REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

PROJECT No

CONTRACT No

CONSTRUCTION OF WATER WORKS IN OUADI ED DELEM – QABB ELIAS AND MRAIJAT

VOLUME 4

PARTICULAR SPECIFICATIONS

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BUREAU TECHNIQUE POUR LE DEVELOPPEMENT (B.T.D.)
P.O.Box : 70-492 Antélias
Tel : 04/712157-712158
Fax: 04/712159
Email: btd@btd-lb.com

MINISTRY OF ENERGY AND WATER

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

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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 Works cover the construction of several water supply works in the caza of Zahle, including the drilling and equipping of a borehole, the construction/rehabilitation and equipping of pumping stations, the construction/rehabilitation of reservoirs, the supply and laying of transmission lines, installation of house connections, execution of remaining distribution lines and the installation of a PV solar power system.

101.3 THE SITE

For work along pipelines within public roads and tracks, 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 or if there is no such clear identified boundary the width shall be taken as one meter beyond the edge of the carriageway.

For work along pipelines within private land or open country, the Site shall comprise an easement width conforming to the relevant land acquisition documents.

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 (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 works covered by this Contract includes the construction of several water supply works in the caza of Zahle.

The project is covered into two parts:

The Part 1 of works is compulsory and the time period for the execution of these works is fixed at 16 months starting from the date of the notice to commence.

The Part 2 of works is optional and conditioned by the issuance of the order to commence by the CDR which will be at least 6 months before the ending of the Part 1 of works.

The time duration for the execution of the entire optional construction works for Part 2 is fixed at 3 months. Therefore, the time duration for the execution of both parts of works (compulsory and optional) will be the duration of part 1 (16 months).

The works covered by this contract are summarized as follows:

- **First Part of works – Compulsory:**

  - Gravity line from Ouadi ed Delem spring catchment works to the solar well reservoir in Qabb Elias (Diameter 80 mm, L = 3264 m).

  - Gravity line from Ras el Ain spring catchment works to the French reservoir is Qabb Elias (Diam 300 mm, L = 1050 m).

  - Lift line from the French reservoir to the proposed 2 x 400 m^3 reservoirs in Qabb Elias (Diam = 250 mm, L = 66 m).

  - Lift line from the proposed well in Mraijat to the Doumani reservoir (Diam 125 mm, L = 1080m).

  - Gravity line from Ouadi ed Delem spring catchment works to the middle reservoir of Mraijat, excluding the part along the Beirut-Damascus Road (Diam 80 mm, L = 2658m).

  - Construction of a borehole and water well in Mraijat

  - Construction and equipping of one pumping station in Mraijat.

  - Rehabilitation and equipping of existing Qabb Elias pumping station.

  - Construction of reservoirs, namely:
    - 2 x 400 m^3 reservoirs in Qabb Elias.
    - 500 m^3 reservoir in Maksé.

  - Rehabilitation of Qabb Elias french reservoir.

  - Rehabilitation of catchment works, namely:
    - Ouadi ed Delem spring catchment works.
    - Ras el Ain spring catchment works.

  - Supply and installation of a PV solar power system in Qabb Elias.

  - Installation of 1500 house connections in Jdita, Maxe, and upper Saadnayel.

  - Connection of the Jalala and Chtaura transmission lines to the 18-inch diameter main line coming from the Jdita wells.

- **Second Part of works – Optional:**

  - Execution of the remaining drinking water distribution lines in Taalabaya.

  - Connection of the Taalabaya transmission lines to the 18-inch diameter main line coming from the Jdita wells.

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 has 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's responsibility and expenses in coordination with the concerned Authorities and according to the Engineer's 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 references 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 required material or article 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

The Contractor shall provide any necessary protective clothing and safety equipment for the use of authorized 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 (Nb. 6, & 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 manufacture's 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 gets the approval of the Engineer to execute a 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, curbs, 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.

Any surveyor who will subcontract topographical works from the Contractor shall be approved of by the Engineer. However, the Contractor will still be held responsible for the accuracy of the survey until it gets approved by the Engineer.

101.21 DRAWINGS AND DOCUMENTS

All drawings and documents submitted by the Contractor shall have been checked and signed, shall 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 the 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 the 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 50 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.
- EUROCODES
- 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
C37	Reinforced concrete for jacketing of reservoirs (400 Kg cement/cu.m)
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. Cement used for structures in contact with wastewater and buried surfaces in contact with underground water shall be sulfate resisting Portland cement (BS 4027). Cement for all other structures shall be ordinary or/and rapid hardening Portland cement (BS12).

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-Clause 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.

Aluminum works shall be of first quality and glazing shall be 8mm thick.

All hardware shall be water resistant.

Buried walls shall receive a bituminous coating for protection.

Washable paint, acid resistant shall be applied elsewhere (Primer and two coats over a double layer of mastic). A tyrolean render shall be applied on external surfaces of buildings.

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 pipe laying, jointing, testing of pipes and backfilling, the trench shall be completely dry.

The trench shall be as per trench details included in the contract drawings.

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.

In addition to all the above, the excavated material arising from trenches executed on main roads should be removed from site, transported to disposal areas approved by the Engineer, all at the contractor's expense without any extra cost, and the trenches on main roads should be backfilled with imported clean granular material.

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, coarse) bedding and surround if the pipeline is above water table, and in gravel bedding and surround if the pipeline is below water table.

Backfilling of pipes trenches on main roads should be executed using imported clean granular material and should be compacted by layers of 30 cm thick each.

a) Material unsuitable for filling:

   Shall mean material other than suitable material and unless accepted by the Engineer shall include:

- Material from swamp, marshes, or bogs and solid containing more than 12% organic matter when tested in accordance with Test 8 of BS 1377, and which occurs below the top soil layer.

- Clay-based materials of liquid limit exceeding 40 and/or plasticity index exceeding 10 as and if directed by the Engineer,

- Boulders.

- Maximum granular diameter > 5 cm.

203.3 PIPELINES AND MATERIALS

As specified in the BOQ, ductile iron pipes K9 and HDPE 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:

1. The manufacturer's name, initials and identification mark.
2. Nominal diameter.
3. Class designation.
4. Initials and number of relevant Standard.
5. Length of pipe if shorter than the standard length.
6. Angle of bends in degrees.
7. 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 (curbstone, 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 K9 pipes in conformance to BS EN 545-2002. Pipes shall be to pressure rating suitable for the condition of service as denoted on the drawings and not inferior to class K9. 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 aluminum foil in a bright color 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 meter.

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 STEP IRONS FOR VALVE CHAMBERS

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

203.8 TEMPORARY AND/OR PERMANENT 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 and 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.

For main roads subject to a permit from the Ministry of Public Works and Transport, the Contractor, at his own expenses and sole responsibility, should deal to obtain and receive this permit, and the asphalt reinstatement works should be carried out in accordance with the specifications and conditions (if any) of the permit.

As for narrow roads not exceeding 3m width, asphalt reinstatement should be executed to cover the entire width of the road.

203.9 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 FLOW METERS

Unless otherwise stated, all flow meters shall be of the mechanical type.

Where a chlorination system is required, the mechanical flow meter of the pipeline on which the chlorine injection point will be located, shall incorporate a pulsed output unit to enable a chlorine injection proportional to the water flow.

204.2 AIR RELEASE VALVES

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

204.3 FLOAT VALVES

1) Float valves shall be globes with two operating chambers, sealed through piston discs.

2) Float valves shall be the mechanically compensating, controlling the flow to tanks by modulating in direct ratio to the minimum fall in water level. Control shall be through mechanically operated, three-position, four-way valves. Moving four-way valve controls in one direction shall open valves and moving levers in other direction shall close out valves. When the lever is moved to the centre, valves shall throttle into an intermediate position.

3) Valve positioning controls consist of float operated linkage mechanisms for remote mounting feeding water level changes back to main valves through low friction, flexible push-pull cables supplied by the same manufacturer.

4) Valve operating controls consist of secondary linkages with the mechanism functioning off common levers connected to both the main valve position indicator rods, control valve position indicator rods and control valve operating levers. Minute changes in water level shall be transmitted through push-pull cables to three-position, four-way control valves.

5) Valves shall be constructed with cast iron bodies to ASTM A 126, bronze valve trim and valve operating mechanisms to ASTM B62 and all stainless steel valve floats and pilots.

