ground level.
- Pumps type shall be centrifugal or helico centrifugal, multicellular.
- Pumps rotating speed shall be that of the electrical driving motor.
- Motopumpsets shall be mounted horizontally on concrete base.

300.1.2 Submersible Motopumpset (Deep Borehole)

- Pumps shall be semi-axial or radial multicellular.
- Motopumpsets shall have vertical axis, flooded, installed vertically in metallic casing (deep borehole).
- Pumps rotating speed shall be that of the electrical driving motor.

300.2 PIPING AND ACCESSORIES

- All pipes, valves, and hydraulic accessories shall have flanged and or mechanical joints.
- All piping of suction and discharge headers, and Motopumpsets inlet and outlet sections shall be internally and externally coated with epoxy (300 microns).
- All valves shall be coated internally and externally with epoxy (150 microns).
- The installation of piping and valves is deemed to include all the necessary miscellaneous hydraulic accessories required for the assembly of the complete system such as flanges, gaskets, coupling, adaptors, tees, bends, pipe supports, nuts and bolts, etc...
- All pressure reducing valves shall be supplied with a strainer installed before the valve.

300.3 DRAINAGE INSTALLATION

Drainage works for the pumping stations, reservoirs and valve chambers shall include but not limited to: drain outlets, floor drains, clean outs, gully traps, above and below ground pipeworks and fittings, drain, overflow, and rainwater installations from roofs, reservoirs, and surfaces inside and outside the pumping stations and reservoir sites as shown on the drawings, diagrams, and as per the specifications.

300.4 GAS CHLORINATION SYSTEM

All water shall be chlorinated before going into public supply.

Chlorination facilities will normally be provided at sources of supply including boreholes and springs or at surface (booster) pumping stations. Where multiple sources feed into a reservoir the Chlorination facilities may be sited at the reservoir or a wet well. Care must be taken to allow maximum possible time/distance before any pump intakes.

Unless otherwise specified, the chlorine source will be bottled chlorine, with the pressure regulating valve mounted directly on chlorine cylinders, and where possible injection shall be by a vacuum chlorinator. In some cases direct injection of chlorine gas may be necessary and in other cases injection of hypochloride solution with dosing pump may be used.

Chlorine dosing shall always have manually adjustable pre-set rate facility, with a maximum dose rate of 5 mg/l.

In all cases chlorine control shall be by flow detection facilities, vacuum switch and where chlorine dosing is undertaken at a borehole or at a surface (booster) pumping station chlorine dosing shall be linked to pump operation, unless otherwise stated it shall be assumed that pump output is constant. At other locations, such as at a reservoir, Chlorination shall be controlled on flow and the Contractor shall include for the installation of the appropriate flow measurement and control facilities.

Unless otherwise specified, sufficient gas bottles or hypochloride solution shall be provided for two weeks usage at a dose rate of 5 mg/L. Above the two weeks usage, requirement for chlorinating substances for a duration of 2 days shall be provided.

The Contractor shall supply and install all necessary safety equipment. This shall include and not limited to, Chlorine leak detector, Gas masks, mechanical ventilation, alarm facilities and shower system with 1 m^3 water tank as per chlorine schematic drawing. The chlorinator shall also be fitted with vacuum alarm switch to detect high and low vacuum for control and signalling purposes

The Contractor shall also provide training and detailed procedures for normal and emergency situations including literature and wall charts in English and Arabic.

300.5 SURGE SUPPRESSION EQUIPMENT

The surge suppression equipment shall include surge vessel(s) for the pumping line, air compressor unit, valves, fittings and also compressor control panel, complete with cabling and wiring. The above panel shall incorporate the power and control gear of the compressor and level indication of the surge suppression system.

The control and monitoring of the surge suppression equipment shall be achieved by the compressor control panel PLC. This PLC shall be linked to the main PLC in the control room.

It shall also include all accessories required for the complete installation such as pipes, bends, gaskets, bolts, nuts, supports, flanges, unions, couplings, adaptors, etc....

300.6 LIFTING AND HANDLING EQUIPMENT (NOT APPLICABLE)

Where lifting and handling equipment is required, it shall consist of an electric hoist controlled by a pendant push button and a gantry type structure which spans the entire valve chambers and pumps rooms of pumping stations, enabling the hoist to lift any component from and to any location inside the room/ chamber.

The Safe working load shall be as mentioned in individual particular specifications.

It shall also include all accessories required for the complete installation such as pipes, bends, gaskets, bolts, nuts, supports, flanges, unions, couplings, adaptors, etc....

301. RAM WELL AND BOOSTER PUMPING STATION

– Reference:
Hydraulic Schematic drawing	N° 472W-105-M01
Chlorination Schematic drawings	N° 472W-105-M02
Mechanical drawing for wellhead	N° 472W-105-M03
Mechanical drawing for PS	N° 472W-105-M04

301.1 PUMPING SYSTEM

301.1.1 Electric Motor

Minimum Power Factor at 75% to 100% Output	Efficiency at 75% to 100% Output	No. of Starts/Hour	Quantity	Remarks
≥ 0.85	≥ 85%	≥ 8	1	Pump in borehole
≥ 0.85	≥ 86 %	≥ 10	4	Pump in Barrel

301.1.2 Pump

Type: - Submersible Motopumpset in Barrel (Qty: 4)

- Submersible Motopumpset (Deep Borehole).

Flow (l/s)	Head (m)	N.P.S.H. (m)	Efficiency at Duty Point	Quantity	Remarks
5	629	≤ 6	≥ 70%	1	Pump in borehole
5	63	≤ 3	≥ 75%	2	Pumps in Barrels
5	111	≤ 3	≥ 75%	2	Pumps in Barrels

301.2 PIPING AND ACCESSORIES

301.2.1 Scope of Works

The hydraulic system of the well is composed of the following:

1. One (1) off submersible Motopumpsets with discharge check valve.
2. One (1) off rising column 80 mm diameters.
3. One (1) off wellhead and hydraulic accessories 80 mm diameter.
4. One (1) off well wash out pipe 80 mm diameter.

5. One (1) off Break Tank inlet pipe 80 mm diameter.

6. Level, pressure, flow and temperature measurements as specified in "Instrumentation, Control Equipment and accessories" section.

The hydraulic system of booster station is composed of the following:

1. Two (2) off Motopumpset suction headers 80 mm diameter.

2. Four (4) off Motopumpset inlet sections 80 mm diameter.

3. Four (4) off submersible Motopumpsets in Barrels

4. Four (4) off Motopumpset outlet sections 80 mm diameter.

5. Two (2) off 80 mm diameter Motopumpset discharge header.

6. Two (2) off 80 mm diameter Motopumpset discharge drain.

7. One (1) off Break Tank overflow line with hydraulic accessories of 100 mm diameter.

8. One (1) off Break Tank drain line with hydraulic accessories of 100 mm diameter.

9. Two (2) off Break Tank suction line with hydraulic accessories of 80 mm diameter.

10. Two (2) surge suppression systems including pipe and accessories.

11. Level, pressure, flow and temperature measurements as specified in "Instrumentation, Control Equipment and accessories" section.

301.2.2 Piping

Piping	Type	Material	DN (mm)	PN (bars)
Rising column	Seamless	Black Steel	80	Schedule 40
Well head piece, pipe and outlet	Seamless	Carbon Steel	80	16
Well wash out pipe	Seamless	Carbon Steel	80	16
Break Tank drain section	ERW/ Seamless	Steel	100	16
Break Tank overflow section	ERW/ Seamless	Steel	100	16
Break Tank inlet section	ERW/ Seamless	Steel	80	16
Break Tank suction section	ERW/ Seamless	Steel	80	16

Surface Motopumpsets suction Header	ERW/ Seamless	Steel	80	16
Surface Motopumpsets inlet sections	ERW/ Seamless	Steel	80	16
Surface Motopumpsets outlet sections	ERW/ Seamless	Steel	80	16
Surface Motopumpsets discharge Header	ERW/ Seamless	Steel	80	16
Surface Motopumpsets discharge drain	ERW/ Seamless	Steel	80	16

301.2.3 Valves

Valves	Type	Material	DN (mm)	PN (bars)	Qty (No)
Well sampling Valve	Ball	Cast Iron	13	16	1
Well regulating valve	Globe	Cast Iron	80	16	1
Well isolating	Butterfly	Cast Iron	80	16	1
Well wash-out valve	Gate	Cast Iron	80	16	1
Well check valve	Anti-Slam	Cast Iron	80	16	1
Well air release valve	3 functions	Cast Iron	50	16	1
Booster discharge air release valve	3 functions	Cast Iron	50	16	4
Booster Motopumpsets inlet sections isolation	Butterfly	Cast iron	80	16	4
Booster Motopumpsets outlet sections isolation	Gate	Cast iron	80	16	4
Booster Motopumpsets outlet sections check valve	Anti-Slam	Cast iron	80	16	4
Booster Motopumpsets Discharge header isolation	Gate	Cast steel	80	16	4
Booster Motopumpsets Discharge header drain	Gate	Cast steel	80	16	2
Booster Motopumpsets outlet Sampling	Ball	Cast Iron	13	16	4
Break Tank drain	Gate	Cast Iron	100	16	1
Break Tank suction header	Gate	Cast Iron	80	16	2

Break Tank suction	Tube Strainer	Stainless Steel	80	16	2
Surface pumps suction Header	Y strainer	Stainless Steel	80	16	2

301.3 FIRE FIGHTING

301.3.1 Portable Fire Extinguishers

Location	"G" Type	"P" Type
Electrical room	2	-
pumping room	1	1

301.4 SURGE SUPPRESSION EQUIPMENT

The Contractor shall submit detailed sizing calculation for the vessel capacity based on the pumping line profile and characteristics towards Ram Reservoir 1

Type : Ductile iron., DN 80, PN16.
Flow: 5 l/sec. Length: 1510 m. Delta H =24 m.

The Contractor shall submit detailed sizing calculation for the vessel capacity based on the pumping line profile and characteristics towards Ram Reservoir 2

Type : Ductile iron., DN 80, PN16.
Flow: 5 l/sec. Length: 2925 m. Delta H =44 m.

301.5 PLUMBING AND DRAINAGE INSTALLATIONS

Refer to Common Particular Specifications.

301.6 GAS CHLORINATION SYSTEM

One manual gas Chlorination system, serving the well water system, shall be supplied and installed on the discharge of the well as shown on the chlorine circuit schematic diagram and as described in the General Specifications. The operation of the Chlorination system circulation pump shall be interlocked with that of the submersible pump. A chlorine gas detection system shall also be supplied and installed. The minimum required distance between the intake and chlorine injection points should be not less than 60 cm.

- Capacity of chlorinator: 0.11 Kg/hr. (Qty=1)
- Injector back pressure: 2 bars
- Chlorine cylinders: 50 Kg each (Qty=3)

301.7 LIFTING AND HANDLING EQUIPMENT

- An electrical lifting and handling system consisting of a monorail type structure shall be supplied and installed to span the entire pumps row enabling the hoist to lift any component from/to the pumping room. Safe working load (SWL) 1000 kg.

- Any other accessories and equipment deemed necessary for the complete installation.

PART 4

ELECTRICAL WORKS

TABLE OF CONTENT

400. ELECTRICAL EQUIPMENT AND ACCESSORIES: COMMON PARTICULAR SPECIFICATIONS - PUMPING STATIONS

400.1 EDL TRANSFORMER

The Contractor shall coordinate with EDL after gathering all necessary information, supply, install test and commission a High Voltage/Low Voltage pole mounted power transformer as follows:

- Dual primary voltage: 15/20 kV
- Secondary voltage: 400 V.
- Rated Power: as specified in the Contract's drawings and BOQ.

The transformer shall be supplied along with subscription to EDL and power meter and all necessary materials as per EDL requirements and recommendations. (Medium voltage power lines are not included).

400.2 GENERATOR SET

One standby diesel operated generated set with associated accessories, cooling air flow system, fuel water separator filter, start up, daily tank, fuel system, batteries & Charger, Instrumentation, protection and control equipment shall be installed to supply the pumping station equipment.

The primary distribution board shall include an incoming section with facilities for connection of a standby generator. An adequately sized opening with a hinged steel door shall be provided at low level in the external wall of the room of the building housing the primary distribution board. The incoming section shall incorporate an interlocked mains/standby supply, manually operated, change over switch. "Mains supply available" and "standby supply on" indicator lights shall be provided on the panel face.

400.3 MOTOPUMPSET SWITCHGEAR

Distribution board: A primary distribution board shall be provided at each installation. The board shall have, as applicable, feeds to :

1. Each motor starter/control panel.
2. Chlorination panel.
3. Instrumentation and control equipment.
4. Building services electrical distribution board.
5. Other as particularly specified.

The primary distribution panel shall be located in the control room. It may be either wall mounted or free standing as appropriate to its rating power factor meter and size. The board shall incorporate door mounted ammeters, voltmeter with a phase-phase and phase-neutral selector switch, frequency meter and power factor meter.

Where the EDL transformer is not in a building or where the incoming EDL supply to the site is at 380 V, an earth fault relay shall be incorporated in the main distribution board to trip out the incoming supply under earth fault conditions.

400.3.1 General Circuit Breakers (G.C.B.)

– G.C.B. shall be a moulded case circuit breaker of type "A" as described in the general specifications.

– G.C.B. shall be installed upstream the Automatic-Transfer Switch, one for network supply and another for emergency supply.

400.3.2 Circuit Breakers for Motopumpsets (C.B.P.)

– C.B.P. shall be a moulded case circuit breaker of type "B" as described in the general specifications.

– C.B.P. shall be installed upstream the starters that control the motopumpsets.

400.3.3 Auxiliaries Switchgear

– Shall include all outgoing feeders and corresponding protection for the auxiliaries of the site.

– The circuit breakers, shall be supplied and installed to supply all Auxiliary equipment of the site.

– The circuit breaker shall be a moulded case circuit breaker of type "B" as described in the general specifications.

400.3.4 Automatic Transfer Switch (A.T.S.) (Main/Standby Supply Changeover)

– A.T.S complete with mechanical inter-lock shall be installed for the pumping station.

– This Automatic Transfer Switch shall be supplied with auxiliary contacts for monitoring and control.

400.3.5 Starter

A combined starter/control panel shall generally be provided at each installation. The panel shall incorporate a suitably screened section for instrumentation and PLC. Panels shall be arranged for front and back access.

The panel shall be fed from the primary distribution board and shall incorporate a main incoming section with door interlocked isolator, "supply on" indicator lamp, voltmeter and ammeters on the panel face.

The panel shall incorporate phase failure, phase reversal and undervoltage protection. It shall not be possible for unauthorised personnel to adjust the voltage protection devices.

Starter/control panels shall be fully compartmentalised with each motor starter enclosed within its own cubicle with a door interlocked isolator. Unless instrumentation is specific to a particular motor separate instrumentation compartment(s) shall be provided, isolated as necessary to prevent pick up from the motor starters induced spurious signals.