Valves shall be protected with an internal coating of epoxy to a thickness of 120 microns and external coating of epoxy and nickel plating to a thickness of 150 microns.

205. REHABILITATION OF QABB ELIAS FRENCH RESERVOIR

The rehabilitation works shall include the following:

1. Removing the existing plaster.

2. Repairing wide and narrow concrete cracks.

3. Grouting concrete with a non-metallic, non-shrink grout having a light grey color to match the color of hardened concrete.

   The epoxy resin bonding agent to be used should conform to the following properties, unless specified otherwise:

Compressive strength	60-70 N/mm^2
Flexural strength	30-35 N/mm^2
Tensile strength	8-20 N/mm^2
Bond strength to concrete	2.5-3 N/mm^2 (Concrete failure)

4. Making reservation for concrete openings
   Openings for electro-mechanical use shall be accurately marked and boxed out before concreting operations start. No openings shall be made after the concrete has set.
   Where bars obstruct openings of size less than 250 mm x 250 mm, the full length of the bar shall be moved to one side unless otherwise indicated on the drawings. For openings exceeding 250 x 250 mm^2, the bars shall be cut on site and overlapped with additional bars of the same size.

5. Jacketing of the existing reservoir:
   The jacket thickness shall be 15 cm for the slab and the walls. The design compressive strength of the concrete shall not be less than f'c = 300 kg/cm^2 (on cylinder ∅ 150 mm and Ht = 300 mm). The cover of reinforcement shall be 5 cm from the inner side of the tank.
   Two layers of steel reinforcement shall be used with a minimum steel overlap of 50 cm horizontally and vertically. The grade of steel shall be FeE400 or equivalent.

6. Concrete repair for the upper slab of the reservoir including the construction of a concrete beam on grade (anchoring rebars with epoxy resin, casting concrete (Grade C30, dosing of cement 350 kg/cu.m, f_{c28} = 25 MPa), fair faced concrete), making reservations, seals and incorporation for rainwater drain and preparation of the support to receive metal works.

7. Concrete repair of the pumping station slab including the creation of openings in the existing slab as per mechanical drawings, and construction of concrete beams, grade C37 (400 kg/cu.m) to reinforce the existing structure.

8. Concrete repair of the existing stairs and other damaged concrete elements.

9. Construction of a flowmeter chamber of concrete grade C30.

10. Waterproofing of internal walls and slab: the used product shall be suitable for use in potable water reservoirs.

11. Testing water retaining structures with water free from impurities and which will not pollute or impair the water structure.

12. Waterproofing of outdoor terrace: the used membranes shall be covered by a 10 years warranty.

Performance and Standards

a) All work shall be provided and carried out in such a way that there shall be undivided responsibility for all component parts and for the whole system as an entity. The membrane shall be covered by 10 years warranty.
b) The system shall not permit water or moisture penetration through any component part of the waterproof layer in any condition of weather that may be encountered.
c) All materials, mineral or organic, shall be resistant to decay over the life expectancy of the whole waterproofing system.
d) The completed waterproofing system and its constituent components must not suffer breakdown or degradation of performance under temperature changes in a range between -10°C and +40°C nor under conditions of thermal shock.
e) All materials shall be of a standard not less than that set out in the current editions of all relevant British Standards.

Materials

a) Screeding
   Screeds thickness shall be as shown on the drawings and shall be cement and sand proportion 1:3 laid to slope.
   Self-leveling to create

b) Waterproofing System
   External Areas

i. The waterproofing system shall be a cold applied emulsion to the dry clean screed at an average of 350 gr/m2 with hot applied elastomeric membrane 4mm thick composed of SBS modified bitumen with 180gr/m2 polyester reinforcement and protected with finish laid on a two 150 microns polyethylene separation layers.
ii. All internal and external angles shall be reinforced with an additional layer of membrane.

c) Primer
Primer for bonding to screed shall be from an approved manufacturer

d) Mastic Pointing
The turn□in of the membrane into the groove in the concrete shall be pointed with mastic.

e) Aluminium Flashings
i. 0.76mm thick with non-corrosive fasteners.
ii. Flashings in accordance with manufacturer's instructions shall be installed.
iii. All pipes, conduits, sleeves and other projections passing through a membrane shall be flashed to provide tight construction throughout.

f) Bituminous Coating
Solvent type bituminous mastic, normally free of sulphur, compounded for 375 micrometers (15 mil) dry film thickness per coat.

g) Polystyrene
Extruded polystyrene 5cm thickness

h) Testing
The horizontal areas of waterproofing membrane shall be water flood tested after plugging all drains, for a period of 48 hours. Dry area where leaks occur shall be drained, thoroughly dried, repaired and then retested at no additional cost to the Employer. Testing certificate shall be issued upon handing over of the works.

i) Completion
All waterproofing components shall be left clean on completion. Debris will not be accepted.

13. Sandblasting and repointing.

14. Metal works:
The below specifications cover ferrous and non ferrous metal intended to be used in the works (access ladders, metallic doors, etc…) all in accordance with the drawings.

Standards and codes of practice:
- Eurocode – EN 1993
- BS 1245: Specification for metal door frames
- BS 1387: Specification for steel tubes
- BS 1449: Specifciation for stainless and heat
- BS 3100: Specifciation for steel casting for General engineering pruposes
- BS 3987: Specification of anodic oxidation coating

- BS 6399, Part 1: loading for buildings. Code of practice for dead and imposed loads
- BS 6510: Steel-framed windows and glazed doors.

Material :

- Grade at least S235.
- Execution class - EXC2 as per EN 1090.

The Contractor shall submit for approval a calculation note to the consultant and four signed copies of each shop drawing produced by Contractor and subsequently four prints and one electronic copy of the approved shop drawings for the custody of the Engineer.

Materials shall not be ordered until shop drawings are approved. Such approval shall not relieve the Contractor from any of his obligations and responsibilities under the contract.
In submitting drawings and erection procedures for approval, the Contractor shall allow sufficient time for review, comment, checking and re-submission as agreed with the Engineer.

The Contractor shall submit, as a minimum, the following information on or with the drawings:

- position of all plates, sections, stiffeners, welds, bolts, holes, shear connectors and temporary attachments including type, size and orientation;
- length of plates and sections with a specified and calculation-supported allowance for shrinkage and curvature caused by the method of fabrication, wherever such deviations may become critical for building tolerances;
- grades of structural materials and connectors.

The Contractor shall maintain and submit a record of the source of all plate, section, bolt and welding consumables, including test certificates.
At least 6 weeks prior to erection, the Contractor shall submit an erection method statement which shall include the following information:

- health and safety statement including procedures relating to safe working practice,
- sequence of program for erection of steelwork and execution of protective coating systems, including drawings detailing crane and steelwork positions during erection, lifting tackles, temporary props, supports and bracing;
- procedures for site bolting, welding and corrosion protection;
- calculations relating to all props, supports and bracing required to maintain the stability of steelwork at all stages of erection;
- details of access to be provided for erection, bolting, welding, corrosion protection and inspections by the Contractor's Quality Personnel representatives and the Engineer.

Welding method

Welding of steels to BS EN 10025 and BS EN 10210: Part 1 shall be metal arc process in accordance with the requirements of BS EN 1011: Part 1.

- Fillet welds shall be continuous to form a complete seal where two members join. Gaps at joints to be fillet welded shall not exceed 1 mm average (measured over 1 m or length of weld, whichever is smaller) and 2 mm maximum.
- Butt welds shall be full penetration welds. Butt welds in flanges and webs shall be dressed flush by grinding in the direction of stress.
- Run-on/run-off plates shall be used during butt welding. No temporary backing strips shall be permitted.
- Penning of welds will not be permitted.
- Welding electrodes shall be of matching chemical composition to the parent metal in compliance with BS EN ISO 2560, and shall give a weld deposit with mechanical properties not less than the minimum specified for the parent metal.
- Hydrogen-controlled electrodes shall be used for butt welding of steel over 25 mm thick.

Holding down bolts on foundations:
The Contractor shall position the holding down bolts and sleeves in accordance with the Contractor's Foundation Plan. The ends of bolts shall be held and linked by cast steel sections.

- Holding down bolts shall be protected by bituminous paint to the unthreaded parts before casting in, and all exposed parts and nuts shall be recoated after grouting and tightening.
- Holding down bolts shall be hand spanner tight when the base plates are grouted, and fully tightened at least 7 days after grouting to a controlled torque as specified by the Engineer.

As-built drawings:
The contractor shall produce all As-Built drawings before hand over, and format size and number shall be as specified in the contract.

15. Roof tiles:
    Clay plain tiles, in compliance with NF P31-202-1-2, can be laid on rafter pitches down to a minimum of 35°. Plain tiles which, for aesthetic reasons, do not comply with the dimensional tolerances must be laid at pitches not less than 40°.

    In all cases, wind uplift calculations in accordance with the recommendations of NF P31-202 should always be completed to ensure that the specification meets the wind load requirements.

    Roof tiles must pass a specified loading test to prove that they have adequate transverse strength. The minimum strength requirements of this test procedure ensure that roof tiles have sufficient strength to withstand normal handling stresses and occasional foot traffic on the roof for maintenance access purposes.
    The average transverse breaking load for the six test specimens shall be not less than 4 N per millimetre of exposed width for all tiles. Additionally, the transverse breaking load for each of the individual test specimens shall be not less than 3.325 N per millimetre of exposed width for all tiles.

    Note: where L/3 is less than 150 mm, reduce the width of the loading and support members to permit a minimum span of 100 mm. The minimum width of these members should be 10 mm.

    Color: natural red-orange, to be validated by the Engineer.

    Installation: contractor shall apply the recommandation of the manufacture and in compliance with NF P31-202-1-2.

206. 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 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.

All the modifications to the design drawings coming out during execution of the works, or after ordering the relating materials (especially for pumping stations building dimensions) should be done by the contractor and approved by the Engineer.

ANNEX 1

Width (2 meters min)

50% of Width

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER
COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

الجمهورية اللبنانية
وزارة الطاقة والمياه
مجلس الإنماء والأعمار

PROJECT NAME: **اسم المشروع:**

Variable

FINANCEMENT: **التمويل:**

CONSULTANT: **الاستشاري:**

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 13495

تحديد دقائق تطبيق وتنفيذ المرسوم الاشتراعي رقم 68 تاريخ 83/9/9 (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 68 تاريخ 83/9/9 (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 98/24-99 تاريخ 1998/10/22)،
وبعد موافقة مجلس الوزراء بتاريخ 1998/10/1،

يرسم ما يأتي:

المادة الأولى – مع مراعاة أحكام المادتين الرابعة والخامسة من المرسوم الاشتراعي رقم 68 تاريخ 83/9/9 (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 30 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 50%
– التآكل (A.L) لا يقل عن 40%
– 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 5 سم.

– تردم هذه المواد على طبقات بسماكة 20 سم وحتى عمق 60 سم ابتداء من طبقة الاساس وحتى الوصول الى كثافة 95% بروكتور معدل.

– من 60 سم وما دون ذلك تردم المواد الصالحة بسماكة 30 سم وحتى الوصول الى كثافة 90% 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 9 سم للطرق (الدولية والرئيسية والثانوية) وعلى ألا يقل عن سماكة 4.5 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 40%
– التآكل (A.L) لا يقل عن 40%
– حد اللدونة (P.I) % 6 P.I xaM
– لا يزيد حجم الحجارة او المواد الصلبة عن 5 سم.
– يتم الردم بسماكة 20 سم حتى عمق 60 سم ابتداء من طبقة الاساس حتى الوصول الى كثافة 95% بروكتور معدل.
– من مق 60 سم وما دون ذلك يتم الردم بسماكة 30 سم وحتى الوصول الى كثافة 30% بروكتور معدل.
– تدرج ضمن حدود المواصفات المطلوبة في دفتر الشروط.

المادة 2 - يبلغ هذا المرسوم من يلزم ويعمل به فور نشره في الجريدة الرسمية.

بعبدا في 5 تشرين الثاني 1998

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

PART 3

MECHANICAL WORKS

TABLE OF CONTENT

300. MECHANICAL WORKS: COMMON PARTICULAR SPECIFICATIONS - PUMPING STATIONS

300.1 PUMPING SYSTEM

300.1.1 Surface Motopumpset

- 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 pipe works 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

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 pumprooms 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. EL MRAYJAT PUMPING STATION

– Reference:

Hydraulic Schematic drawing	N° 509W-102-M01
Chlorination Schematic drawings	N° 509W-102-M02
Mechanical drawing for wellhead	N° 509W-102-M03

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

301.1.2 Pump

Type: - Submersible Motopumpset (Deep Borehole).

Flow (l/s)	Head (m)	N.P.S.H. (m)	Efficiency at Duty Point	Quantity	Remarks
11.6	467	≤ 6	≥ 70 %	1	Pump in borehole

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 100 mm diameters.
3. One (1) off wellhead and hydraulic accessories 100 mm diameter.
4. One (1) off well wash out pipe 80 mm diameter.
5. One (1) off reservoir inlet pipe 125 mm diameter.
6. 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	Steel Grade (B) with minimum wall thickness 6.4 mm	Steel	100	-
Well head piece, pipe and outlet	Seamless	Carbon Steel	100	16
Well wash out pipe	Seamless	Carbon 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	100	16	1
Well isolating	Butterfly	Cast Iron	100	16	1
Well wash-out valve	Gate	Cast Iron	80	16	1
Well check valve	Anti-Slam Spring Loaded	Cast Iron	100	16	1
Well air release valve	Anti-Shock	Cast Iron	60	16	1

301.3 FIRE FIGHTING

301.3.1 Portable Fire Extinguishers

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

301.4 SURGE SUPPRESSION EQUIPMENT

Surge Vessel, total capacity 200 litters, bladder type in vertical or horizontal arrangement with single connection PN 16 DN 80 free of any backflow restrictor but fitted with isolation gate valve.

Precharge pressure: 0.97 Bar, Factory Test: 23 Bar

The Contractor shall submit detailed sizing calculation for the vessel capacity based on the pumping line profile and characteristics.

Type : Ductile iron., DN 125, PN16.
Flow: 11.6 l/sec. Length: 1080 m. Delta H =28 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: 0.21 Kg/hr. (Qty=1)
- Injector back pressure: 6 bars
- Chlorine cylinders: 50 Kg each (Qty=3)

302. QABB ELIAS PUMPING STATION

– Reference: Hydraulic Schematic drawing N° 509W-PS-01M01
Mechanical drawing for PS N° 509W-PS-01M02

302.1 PUMPING SYSTEM

302.1.1 Electric Motor

Minimum Power Factor at 75% to 100% Output	Efficiency at 75% to 100% Output	No. of Starts/Hour	Quantity	Remarks
≥ 0.85	≥ 86 %	≥ 15	1	Submersible motor in pit

302.1.2 Pump

Type: - Single Channel Submersible Motopumpset in the pit

Flow (l/s)	Head (m)	N.P.S.H. (m)	Efficiency at Duty Point	Quantity	Remarks
30	35	≤ 6	≥ 35%	3	Single Channel Submersible pump in the pit

302.2 PIPING AND ACCESSORIES

302.2.1 Scope of Works

The hydraulic system is composed of the following:

1. Three (3) submersible water motopumpset, specified in "Motopumpset" section
2. Three (3) motopumpset outlet sections 150 mm diameter
3. A 250 mm diameter discharge header
4. A 125 mm diameter discharge header drain section
5. Level, pressure and temperature measurements and oil leakage detector which are specified in 'Instrumentation, Control Equipment and accessories" section

302.2.2 Piping

Location	Material	ND (mm)	NP (bars)
Motopumpset outlet section	Ductile Iron	150	16
Discharge header	Ductile Iron	250	16
Discharge header Drain Section	Ductile Iron	125	16

302.2.3 Valves

Location	Type	Material	ND (mm)	NP (bars)	Qty (No)
Motopumpset outlet section No. 1,2,3	Gate	Cast Iron	150	16	3
Discharge header (Main) No. 5	Gate	Cast Iron	250	16	1
Discharge header (Drain) No. 4	Gate	Cast Iron	125	16	1
Air release valve	Double Function	Cast Iron	60	16	3
Motopumpset outlet section	Ball check valve	Cast Iron	250	16	3
Pumping Station inlet section	Float Valve	Cast Iron	300	16	1
Pumping Station inlet section	Globe	Cast Iron	300	16	1

302.3 FIRE FIGHTING

302.3.1 Portable Fire Extinguishers

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

302.4 PLUMBING AND DRAINAGE INSTALLATIONS

Refer to Common Particular Specifications.