All starters shall incorporate, mounted on the outside of the door, in addition to the features stated in the General Specification, the following:
1. Hand/off/auto selector switch.
2. Motor start and stop push buttons for use in hand control of the pump.

3. Emergency Stop push button, shall be of the mushroom headed push to stop/twist to reset type.
4. Motor "running", "stopped", "fault" indicator lights.
5. Cyclometer type running hours indicator.
6. PLC for control, monitoring and transmission purposes used to control:
   - The motopumpset operation.
   - The motopumpset protection and signalling.
   - The motopumpset discharge motorized valve with "local/remote/off" selector.

All panels shall have an audible alarm to sound under fault condition, together with a panel mounted mute push button to silence the alarm when acknowledged. This shall not clear the fault light which shall only be cleared when the fault is cleared.

Lamptest facilities with lamp test push button shall be provided.

In the event of multiple pump installations the panel face shall incorporate a duty selector.

Flow indication, integration and recording shall be provided at the station control panel.

N.B.: - A calculation sheet for design justification of all electrical switchgear shall be submitted.

400.4 ACTUATORS FOR MOTORIZED VALVES

For each motorized valve, a control system shall be supplied and installed and shall include an integrated controller (PLC) with an RS 422/485 output allowing the remote operation and data acquisition through a twisted pair bus.

400.5 UNINTERRUPTIBLE POWER SUPPLY (U.P.S)

Set of two U.P.S. systems each, of adequate power output operating in redundancy shall be installed to supply the control, protection, measuring, signalling, valve actuators,... circuits of the pump station and suction reservoir.

Operation: One source is on duty, the other is on standby. Should the first source be out of service, the automatic change over to the second source occurs within the cycle at zero voltage.

400.6 GROUNDING SYSTEM - LIGHTNING & SURGE PROTECTIONS

- The Contractor shall supply and install a lightning protection system, covering all the pumping stations and reservoir or chlorination sites, and using early streamer emission type lightning conductors which number and type will be determined according to the site protection demand and in compliance with general specifications and latest standards.

- The lightning protection down conductors shall be flat conductors.

- The Contractor shall implement also an earthing circuit for the site, independent from the lightning ground network.

- The Contractor shall supply and install as well, a lightning current arrester at the point of entry of each power supply line into the stations and reservoir sites.

– The Contractor shall supply and install over-voltage protection systems for all power, data and communication networks in the station.

– The Contractor shall also connect to the grounding system all electromechanical equipment such as piping, electrical panels, H.V.A.C. system, switches, instruments, power outlets, luminaire chassis, etc...

400.7 PROTECTION OF MOTOPUMPSETS

The automatic shut off of the motopumpset shall occur in case of the following:

– Minimum water level in suction reservoir for motopumpsets fed from reservoirs.

– Minimum water level in borehole for well motopumpsets.

– High flow at the discharge of the motopumpset (with delay).

– Insufficient flow at the discharge of the motopumpset (with delay).

– High pressure at the discharge of the motopumpset (with delay).

– Low pressure at the discharge of the motopumpset (with delay).

– Unauthorized starting when main circuit-breakers are open.

– High water temperature at the suction of motopumpsets inside barrels (where applicable).

– High pressure at the suction of motopumpsets inside barrels.

– Low pressure at the suction of motopumpsets inside barrels.

– Minimum water level in barrels.

400.8 ALARMS & SIGNALLING

A visual indication and sound alarm shall be foreseen, in the electrical room with the switchgear, for the following faults (where applicable):

– Tripping of medium voltage circuit-breaker.

– Voltage fault.

– Minimum level in the suction and discharge reservoirs.

– Maximum level in the suction and discharge reservoirs.

– High pressure at the suction of motopumpsets.

– Low pressure at the suction of motopumpsets.

– Minimum water level in boreholes.

– Minimum water level in barrels.

- High pressure at the discharge of motopumpsets.
- Low pressure at the discharge of motopumpsets.
- Excessive flow at the discharge of motopumpsets.
- Insufficient flow at the discharge of motopumpsets.
- Motorized valve fault for each valve.
- Extreme levels in surge protection vessel (for each level).
- Emergency stop.
- Overheating of cooling air.
- Chlorine leakage.
- Fire alarm.

These defects shall be signalled on a luminous panel, constituted of labels of translucent material specific for each fault, and comprizing two associated push-buttons : lamp test and reset (acknowledge).

A visual signalling (independent) of the state of each set shall be provided: RUN, STOP.

400.9 ELECTRICAL INSTALLATION FOR BUILDINGS

400.9.1 Electrical Panel Boards

Including signalling lamps, measuring instruments, selectors, bus bars, glands, cables, wiring, connections, to incoming and outgoing feeders, installations, connection, labelling, accessories, identification, etc...

These panels shall be installed where shown on drawings.

400.9.2 Circuit Breakers

The ratings and types of circuit breakers shall be as indicated on the respective panel drawings including installation, connections, labelling, accessories, etc...

400.9.3 Electrical Cables

Including conduits, cable trays, connections, supports, installation, accessories, identification, etc...

400.9.4 Conduits

Including clamps, flexible, fittings, connections, installation, accessories, etc...

400.9.5 Junction and Distribution Boxes

Including glands, installation, connections, labelling, accessories, covers, etc...

400.9.6 Switches

Including boxes, covers, installation, accessories, cables, conduits, wiring, connections to panel boards, etc...

400.9.7 Power Outlet Sockets and Plugs

Including plugs, boxes, covers, installation, cables, conduits, wiring, connections to panel boards, labelling, accessories, etc...

400.9.8 Lighting Fixtures

Including lamps, supports, poles, installation as and where shown on drawings, accessories, cables, conduits, wiring, connections to switches, etc...

400.9.9 Emergency Lighting System

Including luminaires where shown on drawings, lamps, conduits, installation, labelling, accessories, cables, wiring, connections to power supply, etc...

400.9.10 Testing and Commissioning

Including measuring of resistances of the grounding and the lightning protection systems, luminaires, power, continuity and insulation meggering of cables installation, etc...

N.B.:

- All conduits used for domestic electrical installation shall be imbedded in walls or in floor.

- All outlet sockets and switches shall be flush mounted.

401. RAM WELL AND BOOSTER PUMPING STATION

– Reference: Electrical schematic drawing No: 472W-105-E01
Domestic electrical installation drawing No: 472W-105-E02
Electrical installation drawing No: 472W-105-E03

401.1 EDL TRANSFORMER

The Contractor shall coordinate with EDL after gathering all necessary information, supply, install test and commission a High Voltage/Low Voltage power transformer as follows:

- Dual primary voltage: 15/20 kV
- Secondary voltage: 400 V.
- Rated Power: 250 KVA.

The transformer shall be supplied along with switchgear panel and power meter and all necessary materials as per EDL requirements and recommendations.

(MEDIUM VOLTAGE POWER LINES ARE NOT INCLUDED).

401.2 GENERATOR SET

- A standby generator set with connecting cables and accessories shall be installed on a concrete pad, inside sound proof canopy, to supply the plant with the following main characteristics:

  - Rated Power (Continuous Rating): P = 200 kVA

  - Fuel Storage Tank : Volume: V = 5,000 litters, carbon steel sheets 4mm minimum thickness, fabricated with level indication, filling pipe and washout valve.

  - Class of Protection : IP 23

  - Switch Gear: include monitoring, control protection and displays.