302.5 GAS CHLORINATION SYSTEM

One manual gas Chlorination system, serving the well water system, shall be supplied and installed on the discharge header of the booster pumping station 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: 1.08 Kg/hr. (Qty=1)
- Injector back pressure: 4 bars
- Chlorine cylinders: 50 Kg each (Qty=3)

302.6 LIFTING AND HANDLING EQUIPMENT

Two (2) lifting and handling systems consisting of a manual hoist and a monorail type structure shall be supplied and installed as follows:

- Two, which spans the entire pumps row enabling the hoist to lift any component from/to the sump.
  Safe working load (SWL) 1000 kg.

- One, which spans over the discharge gallery enabling the hoist to lift the sludge bucket for outside discharge.
  Safe working load (SWL): 250 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 (NOT APPLICABLE)

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. EL MRAYJAT WELL PUMPING STATION

– Reference: Electrical schematic drawing No: 509W-102-E01
Domestic electrical installation drawing No: 509W-102-E02
Electrical installation drawing No: 509W-102-E03

401.1 EDL TRANSFORMER

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

- Dual primary voltage: 15/20 kV
- Secondary voltage: 400 V.
- Rated Power: 160 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 = 250 kVA

  - Fuel Storage Tank : Volume: V = 5,000 litters, carbon steel sheets 4 mm 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	240	1
4	375	1

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

No. of Poles	Rating (A) at 380 V	Qty (No)
3	220	1

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	Qty (No)
SOFT STARTER	≥ 101	1

401.4 LOCAL ELECTRICAL INSTRUMENTATION

Local Electrical Instrumentation	Quantity (set)
Set of three digital Ammeters with current transformers	3
Set of digital voltmeters with selector switches	1
Digital hour meters	1
Digital frequency meters	1
Digital power factor measurement (Response time ≤ 1 s)	1
Signalling lamps (Set of three)	5

– 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 UNINTERRUPTIBLE POWER SUPPLY (U.P.S)

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

401.6 GROUNDING SYSTEM - LIGHTNING & SURGE PROTECTIONS

Shall be as described in the Common Particular Specifications.

401.7 PROTECTION OF MOTOPUMPSETS

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

401.8 ALARMS & SIGNALLING

Shall be as described in the Common Particular Specifications.

401.9 ELECTRICAL INSTALLATION FOR BUILDING

Shall be as described in the Common Particular Specifications.

402. QABB ELIAS PUMPING STATION

– Reference: Electrical schematic drawing No: 509W-PS-01E01

402.1 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: 160 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 AND SUBSCRIPTION TO EDL ARE NOT INCLUDED).

402.2 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 = 110 kVA

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

  - Class of Protection : IP 23

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

402.3 MOTOPUMPSET SWITCHGEAR

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

No. of Poles	Rating (A) at 380 V	Qty (No)
4	240	1
4	165	1

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

No. of Poles	Rating (A) at 380 V	Qty (No)
3	70	3

402.3.3 Auxiliaries Switchgear

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

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

No. of Poles	Rating (A) at 380 V	Qty (No)
4	240	1

402.3.5 Starter

Type	Rating (KW) at 380 V	Contactors Mechanical Life (Cycles)	Contactors Switching Frequency (Cycles/Hour)	Qty (No)
Variable Speed	≥ 30	≥ 10 million	≥ 2400	3

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.
- Enclosure 200 x 80 x 40 cm.
- Filter

402.4 LOCAL ELECTRICAL INSTRUMENTATION

Local Electrical Instrumentation	Quantity (set)
Set of three digital Ammeters with current transformers	6
Set of digital voltmeters with selector switches	2
Digital hour meters	3
Digital frequency meters	2
Digital power factor measurement (Response time ≤ 1 s)	1
Signalling lamps (Set of three)	7

- 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.

402.5 UNINTERRUPTIBLE POWER SUPPLY (U.P.S)

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

402.6 GROUNDING SYSTEM - LIGHTNING & SURGE PROTECTIONS

Shall be as described in the Common Particular Specifications.

402.7 PROTECTION OF MOTOPUMPSETS

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

402.8 ALARMS & SIGNALLING

Shall be as described in the Common Particular Specifications.

402.9 ELECTRICAL INSTALLATION FOR BUILDING

Shall be as described in the Common Particular Specifications.

403. QABB ELIAS PHOTOVOLTAIC SYSTEM

403.1 SITE DESCRIPTION

The site of installation of the photovoltaic system will be at the free yard (388) of the coordinates (33°47'38"N, 35°49'30"E) over the water tanks. Below shows a map locating the location for the PV system to be installed on. Where the PV pumping systems and three pumps 30kw each will be at the location with the following coordinates (33°47'56"N, 35°49'19"E). Which is about 70 meters' line of site to the north of the PV system.