401.3 MOTOPUMPSET SWITCHGEAR

401.3.1 General Circuit Breakers (G.C.B.)

No. of Poles	Rating (A) at 380 V	Qty (No)
4	375	1
4	300	1

401.3.2 Circuit Breakers for Motopumpsets (C.B.P.)

No. of Poles	Rating (A) at 380 V	Qty (No)
3	135	1
3	18	2
3	30	2

401.3.3 Auxiliaries Switchgear

No. of Poles	Rating (A) at 380 V	Qty (No)
3	60	1

401.3.4 Automatic Transfer Switch (A.T.S.) (Main/Standby Supply Changeover)

No. of Poles	Rating (A) at 380 V	Qty (No)
4	375	1

401.3.5 Starter

Type	Rating (KW) at 380 V	Contactors Mechanical Life (Cycles)	Contactors Switching Frequency (Cycles/Hour)	Qty (No)
Variable Speed	≥ 62	≥ 10 million	≥ 2400	1
Variable Speed	≥ 8.5	≥ 10 million	≥ 2400	2
Variable Speed	≥ 14	≥ 10 million	≥ 2400	2

Variable Frequency Drive control panel Should Have the following features:

- Open Loop.
- Proportional differential pressure.
- Constant Differential Pressure
- Constant level.
- Constant Flow Rate.
- Constant Temperature.
- Constant "Other Value".
  - Duty/Standby Function to alternate between two pumps (each pump operated on separate Drive).
- Dry Running protection.
- 2 analog inputs, 1 analog output, 4 digital inputs, 2 signal relay.
- Availability of Output Filters from same brand "IF needed".
- Enclosure 200 x 80 x 40 cm.
- Filter

401.4 LOCAL ELECTRICAL INSTRUMENTATION

Local Electrical Instrumentation	Quantity (set)
Set of three digital Ammeters with current transformers	7
Set of digital voltmeters with selector switches	1
Digital hour meters	5
Digital frequency meters	1
Digital power factor measurement (Response time ≤ 1 s)	1
Signalling lamps (Set of three)	9

– Current, voltage, power factor and frequency measurements shall also be transmitted, via the relevant Programmable Logical Controller (PLC) and the main PLCs, to the supervisor program for calculation, remote display or any other application.

401.5 ACTUATORS FOR MOTORIZED VALVES

Electric actuators for motorized Valves	Valve Type	Valve DN (mm)	PN (bars)	Qty (No)
Well wash-out valve N° 3	Gate	80	16	1
Well regulating valve N° 1	Globe	80	16	1
Well isolating N° 2	Butterfly	80	16	1
Surface Motopumpsets inlet sections isolation	Butterfly	80	16	4
Surface Motopumpsets outlet sections isolation	Gate	80	16	4
Surface Motopumpsets Discharge header isolation	Gate	80	16	4
Surface Motopumpsets Discharge header drain	Gate	80	16	2

401.6 UNINTERRUPTIBLE POWER SUPPLY (U.P.S)

Set of two U.P.S. systems each.

401.7 GROUNDING SYSTEM - LIGHTNING & SURGE PROTECTIONS

Shall be as described in the Common Particular Specifications.

401.8 PROTECTION OF MOTOPUMPSETS

The automatic shut off of the motopumpsets shall be as described in the Common Particular Specifications.

401.9 ALARMS & SIGNALLING

Shall be as described in the Common Particular Specifications.

401.10 ELECTRICAL INSTALLATION FOR BUILDING

Shall be as described in the Common Particular Specifications.

PART 5

INSTRUMENTATION AND CONTROL

TABLE OF CONTENT

500. INSTRUMENTATION AND CONTROL: COMMON PARTICULAR SPECIFICATIONS - PUMPING STATIONS

500.1 PUMPING SYSTEM

The control system shall be designed and implemented on the following basis:

- All general circuit breakers (GCB), the corresponding MTS system, the circuit breaker for auxiliaries, the relevant signalling and electric parameters (voltage, current, frequency, power factor) shall be connected and/or controlled by one PLC unit adequately sized (PATS).

- For each motopumpset system, the circuit breaker (CBP), the starter, the suction and discharge motorized valves, where applicable, the discharge pressure, the discharge flow, the motor temperature measuring instruments, the relevant signalling and electric parameters (voltage, current, frequency, power factor) shall be all connected and/or controlled by one PLC unit adequately sized (PSC).

- One main P.L.C. unit (MPLC), shall be installed and connected to all PLC units through a communication bus, and shall be responsible for the automation and control of the pumping station/system according to the relevant parameters and variables.

- For each group of surface motopumpsets, and unless otherwise specified, the motopumpsets shall be operated cyclically and the maximum number of pumps simultaneously running is the total number of pumps less one pump.

- Where the pumping station consists of only one motopumpset system (borehole or surface), then this system and the electric ATS shall be controlled by the main PLC (MPLC) of the station.

- The Contractor shall supply one portable programming unit for the above PLC unit(s).

- The proposed equipment and add-in options shall offer and support cable redundancy on the network components.

- Where specified to lay down telemetry cables, they shall be drawn into ducts laid in the pipe trenches. Ducts shall be 63 mm Polyethylene (PE) pipe laid with 750 mm cover with draw pits at the ends and intermediately such that no length of continuous duct exceeds 100 m. Draw pits shall be installed at all changes of direction in excess of 22^{o}.

- Cable route markers shall be installed at bends and along the cable length.

- Where the Contractor does not have a pipeline to install, he shall provide for the execution of all necessary civil works, trenches, etc... as described in the general specifications.

- In addition to the control and indication equipment (measurements display, alarms, push buttons, etc...) installed in the control room of the pumping station, this latter shall be designed to house a mimic panel representing the pumping system.

500.2 RESERVOIR

Each location of reservoir(s) shall be equipped with a remote terminal unit (RTU), adequately sized for the control of the water levels in the reservoir, motorized valves and flow meter, etc. ...

500.3 CHLORINATION SYSTEM

Where a chlorination system is specified (at pumping station or reservoir) then its controller shall be connected to the main PLC of the pumping station or the RTU of the reservoir for monitoring and supervision.

501. RAM WELL AND BOOSTER PUMPING STATION

– Reference: Control schematic No: 472W-105-I01
Electrical schematic No: 472W-105-E01
Hydraulic schematic No: 472W-105-M01
Chlorination schematic No: 472W-105-M02

501.1 INSTRUMENTATION

The Contractor shall supply and install the following systems for the measurement of the operation parameters of the pumping installation, their local display and remote transmission.

501.1.1 Level Measurements

Location	Type	Qty (No)
Well (L1)	Piezoresistive	1
Well (LE)	Electrode	1 (set of 3 electrodes)
Break tank (L2, L3)	Piezoresistive	2
Reservoir (L4, L5)	Piezoresistive	2

501.1.2 Pressure Measurements

Location	Type	Qty (No)
Well Motopumpset outlet	Manometer	2
Booster Motopumpset outlet	Manometer	2
Well Motopumpset outlet (P1)	Piezoresistive	1
Booster Motopumpset outlet (P2, P3, P5, P6)	Piezoresistive	4
Delivery header (P4,P7)	Piezoresistive	2

501.1.3 Flow Measurements

Location	Type	DN (mm)	PN (bars)	Qty (No)
Well Motopumpset outlet (F1)	Electromagnetic	80	16	1
Booster motopumpset suction header (F2, F3)	Electromagnetic	80	16	2
Booster motopumpset suction header (FS1, FS2)	Flow switch	13	16	2

501.1.4 Temperature Measurements

Location	Type	Qty (No)
Well Motopumpset electric motor	PT 100	1 (1 per motor)
Booster Motopumpset electric motor	PTC	4 (3 per motor)

501.2 CONTROL EQUIPMENT

- The main PLC shall have a provision for the connection to the RTU of reservoir.
- The control system of well pumping station shall use a cable link for the communication between the main PLC (MPLC) of well pumping station and the (RTU) of reservoir.
- The Contractor shall supply and install telemetry cables from well pumping station to the location of reservoir.
- The Contractor shall supply and install a mimic panel showing the entire pumping system.
- The chlorine parameters (Vacuum switch, leakage detection, flow switch and or measurement, modulating valve…) shall be connected to the MPLC of well pumping station for control and protection.
- The anti-water hammer system shall be connected to the MPLC of the well pumping station for control and protection.