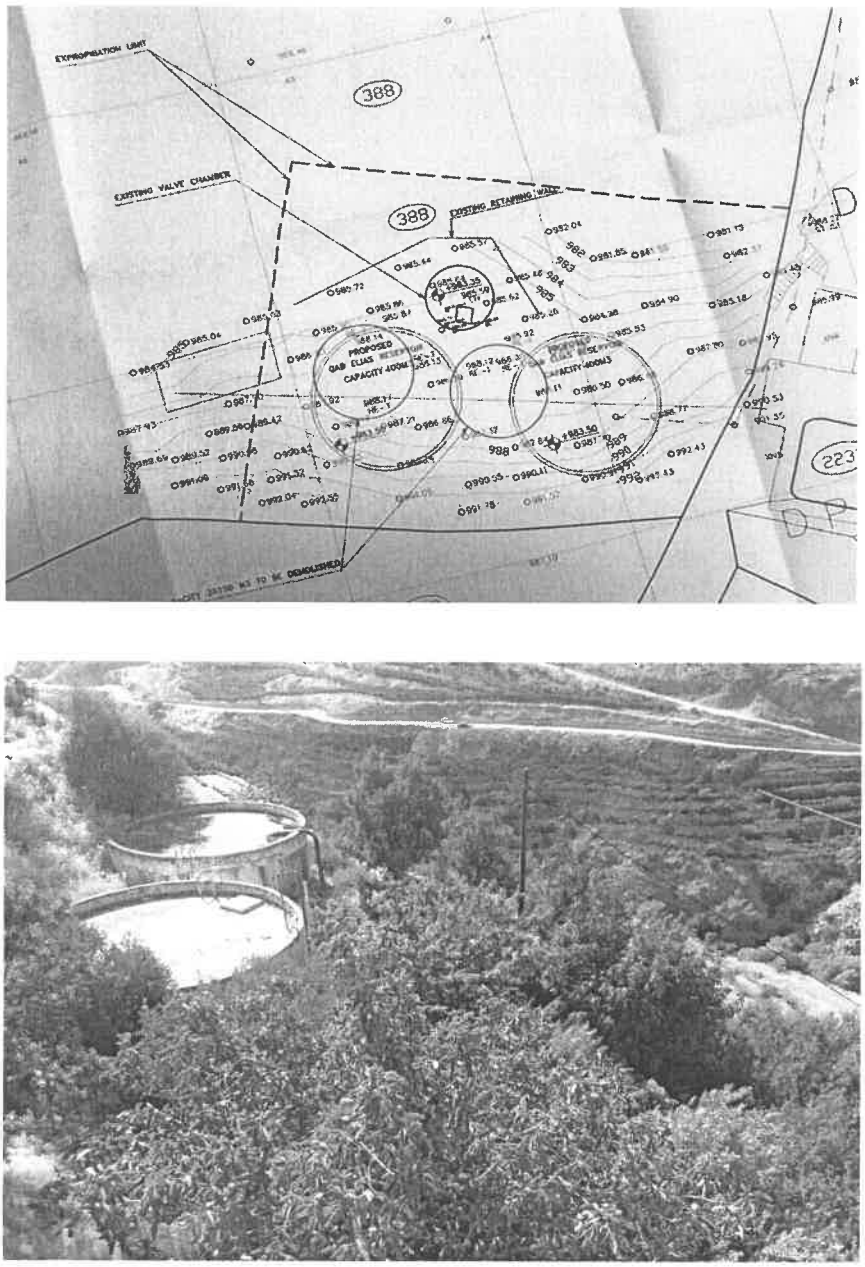


Figure 1: Site Location 33°47'38"N, 35°49'30"E

403.1.1 Photovoltaic Systems; General Description

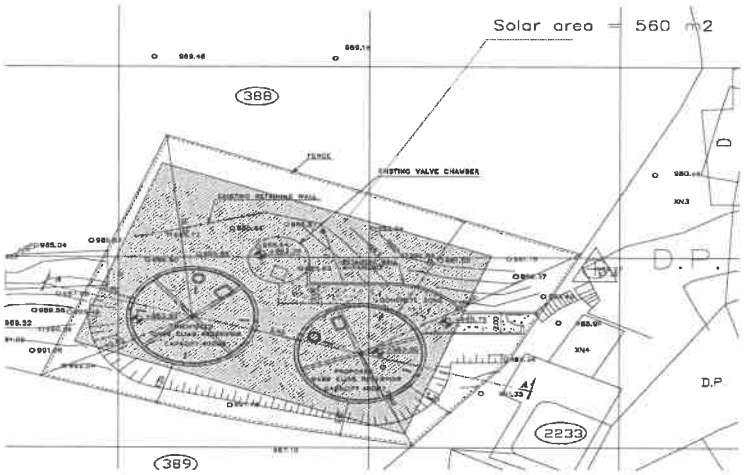
All bidders shall propose a technical and financial proposal for the system capacities shown below taking into account the training of staff and maintenance of the system.

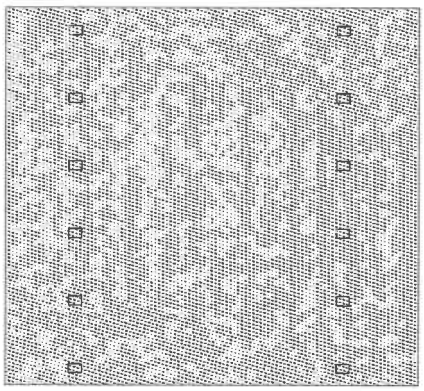
The Photovoltaic system capacity in this tender is as the following:

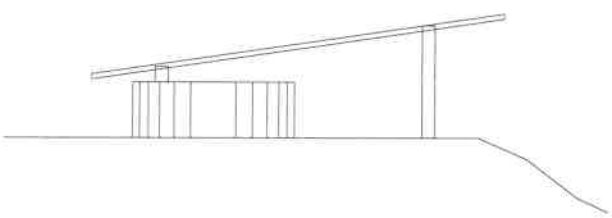
96 kWp as solar pumping system project.

48 kWp for each pumping system while the third pump will be on the standby mode, the PV plant shall be installed in the location shown in the site description where a DC power shall be transmitted to the location of the pumps that located 200 m away from the PV plant.

403.2 PV LAY OUT

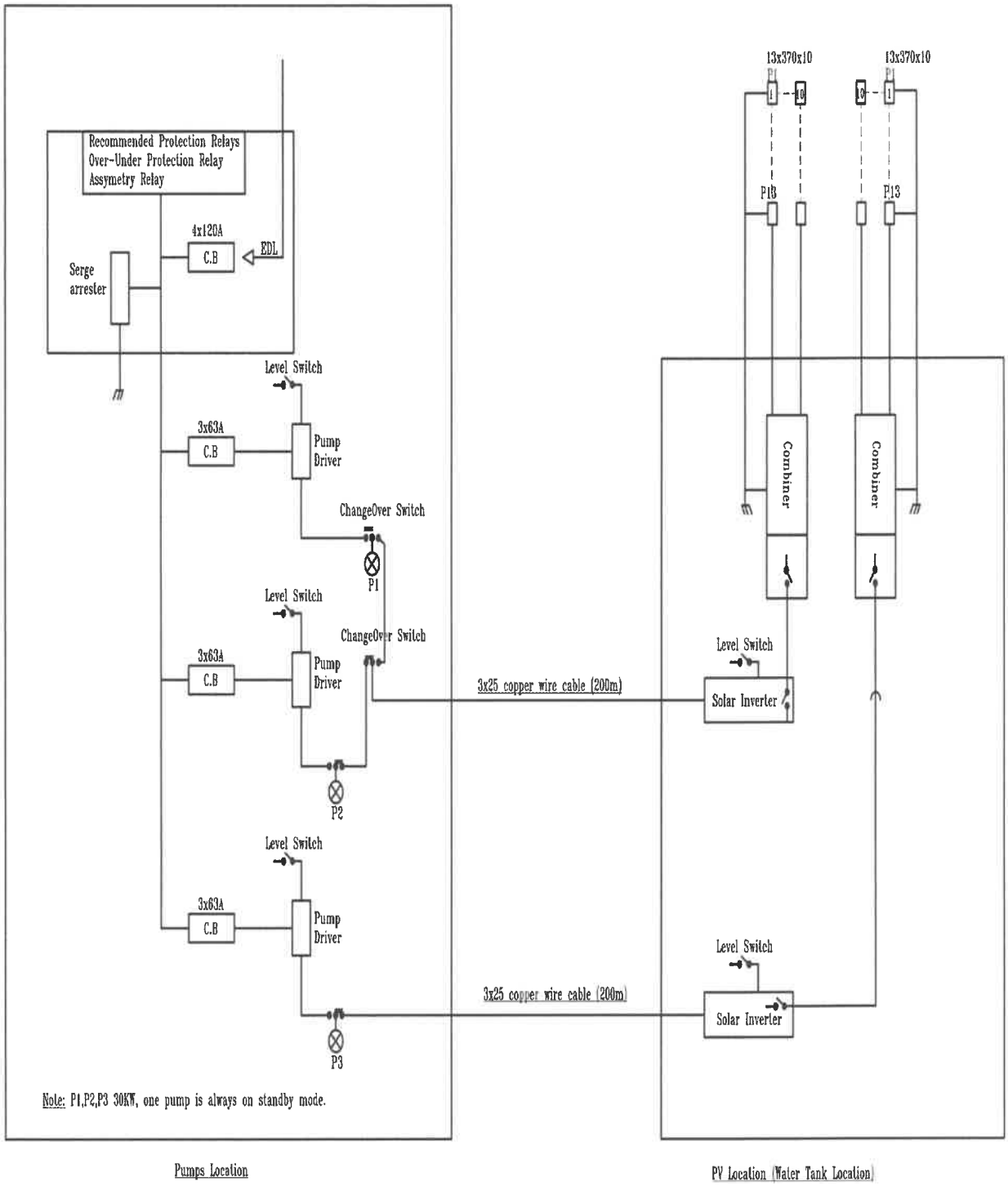






403.3 BLOCK DIAGRAM

Electrical Design:



403.3.1 Photovoltaic Systems; Technical Specification

All Proposed designs & work shall be in full compliance with the applicable regulations

The bidder shall include a technical site description including the solar radiation on the site, site and installation criteria, boundaries, near and far shading obstacles, structural, civil and electrical assessment, and any relevant information.

403.3.1.1 Electrical PV System Design

- The technical offer shall include an Electrical PV System Design Description including at minimum:
  - A simulation model for forecasting the energy yield/ water yield output of the proposed designs with a detailed simulation report.
  - A detailed Single Line Diagram for the PV system
  - Voltage drop and power loss calculations for all circuits and cables.
  - An earthing design plan for all metallic parts.
- The Proposers shall consider in their electrical design the Industry Standards, the National Electric Code, IEEE 1547-2003 "IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems." and other applicable codes and standards.
- All proposed AC- electrical designs must comply with the DISCO requirements and IEC standards.
- The simulation software design and results shall take into account all shading patterns and shall include near and far shading analysis for the design.
- The bidder must take into consideration the following input parameters in the simulation software, and all values must be realistic and close to the field norms and standards:

  o Thermal loss factor

  o DC wiring losses (less than 2%)

  o AC wiring losses (less than 2%)

  o Transformer losses

  o LID losses

  o Mismatch losses

  o Soiling losses (according to the prosper cleaning plan)

  o Shading factor table

  o Shading limit angle

- The electrical design provided in the offer documents shall include the appropriate sizing of all cabling works and all protection equipment (above and below ground) that will connect the modules, strings, arrays, inverters and to the point of interconnection.
- All protection equipment throughout the system shall be sized and specified to reduce damage on all components and the interconnection point in case of an electrical failure (e.g., over voltage, under voltage, over current and intermittency protections).

- The Proposer shall include in the offer all the required sizing, cross-sectional areas and lengths of the DC and AC cables along with required conduits and trenches.
- The Proposer shall provide voltage drop and energy loss calculations for all PV and AC circuits to meet the allowed percentages as follows:
    - For PV/DC circuits: <2% voltage drop from the nominal voltages for all DC circuits.
    - For PV/DC circuits: <2% power loss from the STC DC capacity.
    - For AC circuits: <2% voltage drop from the nominal voltages for all AC circuits.
    - For AC circuits: <2% power loss from the rated AC capacity.

- Earthing system shall be provided for the earthing of the entire project including distribution boards, panel boards, electrical circuits, PV modules, mounting structure, inverters, building structure, and bonding…etc. and associated equipment.
- The DC and AC earthing systems must be separated according to DISCO's regulation and requirements.
- The earthing system shall achieve a maximum total resistance of 5 Ω.

403.3.1.2 PV system Layout

- The technical offer shall include PV System Layout Drawings including 2D and 3D Layouts of the system. All details of the structure location and methodology of fixation.
- The 2D and 3D layouts of the system shall:
    - Consider service passages to enable the ease of maintenance and system cleaning.
    - Include the location of the PV modules, inverters and cable routes.

403.3.1.3 Civil Designs

- The technical offer shall include Civil PV System Design Description including the details of the structural metal elements for the PV mounting structure.
- The Proposer shall provide the following details for the structural metal elements for the PV mounting structure:
    - Manufacturer datasheet and mill certificate
    - Model number
    - Details of the metal to be used.
    - Details of the method for fixing the structure of the PV system.
    - Declaration of compliance with the structural design requirements mentioned in this RFP.
- The Proposer shall use array mounting hardware compatible with the site considerations and environment.
- The Contractor shall consider when awarded the contract that all civil studies and designs shall be reviewed and approved by a registered engineering office and a structural engineer (Certified Third Party) with a minimum experience of 10 years that shall be approved by the contracting authority.

- The Proposer shall include a site plan indicating all civil requirements.

403.3.2 Selected Components and Equipment

The Proposer shall include at minimum but not limited to the following Selected Components and Equipment along with a description of their specifications. The datasheets, guarantees and warrantees shall also be attached:

- PV modules
- PV Mounting Structures
- Solar pumping Inverters
- Pumping VVVF driver
- PV/DC and AC cables and conduits
- PV / AC Cables and Accessories
- Distribution Boxes

The awarded contractor must provide the warranties from the manufacturer. The proposer must attach international compliance/test certification for each component issued from a reputable party.

The Proposer shall include a detailed Bill of Quantities for all materials and equipment proposed.

403.3.3 Description of Works

The Proposer shall include a Description of the Works which will be provided throughout the project in details including all procurement, installation and operation tasks.

403.3.4 Testing and Commissioning Plan

The Proposer shall include in the technical offer a Testing and Commissioning Plan in compliance with the testing and commissioning technical requirements.

403.3.5 Maintenance and Cleaning Plan.

The Proposer shall include in the technical offer a Maintenance and Cleaning Plan for 2 years including the following:

- A detailed maintenance plan including a maintenance checklist and technical support.
- A detailed cleaning mechanism and plan for the PV system including the devices used for cleaning.
- The cleaning frequency per year.

403.3.6 System Components Specifications

403.3.6.1 PV Modules

- The photovoltaic modules have to be based monocrystalline silicon technology, and they have to fulfil the following technical specifications and standards, which have to be certified by an official institute if applicable:
- The Photovoltaic modules should be manufactured in not before 2018.
- The Photovoltaic modules should be grade A, tier 1
- Cell Type: Mono-crystalline
- The output power of the crystalline module should not be less than 365Wp at standard test condition. (STC).
- Module Efficiency shall be at least 19%.
- Operating PV temperature ranges between -10 °C & + 80 °C.
- Modules temperature sensitivity at peak power should not exceed -0.40%/°C.
- Module's weight should not exceed 30 kg.
- The PV modules frame should be made from Anodized Aluminum.
- The PV modules maximum system voltage should not be less than 1,000 V.
- The PV modules should be PID resistant.
- The PV modules should be Salt Mist and Ammonia Resistant.
- The PV modules should have a positive power tolerance.
- The PV modules shall have individual serial numbers behind each front glass and on the back side of the module.
- Electrical connection shall be on a robust terminal block in an IP65 junction box or higher.
- The warranty for module defects after installation should be at least 10 years.
- The awarded Proposer shall provide a manufacture power guarantee for all PV modules that will be installed with their serial numbers that guarantees that the loss of the output is not more than 10% during the first 10 years and up to 20% in total after 25 years. The warranty must state that the malfunctioning solar photovoltaic module must be exchanged by the manufacturer. The replacement solar module must be identical to, or an improvement upon, the original design of the malfunctioning solar module.
- Mechanical stability – IEC 61215: Design qualification and type approval for crystalline silicon terrestrial photovoltaic (PV) modules.
- PV module safety qualification standard: IEC/EN 61730 for safety class II test.
- Along with TUV, CE compliant and UL certification, salt mist/ammonia resistance should be provided.
  - Mechanical load tests up to 5400 Pa, Damp Heat, Thermo Cycle and Humidity and Freeze tests.
- Flash reports of PV modules (SN, Voc, Ipmax,…) shall be provided.
- The Proposer shall provide evidence that the photovoltaic modules manufacturer has been operating in the business of solar modules market for the past five (5) years.

403.3.6.2 PV Mounting Structures

The modules have to be mounted on metallic sub constructions of suitable height from the water tank and with the necessary declination in relation to the horizontal plane, so as to gain the maximum of solar radiation and energy production.

The supporting structure has to be compatible with the offered photovoltaic modules and should be made of hot-dip-galvanized or anodized aluminium.

In detail, the minimum specifications of the mounting structure are:

- The minimum wind speed of 160 km/h shall be considered for the mounting structure design (shall be proved with test certificate by authorized party).
- The hot-dip-galvanized and painted steel must be:
  - The thickness of the galvanization of the Hot-dip- galvanized steel must not be less than 100 µm (shall be proved with test certificate by authorized party).
  - The coating layer of the painted steel must have minimum of three layers of coating (Prime coat, intermediate coat and finish coat) in order to withstand expected weather conditions for at least (10) years.
- Aluminium structure must be protected by (Anodizing or Coating) to withstand corrosion and humidity for at least 10 years,'' warranty must be provided '' (shall be proved with test certificate by authorized party). • The mounting structure shall be all fitted (no welding).
- All bolts, nuts, and washers for the PV modules' mounting structure must be made of stainless steel. Hot-dip-galvanized steel must not contact the PV modules' aluminium frames.
- All clamps in contact with the PV modules' aluminium frames must be made of aluminium.
- The PV modules' aluminium frame must not directly contact any dissimilar metal

• A detailed structural analysis shall be submitted taking into account the Lebanese Loads Code and each area specific conditions (additional safety factor).

- Anti-corrosion guarantee from the weather conditions.
- Manufacturer's warranty should be at least 10 years.

403.3.6.3 Pumping Inverter (Solar Pump Drive)

- The inverter(s) shall comply with the applicable regulations and standards.
- The Inverter shall be sized and designed to operate the PV array up to its Maximum Power Point (MPP).
- The Inverter shall be equipped with built-in flow measurement and sensorless flow calculations to pause pump's dry operation (no water).
- The Inverter shall be transformerless with max-power efficiency not less than 90% (EURO-ETA / Euro-efficiency).
- The Inverter shall be provided with LCD display screen to provide instantaneous information about the subsystems and system output data and performance.
- The Inverter shall have the following protections: reverse current, input over voltage & over current via fuses.
- The drive shall have fuse and protection for the AC side in case operated from the grid instead of PV system.
- Temperature operating range: -20 °C to 50 °C.
- Protection degree is IP65 or higher. If the solar pump drives are below than IP65, then the drive shall be installed in an enclosure IP66 withstanding the local weather conditions.
- The drives shall be fitted with cooling fans as standard; also the cooling air must be free from corrosive substances.
- The inverter must be installed on a separate hot-dip galvanized steel or aluminium mounting structure i.e. separate from the PV mounting structure and must be protected from direct sun light and rain (weather conditions) if the inverter is installed outdoors.
- TUV and CE compliant.
- Warranty after installation should be at least two year.
- The Inverter panel shall be provided with integrated fuses and AC & DC switches and breakers.
- Fuses shall be dimensioned according to the manufacturer recommendations.