PART 6

TRAINING, TESTING AND COMMISSIONING

Table of Content

601. PUMPING STATIONS

601.1 TRAINING, TESTING AND COMMISSIONING

Refer to General Specifications, Volume 3, Part 6.

1) Testing and Commissioning of all Mechanical Equipment and installations.
2) Testing and Commissioning of all Electrical Equipment and installations.
3) Testing and Commissioning of all Controls/Instrumentation Equipment and installations.
4) Training of personnel.

601.2 WATER ANALYSIS

Reference : Pumping Station

Number of Analysis: 3 analysis

Type of Analysis : C3 + B2

PART 7

BOREHOLES

3.2.1 – General Requirements

TABLE OF CONTENTS

3.2.1 GENERAL REQUIREMENTS

3.2.1.1 APPLICATION OF PARTICULAR SPECIFICATION

This Particular Specification is to be read and construed together with the General Specification contained in Volume 3 of the Contract Documents for this Tender. In case of ambiguities or discrepancies between this Particular Specification and the General Specification, the Particular Specification shall prevail, except if and to the extent otherwise provided by the Contract or directed by the Supervisor.

Whenever the term "Specification" without further qualification is used in the Contract Documents, it shall mean the General Specification together with the Particular Specification.

3.2.1.2 LOCATION OF WORKS

The Works cover the drilling, casing, and pump testing of a new borehole in the village of EL KHIYAM in South Lebanon.

3.2.1.3 THE SITE

For work within public lands and tracks, the limits of the Site shall be the limits of land in public ownership which shall be taken to be any boundary fence or wall or if there is no such clearly identified boundary the width shall be taken as one meter beyond the edge of the carriageway.

In some areas the width of the Site will be physically restricted by physical boundaries such as boundary wall or by natural topographic features. The Contractor shall have inspected the Site and shall have included for the provision of any additional working area that he may require outside the limits of the Site.

3.2.1.4 SCOPE OF WORK

The works covered by this contract are summarized as follows:

- Drilling by rotary machine with drilling bit diameters 22", 17.5" and 14.75" to the total depth of 350 m.
- Installing 18", 15.5" and 12" final casings and screens to the total depth of 350 m.
- Development and pumping test of the well with a flow of 40 l/sec with the installing pump at a depth of 330 m.

3.2.1.5 CONDITIONS PREVAILING AT SITE OF WORKS

The Contractor's attention is drawn to his obligation to satisfy himself, before submitting his Tender, as to the conditions prevailing at the Site of Works and its surroundings and relevant sections of the General Specification for Borehole Drilling Works.

3.2.1.6 PRIVATE LANDS

The Contractor shall not enter upon or occupy with men, tools, or materials of any nature, any lands other than the working areas shown on the Drawings, except after consent shall have been received by him from the proper parties and a certified copy of such consent shall have been furnished to the Supervisor. Any rentals or damages paid for occupying private lands shall be at the Contractor's expense.

3.2.1.7 EXISTING SERVICES

In the course of works, the Contractor will encounter within the limits of the working areas and in the vicinity, miscellaneous above ground and underground services such as drains, pipes, cables, telephone and electric poles and lines, water supply and similar existing services.

3.2.1.8 ACCESS ROADS

3.2.1.8.1 Temporary access roads

The necessity of construction of Access Roads and/or temporary roads may arise, in which case such temporary roads shall be executed at the contractor responsibility and expenses in coordination with the concerned Authorities and according to the Supervisor requirements.

3.2.1.9 PROGRAM AND MONITORING

It is a primary requirement of the Contracting Authority that a comprehensive knowledge of the status of progress to date, predicted progress, costs and cash flow forecasts is available at all times. The Contractor shall be responsible of the requisite information and shall be responsible for programming the Works, preparation of cash flow estimates and measuring and reporting the progress of the works in an approved format. In order that programming, progress measurements and reporting is executed in a timely and efficient manner, the Contractor shall program the Works, monitor progress and generate cost reports and cash flow projections by utilizing a recognized industry standard approved P.C. based Project Management software package.

The Contractor's master program and cash flow estimates and subsequent updates, submitted, as a minimum, detail the sequence of procurement, for each of the works items including each item described in the Bill of Quantities.

At least 21 days prior to taking possession of any portion of the Site and starting of work, the Contractor shall submit a detailed construction program for that portion of the Site. The detailed construction program shall be to a level to adequately identify the intended sequence of working on each individual item of work. The minimum level of detail shall not be less than that needed to identify each individual payment item included in the Bill of Quantities.

The Supervisor's obligation to measure the Works shall be dependent on the Work being programmed and progress being monitored and reported in accordance with the requirements of the Contract.

3.2.1.10 LIST OF ABBREVIATIONS

In the Contract Documents, the following abbreviations have been employed :

A	The slope of the curve
α	The slope of the curve (Gosselin method)
B	The intercept of the best fit line with the ordinate axis
C	The intercept of the best fit line with the ordinate axis (Gosselin method)
CEE	Communauté Economique Européenne
CCTV	Downhole video camera
BH	Borehole
DWL	Dynamic water level
Δs	Drawdown variations in one logarithmic cycle
I.D.	Internal diameter
L/sec	Litres per second
MHER	Ministry of Hydraulic and Electrical Recources
m^3/hr	Cubic meters per hour
m^3/d	Cubic meters per day
O.D.	Outside diameter
O.M.S.	Organisation Mondiale de la Santé
POH	Pulled out of hole
Q	Discharge rate
R	The effective borehole radius
r	The distance to the piezometer at the well location
S	Aquifer storativity
s	Drawdown inside the borehole
s/Q	Specific drawdown
SWL	Static water level
T	Transmissivity
t	Time
t_c	Well capacity effect

3.2.1.11 OR EQUAL CLAUSE

Wherever reference to Standard Specifications, such as British Standards are made they shall not be construed to restrict materials to British products. Materials from other scheduled countries will be considered provided that the producer of the material certifies its conformity to the appropriate Standard Specification.

Similarly whenever a material or article required is specified or shown in the plans by using the name of the proprietary product or of a particular manufacturer or vendor; any material or article which will perform adequately the duties imposed by the general design will be considered equal and satisfactory provided the material or article so proposed is of equal substance and function in the Supervisor's opinion. It shall not be purchased or installed without his written approval.

3.2.1.12 GOVERNMENT REGULATIONS

The Contractor shall comply with all provisions of the rules, regulations and orders of Government and Municipal agencies, such as the Public Works Department, Electricity of LEBANON, and Telecommunications Authority.

The Contractor shall co-operate with the Contracting Authority in promptly furnishing any information that may be required by such governmental agencies. It shall be the obligation of the Contractor to keep himself informed of these governmental rules, regulations, and orders and the Contractor shall make the requirements of this article a part of any sub-contract he may enter into.