403.3.6.4 DC Combiner box for Pumping Inverter

- The strings of the PV module must include fuses in both poles. String fuses must be rated (at 50°C) 2 times the STC short-circuit current, in addition to a protection diodes.

- Surge arresters in both poles, and surge protection for instrumentation and control in accordance with IEC 62305 shall be installed.
- The combiner box shall have Load-breaking switch.
- Protection from direct sunlight.
- The combiner box shall be, at least, IP 65 in accordance with IEC 60529, and should be UV resistant.
- The elements inside the connection box should be disposed in such a way that positive and negative poles are as separated as possible. This is for minimizing the risk of direct contacts.
    - IEC 61140 Protection against electric shock - Common aspects for installation and equipment.
    - IEC 60664 Insulation Coordination with Low-voltage Systems including clearances and Creepage Distances for Equipment.
    - IEC 61008-1 Residual Current operated circuit Breakers without integral overcurrent.

3.2.8. PV / AC Cables and Accessories

The minimum specifications of the PV and AC cables are:

- PV cables shall comply with TUV standards.
- Operation temperature for PV cables should be up to +80°C
- PV cables shall be UV resistant, flame retardant, and with low smoke characteristics.
- PV and AC cables shall comply with local and international standards and the DISCO's requirement.
- AC cables shall be insulated, (armoured is a plus), sheathed **copper** cables drawn from the PV yard up to the connection points and shall be rated at minimum of 600Vac.
- All external cables must be installed inside an external use or hot dipped galvanized cable tray with minimum thickness of 1.5 mm and minimum galvanization thickness of 30µm.
- PVC Flexible pipes with glands shall be used between the modules and the cable tray.
- The cable ties shall be UV resistance.
- All cables connecting the Combiner Boxes with the mechanical room of the water pumps, should be laid in PVC pipes buried in trenches to be protected from harsh weather conditions, fire and other accidents (animal attack, etc).
- All cables shall be marked properly by means of good quality labels or by other means so that cable can be easily identified.
- All cables shall be marked in compliance with IEC 60446-3 category C Basic and safety principles for man-machine interface, marking and identification.
- Factory warranty shall be not less than 5 years.
- Reference codes and standards for cables:

- IEC 60189-2 Low-frequency cables and wires with PVC insulation and PVC sheath – Part 2: Cables in pairs, triples, quads and quintuples for inside installations.
- IEC 60228 Conductors of insulated cables.
- IEC 60502-1 Power cables with extruded insulation and their accessories – Part 1: Cables for rated voltages of 1 kV ((Um = 1, 2 kV) and 3 kV (Um = 3, 6 kV).
- IEC 60502-2 specifies the construction, dimensions and test requirements of power cables with extruded solid insulation from 6 kV (Um=7.2kV) up to 30 kV

(Um=36kV) for fixed installations such as distribution networks o
Reference codes and standards for cable testing:

- IEC 60885 Electrical test methods for electric cables
- IEC 60332 Tests on electric and optical fiber cables under fire conditions

403.3.6.5 AC Distribution Boards

- The Distribution Boxes shall be made of hot coated or galvanized steel; dust and vermin proof with a protection degree IP66 at least.
- The distribution board shall house the PV energy meter and all required electrical protection relays, fuses, C.B. changeover switches.
- The terminals and bus bars shall be made of tin coated copper and appropriately sized; the boxes shall have suitable cable entry with suitable glands arrangement for both input and output cables.
- Suitable markings on the bus bars shall be provided to identify the bus bars.
- The distribution box shall be grounded and for this purpose a suitable ground terminal is to be arranged.
- The distribution boards shall be completely factory assembled, pre-wired, and tested.
- The distribution boards shall be designed to meet the requirements of applicable parts of the following Standard's last edition:
  - IEC 60038 IEC Standard Voltages
  - IEC 60044-1 Instrument Transformers - Part 1: Current Transformers
  - IEC 60044-2 Instrument Transformers - Part 2: Inductive Voltage Transformers
  - IEC 60051 Direct acting indicating analogue electrical measuring instruments and their accessories
  - IEC 60073 Basic and safety principles for man-machine interface, marking and identification - Coding principles for indication devices and actuators
  - IEC 60085 Electrical Insulation - Thermal Evaluation and Designation
  - IEC 60255 Electrical Relays
  - IEC 60269 Low Voltage Fuses
  - IEC 60445 Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors
  - IEC 60529 Degrees of protection provided by enclosures (IP Code)

- IEC 60865 Short-circuit currents - Calculation of effects
- IEC 60934 Circuit-breakers for equipment
- IEC 61000 Electromagnetic compatibility (EMC)
- IEC 61140 Protection against electric shock - Common aspects for installation and equipment.
- IEC 60664 Insulation Coordination with Low-voltage Systems including clearances and Creepage Distances for Equipment.
- IEC 61008-1 Residual Current operated circuit Breakers without integral overcurrent protection.

403.3.6.6 Labelling

- Each item of equipment must have nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place.
- Tags for each power cable or wire located in manholes, hand holes, and vaults shall be provided.
- Warning labels shall be provided and affixed in a conspicuous place.
- All labelling material shall be weather-resistant.

403.3.7 Engineering Works

- The Contractor shall provide structural design of the structural steel elements as per the following requirements:
  - Include a simulation model shall be provided for showing all nodes and elements with detailed loads and reactions calculations.
  - Be in accordance with the AISC-306: Steel construction manual.
  - Consider that if secondary members' or rails' material is different from the PV module material, then a separator shall be used to prevent corrosion.
  - Include seismic and snow load design calculations for the mounting system and its attachments showing compliance to the requirements of the National Building Code (Loads and forces). The mounting structure of PV shall withstand a wind speed of **160 km/hour**, relative humidity of 100% and a temperature of 60 ^{0}C.
  - Include designs for all elements of the hardware required for mounting the PV system and assembling the PV modules and the attachments to the mounting structure.
- The awarded Proposer shall submit within 14 days of official awarding date a working program showing the planned duration for project implementation phases.
- The contractor shall get consent from the Municipality of the equipment to be installed before doing purchase order.
- The contractor shall notify the Municipality the date of the on-site delivery of the components so they can verify the compliance with RFP requirements.

403.3.8 Construction Works

- The Contractor shall respect the site safety, security and general regulations and to be highly cooperative with the Municipality staff.
- The Contractor shall apply Lebanese "labour law" that includes the use of underage labour, non-resident or unlicensed labourers.
- All permits and approvals required to execute the work are the responsibility of the Contractor, The Contractor shall provide copies of all approved permits and applications for permits still in process on the effective date of the contract.
- The contractor is responsible for all fees required for obtaining all approvals and permits required for the project.
- It is the Contractor's responsibility to execute the work and identify the required permits at his own expenses.
- It's the contractor's responsibility to do the following test and any other tests for verification at the any authorized laboratories:

- Concrete
  - ✓ Compressive strength of concrete, where the results shall be compliance with the design requirements.

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°.

- 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. EL MRAYJAT WELL PUMPING STATION

– Reference: Control schematic No: 509W -102-I01
Electrical schematic No: 509W -102-E01
Hydraulic schematic No: 509W -102-M01
Chlorination schematic No: 509W -102-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)
Reservoir (L2)	Piezoresistive	1

501.1.2 Pressure Measurements

Location	Type	Qty (No)
Well Motopumpset outlet	Manometer	2
Well Motopumpset outlet (P1)	Piezoresistive	1

501.1.3 Flow Measurements

Location	Type	DN (mm)	PN (bars)	Qty (No)
Well Motopumpset outlet (F1)	Electromagnetic	100	16	1
Well Drain (FS1)	Flow Switch	13	16	1

501.1.4 Temperature Measurements

Location	Type	Qty (No)
Well Motopumpset electric motor	PT 100	1 (1 per motor)

501.2 CONTROL EQUIPMENT

- The main PLC shall have a provision for the connection to the 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 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 HMI 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.