3.2.1.13 FACILITIES FOR THE SUPERVISOR'S REPRESENTATIVE

Not applicable.

3.2.1.14 ACCESS TO WORK

The Supervisor and his duly appointed representatives and the Contracting Authority or his representatives or agents may at any time and for any purpose whatsoever enter into and upon the work and the premises used by the Contractor. The Contractor shall provide free, proper, and safe facilities therefore.

3.2.1.15 SURVEY AND SETTING OUT

Not applicable.

3.2.1.16 NOTICE BOARDS

The Contractor shall provide and erect sign boards at the sites where works are being executed, giving information to the public on the Project and the Contracting Authority and further details as will be prescribed by the Contracting Authority. The location and number of the sign boards at the sites will be indicated by the Supervisor. The Contractor shall maintain, alter, move and adapt the sign boards from time to time as instructed by the Supervisor. The display of any named Subcontractors or any other information associated with the Works shall be to the approval of the Supervisor.

3.2.1.17 MANUFACTURE'S CERTIFICATES

The Contractor shall furnish the Supervisor with a manufactures certificate confirming compliance to the specification in respect of all items of equipment.

The original and one copy of the manufacturer's certificate shall be delivered to the Supervisor not later than 14 days prior to the intended date of delivery of the Item to site.

3.2.1.18 PRECAUTIONS AGAINST CONTAMINATION OF THE WORK

The Contractor shall at all times take every possible precaution against contamination of the works. The site and all permanent and temporary works shall be kept in a clean, tidy and sanitary condition. The Contractor shall at all times take measures to avoid contamination of the existing water courses and drains by petrol, oil or other harmful materials.

3.2.1.19 ACCESS TO PROPERTIES

The Contractor shall not disrupt any private or public access way without first providing alternative arrangements.

3.2.1.20 TOPOGRAPHIC SURVEY

Where the Contractor get the approval of the Supervisor to execute topographical survey, mapping shall be at 1:200 with contour lines at an interval of 1 meter. A ground profile along the centerline of the pipe route shall be provided and shall be at the same scale of the construction drawings relatives to the contract.

The extent of mapping shall be the width of roads or dual carriage ways up to the property lines on either side of the public land, or one meter from the edge of road which ever is nearer to the road centerline.

In open areas and along water courses the mapping corridor shall be 20 meters. The mapping shall be supplied on film plotted from digital data.

All control points, and heights shall be related to the National Height Datum in meters. Station Descriptions with distances to reference objects and a list of coordinates and heights shall be submitted to the Supervisor.

Permanent bench marks shall be constructed from steel pins, road nails or painted marks on existing stable features. A minimum of two site bench marks shall be established on existing stable features.

All man-made hand detail features, road edges, kerbs, existing manholes, inspection covers, culverts, and underground service pipeline shall be surveyed in their true position and shown by conventional symbols. The detection of the existing services will be paid separately and must be approved by the Supervisor.

All surveyor which will subcontract the Contractor for the topographicals works shall be approved by the Supervisor and the responsibility still on the Contractor to satisfy the Supervisor by the accuracy of the survey.

3.2.1.21 DRAWINGS AND DOCUMENTS

Not applicable.

3.2.1.22 MEASUREMENT AND PAYMENT

Unless otherwise provided for in the B.O.Q, all costs incurred in complying with the requirements shall be deemed to be included by the Contractor in his unit rates in Bill of Quantities and shall not be paid for separately.

3.2.1 ER RAM BOREHOLE

3.2.1.1 BOREHOLE LOCATION

The well is located in Plot No. 195 to the left side of the road leading to Mrah el Aouja to the north west of Er Ram village the following coordinates **(Fig. 1)**.

X = -274.440 km
Y = +1.913 km
Z = 1276 m
(Nabha map, 1/20.000)

3.2.1.2 ACCESS TO BOREHOLE

Access to the site is easy on main road, but some cleaning of the drilling site is necessary

3.2.1.3 DEPTH

750m

3.2.1.4 EXPECTED DISCHARGE

5 L/sec.

3.2.1.5 STATIC WATER LEVEL

300 m below ground level.

3.2.1.6 GEOLOGY

The borehole is located beside a west east major fault. The drilling of the water well will start in Limestones of the Upper Cenomanian Formation (C4c) to reach the limestones and dololmitic limestones of the Lower Cenomanian Formation (C4a).

3.2.1.7 SCHEDULE OF DRILLING, CASING AND GROUTING

The well is to be drilled with a rotary rig and the contractor shall provide for all additional equipment such as water and fuel, as well as treating collapsing rocks at his own expense.

Nevertheless, the schedule of the proposed works could be as follows **(Fig. 2)**:

- Drilling by rotary methods with a 22” bit from 0 to 20m to avoid contamination from surface water that is mixed with wastewater, with samples collection as described in the general specifications from ground level and onwards.

- Installing 18” I.D. casing (black steel, thickness 5mm total length 20m)

- Grouting the annular space from the bottom to the surface, then waiting between 36 to 48 hours for the cement to set, and then continue the works.

- Drilling with 17.5" bit from 20 to 200 m.

- Installing 15.5" temporary casing if necessary (black steel, thickness 6 mm, total length 200 m).

- Drilling with 14.75" bit from 200 to 500 m.

- Installing 12.5" temporary casing if necessary (carbon steel, thickness 6 mm, total length 500 m).

- Drilling with a 12.25" bit from 500 to the total depth of 750 m.

- Installing 10" casing and screens as shown below:
  a) Casing:
     Diameter: 10" ID
     Type: Carbon steel
     Thickness: 6 mm
     Total length: 650 m

  b) Screens:
     Diameter: 10" OD
     Type: Carbon steel, bridge slotted 12.2% void, 1.5-2mm slots.
     Thickness: 6 mm
     Total length: 100 m.

  The installation of the casing and screens will be in accordance with the general specifications, and in particular, the welding and closure of all openings such that the water only enters the well through the screen openings, in order to minimize the pollution from zones above the SWL.

3.2.1.8 WELL DEVELOPMENT

The well development shall be executed by pumping through variable pumping rates equal to 2, 3, 4 and 5 l/s. Each pumping rate will not stop until reaching 20 mg/l of sediments in the water, as mentioned in the general specifications. In both cases, the development pump, shall be installed at a depth of 700 m, and shall have a manometric head of 650 m with a maximum flow of 5 l/sec. In case of lower depth of the well, the pump will be installed according to the instructions of the supervisor

For the above-mentioned development and the pumping tests (mentioned below), the installation system of the pipes, the flowmeters, and the piezometric tube should adhere to what is mentioned in the general specifications (pipes diameters, valve diameters, flow meters types and diameters should be approved by the Client representative prior to their installation). The Contractor should select the area toward which the disposed pumping water should be conveyed, and its distance should not be less than 100m from the borehole.

3.2.1.9 PUMPING TESTS

Pumping tests should be performed only in dry period of the year (between June and October).

A) Well Test (Step drawdown test)
The Contractor shall carry out a pumping test at different rates: 2, 3, 4 and 5 l/s.
Each step shall be of 4 hours duration and shall be followed by a period of recovery of not less than 4 hours.

B) Aquifer Test (Constant rate pumping test)
The constant rate discharge test shall be of 72 hours duration, and followed by a period of recovery not less than 24 hours. The lift flow shall be of maximum 5 l/s and shall be clearly defined upon the results of the step drawdown testing.

The submersible pump should be installed at a depth of 700 m, and should have a max head of 650 m and should be able to lift a max flow of 5 l/sec.

3.2.1.10 PUMPING MEASUREMENTS AND EQUIPMENT

All measurements, such as Flow Measurements, Time Measurements and Water Level Measurements in the main well and the observation boreholes (piezometers), are recorded according to a preset plant. The details of which can be seen in the general specifications. All the details concerning the pumping and the accompanying measurements (during the development or all pumping tests) are recorded in the general specifications. The water recovery measurements are duly noted following the end of the pumping stage, as mentioned on the general specifications.

The Contractor shall provide all the necessary measuring devices that should be approved by the Consultant prior to the pump testing, in order to ensure the collection of accurate data by experienced number of technicians.

The Contractor shall also provide the necessary pump that would discharge the required amounts of water as well as a suitable electrical generator and fuel reservoir. A flexible polyethylene dip tube with a diameter of 1.5 inches shall be installed along with the pumps from 0.5m above ground level to the level of the pump assembly in order to measure the water levels inside the well. All the necessary maintenance of the generator should be done ahead of the pumping notably the Constant Rate Pumping Tests, which will be undertaken for 72 continuous hours without interruption.

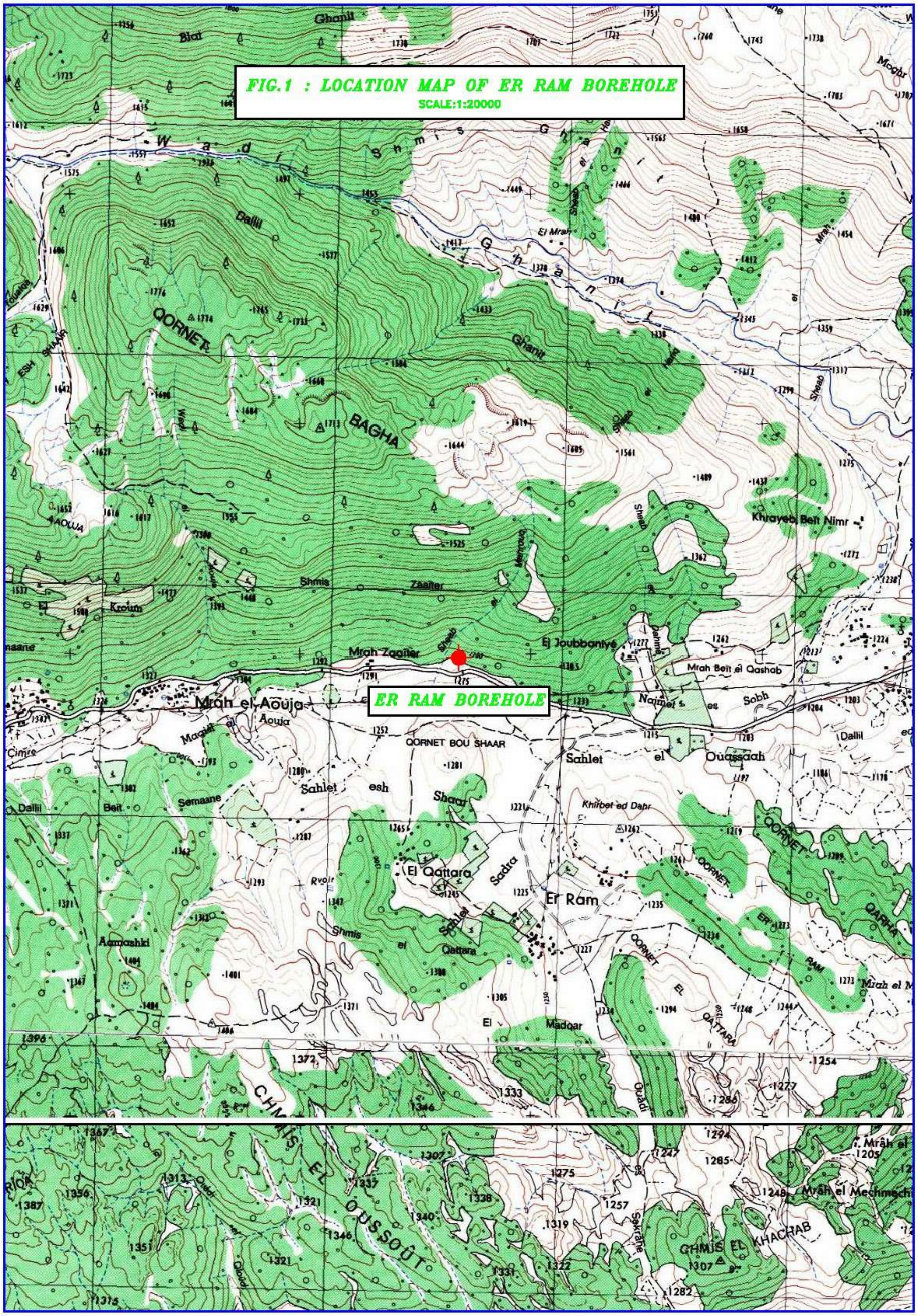
FIG.1 : LOCATION MAP OF ER RAM BOREHOLE
SCALE:1:20000
ER RAM BOREHOLE
Mrah el Aouja
Mrah Zaaiter
Ej Joubbaniye
Mrah Beit el Qashab
QORNET BOU SHAAR
Sahlet el Ouassaah
Sahlet esh Shaar
El Qattara
Er Ram
QORNET
BAGHA
Khrayeb Beit Nimr
Khirbet ed Dabr
Aamashki
El Madqar
CHMIS EL OUSSOUT
CHMIS EL KHACRAB
Mrah el Mechmechi