502. QABB ELIAS PUMPING STATION

– Reference: Control schematic No: 509W-PS-01I01
Electrical schematic No: 509W-PS-01E01
Hydraulic schematic No: 509W-PS-01M01

502.1 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.

502.1.1 Level Measurements

Location	Type	Qty (No)
Sump Pit (L1)	Piezoresistive	1
Reservoir (L2)	Piezoresistive	1
Sump Pit (L3,L4,L5,L6)	Electrical Float Switch	4

502.1.2 Pressure Measurements

Location	Type	Qty (No)
Submersible Motopumpset outlet	Manometer	3
Submersible Motopumpset outlet	Piezoresistive	3
Discharge Header	Manometer	1
Discharge Header	Piezoresistive	1

502.1.3 Flow Measurements

Location	Type	DN (mm)	PN (bars)	Qty (No)
Pumping Station inlet section (F1)	Electromagnetic	300	16	1
Submersible motopumpset discharge header (F2)	Electromagnetic	250	16	1
Submersible motopumpset drain section (FS)	Flow switch	13	16	1

502.1.1 Oil Leakage Detector

Location	Qty (No)
Motopumpset electric motor (O1, O2, O3)	3

502.1.2 Temperature Measurements

Location	Type	Qty (No)
Submersible Motopumpset electric motor	Ptc	3 (3 per motor)

502.2 CONTROL EQUIPMENT

- The main PLC shall have a provision for the connection to the existing PLC.
- The control system of pit pumping station shall use a cable link for the communication between the main PLC (MPLC) of the new booster pumping station and the PLC of the existing well pumping station.
- The Contractor shall supply and install a mimic panel showing the entire pumping system.

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

700 EL MRAIJAT BOREHOLE

700.1 BOREHOLE LOCATION

The well is located in public land to the east of El Mraijat village at the following coordinates **(Fig. 1)**.

X = -309.452 km
Y = -38.695 km
Z = 1217 m
(Chtaoura map, 1/20.000)

700.2 ACCESS TO BOREHOLE

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

700.3 DEPTH

500m

700.4 EXPECTED DISCHARGE

11.6 L/sec.

700.5 STATIC WATER LEVEL

225 m below ground level.

700.6 GEOLOGY

The drilling of the water well will start in compact Limestones of the Upper Aptian Formation(C2b) to reach the limestones and dololmitic limestones of the Middle Jurassic Formation (J4).

700.7 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 350 m.

- Installing 12.5" temporary casing if necessary (carbon steel, thickness 6 mm, total length 350 m).

- Drilling with a 12.25" bit from 350 to the total depth of 500 m.

- Installing 10" casing and screens as shown below:
  a) Casing:
     Diameter: 10" ID
     Type: Carbon steel
     Thickness: 6 mm
     Total length: 400 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.

700.8 WELL DEVELOPMENT

The well development shall be executed by pumping through variable pumping rates equal to 6, 8, 10 and 12 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 480 m, and shall have a manometric head of 450 m with a maximum flow of 12 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.

700.9 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: 6, 8, 10 and 12 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 12 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 480 m, and should have a max head of 450 m and should be able to lift a max flow of 12 l/sec.

700.10 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.

PART 7

BOREHOLES

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The well is located in public land to the east of El Mraijat village at the following coordinates **(Fig. 1)**.

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

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- Drilling with a 12.25" bit from 350 to the total depth of 500 m.

- Installing 10" casing and screens as shown below:
  a) Casing:
     Diameter: 10" ID
     Type: Carbon steel
     Thickness: 6 mm
     Total length: 400 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.

700.8 WELL DEVELOPMENT

The well development shall be executed by pumping through variable pumping rates equal to 6, 8, 10 and 12 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 480 m, and shall have a manometric head of 450 m with a maximum flow of 12 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.

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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.

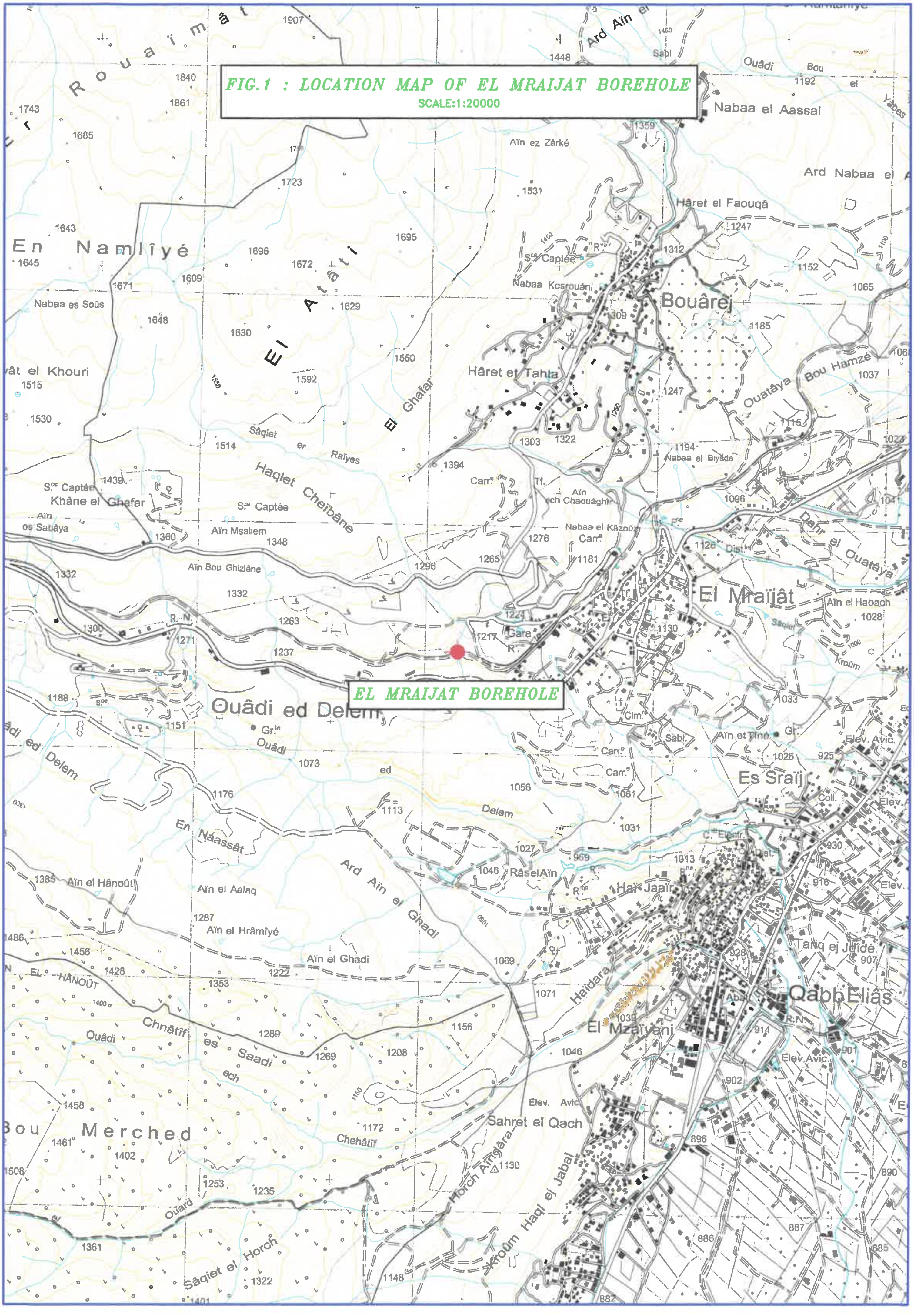
FIG.1 : LOCATION MAP OF EL MRAIJAT BOREHOLE
SCALE:1:20000
EL MRAIJAT BOREHOLE
El Mraïjât
Bouârej
Qabb Elias
Ouâdi ed Delem
Es Sraïj

FIG. 2 : VERTICAL CROSS SECTION OF EL MRAIJAT BOREHOLE