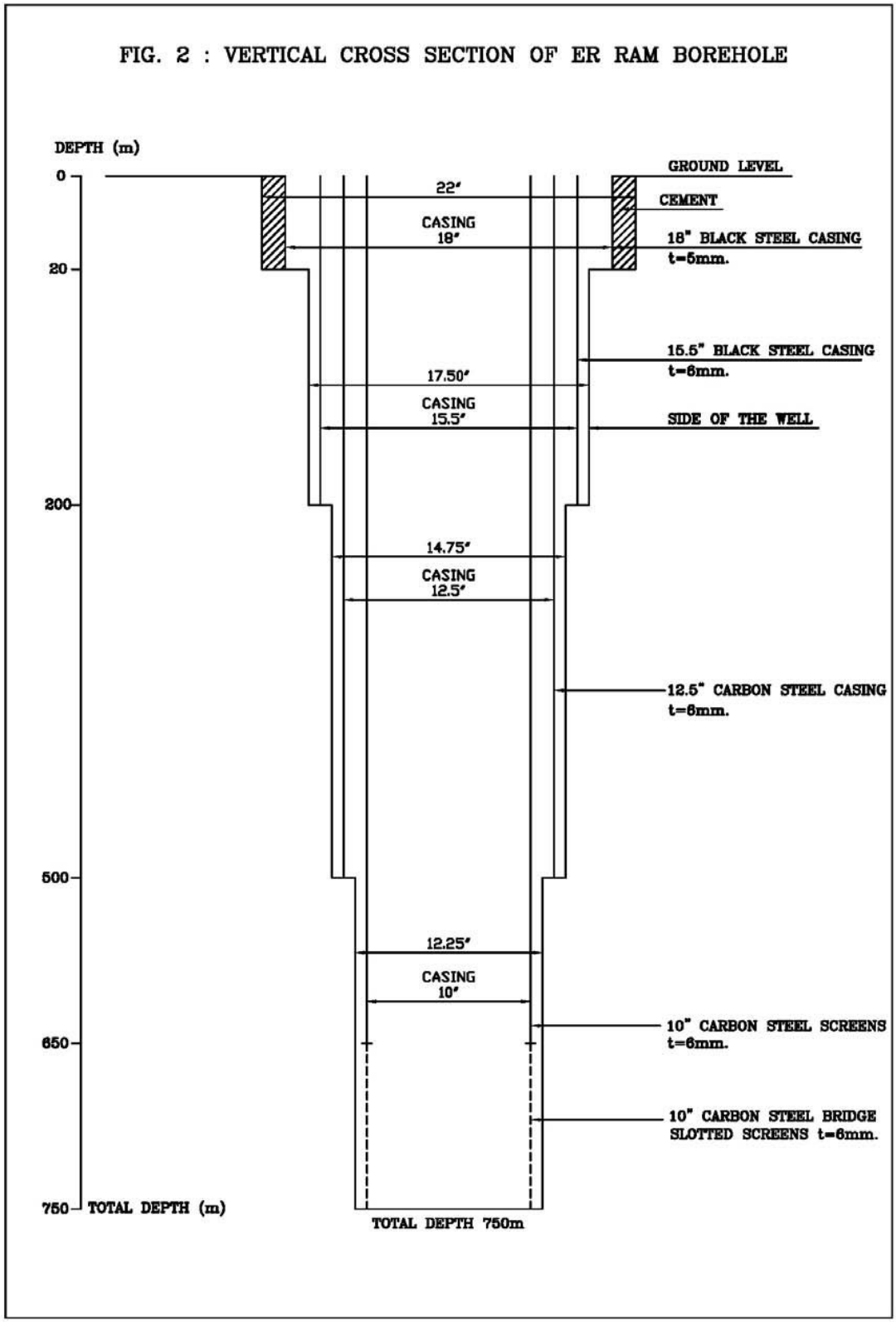
FIG. 2 : VERTICAL CROSS SECTION OF ER RAM BOREHOLE
DEPTH (m)
0
20
200
500
650
750
TOTAL DEPTH (m)
22"
CASING
18"
17.50"
CASING
15.5"
14.75"
CASING
12.5"
12.25"
CASING
10"
GROUND LEVEL
CEMENT
18" BLACK STEEL CASING
t=5mm.
15.5" BLACK STEEL CASING
t=6mm.
SIDE OF THE WELL
12.5" CARBON STEEL CASING
t=6mm.
10" CARBON STEEL SCREENS
t=6mm.
10" CARBON STEEL BRIDGE
SLOTTED SCREENS t=6mm.
TOTAL DEPTH 750m

ANNEX 1

Width (2 meters min)

50% of Width

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

الجمهوريــة اللبنــانيــة
وزارة الطاقة والمياه

PROJECT NAME: **اسم المشروع:**

Variable

FINANCEMENT: **التمويل:**

CONSULTANT **الاستشارى:**

CONTRACTOR: **المتعهد:**

COMMENCEMENT OF WORKS: **تاريخ المباشرة بالعمل:**
TIME FOR COMPLETION: **مدة التنفيذ:**

Font: Helvetica, capitalized lower case, uniform size (3% of width)

Text layout: upper half in bold

Colors: background light yellow; CDR text in dark blue; all other text in black

Logos multicolor: maximum size: 10% of width

مرسوم رقم ١٣٤٩٥

تحديد دقائق تطبيق وتنفيذ المرسوم

الاشتراعي رقم ٦٨ تاريخ ٩/٩/٨٣ (تنظيم أشغال الحفر لمد خطوط الخدمات العامة في الطرق وبراحاتها)

ان رئيس الجمهورية،

بناء على الدستور، بناء
على أحكام المادة الثامنة من المرسوم

الاشتراعي رقم ٦٨ تاريخ ٩/٩/٨٣ (تنظيم أشغال الحفر لمد خطوط الخدمات العامة في الطرق وبراحاتها)،
بناء على اقتراح وزير الاشغال العامة ووزير الشؤون البلدية والقروية،
وبعد استشارة مجلس شورى الدولة (الرأي رقم ٩٩-٢٤/٩٨ تاريخ ٢٢/١٠/١٩٩٨)،
وبعد موافقة مجلس الوزراء بتاريخ ١٩٩٨/١٠/١،

يرسم ما يأتي:

المادة الأولى – مع مراعاة أحكام المادتين الرابعة والخامسة من المرسوم الاشتراعي رقم ٦٨ تاريخ ٩/٩/٨٣ (تنظيم أشغال الحفر لمد خط الخدمات العامة في الطرق وبراحاتها)

تطبق عند ردم اشغال الحفر المواصفات والشروط التالية:

أولا: في طبقة الاساس

granular base coarse (T.V) :
تردم بسماكة ٣٠ سم على طبقتين تحت طبقة الاسفلت على أن تتكون كل طبقة من مواد صلبة مكسرة خالية من المواد الدلغانية (clay) وتتضمن المواصفات التالية:

– معادل رملي لا يقل عن ٥٠%
– التآكل (A.L) لا يقل عن ٤٠%
– تدرج ضمن حدود المواصفات المطلوبة في دفتر الشروط.

ثانيا: المواد الصالحة للردم:

تعتبر مواد صالحة للردم Suitable material المواد ذات المواصفات التالية:

L.L = Max 40%
P.T = Max 10%

على ألا تحتوي على حجارة او مواد صلبة يزيد حجمها عن ٥ سم.

– تردم هذه المواد على طبقات بسماكة ٣٠ سم وحتى عمق ٦٠ سم ابتداء من طبقة الاساس وحتى الوصول الى كثافة ٩٥% بروكتور معدل.

– من ٦٠ سم وما دون ذلك تردم المواد الصالحة بسماكة ٣٠ سم وحتى الوصول الى كثافة ٩٠% بروكتور معدل.

ثالثا: فلش الطبقة الاسفلتية:

تفلش الطبقة الاسفلتية فوق طبقة الاساس على الشكل التالي:

نفس سماكة الزفت الموجود على الطرق على الا يقل عن سماكة ٩ سم للطرق (الدولية والرئيسية والثانوية) وعلى ألا يقل عن سماكة ٥,٤ سم للطرق المحلية والداخلية.

رابعا: في حال عدم توفر الردميات المنصوص عنها في البند ثانيا يتم الردم بواسطة ردميات (sraoc esab buS) على ان يتضمن المواصفات التالية:

– معادل رملي لا يقل عن ٤٠%
– التآكل (A.L) لا يقل عن ٤٠%
– حد اللدونة (P.I) ٦ % xaM P.I
– لا يزيد حجم الحجارة او المواد الصلبة عن ٥ سم.
– يتم الردم بسماكة ٢٠ سم حتى عمق ٦٠ سم ابتداء من طبقة الاساس حتى الوصول الى كثافة ٩٥% بروكتور معدل.
– من مق ٦٠ سم وما دون ذلك يتم الردم بسماكة ٣٠ سم وحتى الوصول الى كثافة ٣٠% بروكتور معدل.
– تدرج ضمن حدود المواصفات المطلوبة في دفتر الشروط.

المادة ٢ ـ يبلغ هذا المرسوم من يلزم ويعمل به فور نشره في الجريدة الرسمية.

بعبدا في ٥ تشرين الثاني ١٩٩٨

الامضاء: الياس الهراوي

صدر عن رئيس الجمهورية

رئيس مجلس الوزراء

الامضاء: رفيق الحريري

وزير الاشغال العامة

الامضاء: علي حراجلي

وزير الشؤون البلدية والقروية بالوكالة

الامضاء: باسم السبع
