3.6.4 Detailed Electrical Design

(1) Design conditions and criteria

The following design conditions and criteria were established for the detailed electrical design.

(a) Codes and standards

Any authorized national or local codes and standards in Egypt must be applied to the design of the electrical systems and equipment. However, where the applicable national or local codes and standards are not in existence, internationally recognized codes and standards may be applied. Major codes and standards applied are as follows:

- National Electrical Manufacturers Association (NEMA);
- Under Writer's Laboratories (UL);
- International Electrotechnical Commission (IEC);
- National Fire Protection Agency (NFPA);
- General Specifications for Building Construction published by the Ministry of Public Works and Housing;
- Standards and regulations of the Ministry of Electricity;
- Standards and regulations of ARENTO;
- National Electrical Code (NEC);
- Illuminating Engineering Society (IES);
- European standards such as VDE and DIN;
- Japanese standards such as JIS, JEC and JEM.

(b) System and equipment design criteria

The electrical system and equipment must be designed in such a manner to ensure a high level of reliability, continuity, safety and quality and high efficiency in operation, with minimum maintenance.

1) Low voltage distribution system

The secondary utilization voltage is 380/220 V, 3-phase, 4-wire, 50 Hz.

- Panel boards: All panel boards are of circuit breaker type.

- Cables: Low voltage cables are, in principle, copper multi-conductor, P.V.C-

insulated and PVC-sheathed. A minimum of 25% spare is taken into consideration.

- Conduits: Conduits encased in concrete are intermediate metal conduits (IMC) or rigid galvanized steel (RGS). Polyvinyl chloride (PVC) conduits may also be used as appropriate. All exposed conduits must be RGS or IMC.

- Voltage drop
  The maximum voltage drop between a main L.V. switchboard and a secondary panel board is not more than 2.5%.

2) Lighting system:

The ordinary lighting system in different areas vary to reflect the inherent differences between residential and commercial/industrial areas.
Special features such as fountains, sculptures, gateways, various entrances, and other important site features are highlighted to provide landscape interests and to help orienting the traffic movements.
For safety reasons, emphasis is laid on illumination system for ingress/egress points, and an appropriate emergency lighting system is provided along the ingress/egress routes. Ramps and other discontinuities in traffic paths are highlighted as appropriate for traffic safety.
The illumination design is made with an aim at optimizing the quality of the working and social environment, as well as promoting the safety, convenience and enjoyment as a whole.

The following minimum illumination levels are introduced in accordance with the I.E.S. standard:

Area or Activity	Minimum Level (Lux)
Ataqa Port Grain Terminal	
- Maintenance shop	500-700
- Administration building	300
- Rest house	150
- Gate control building/storage	150
Adabiya Industrial Free Zone (Center C)	
- Branch office of Ministry	300
- Fire station	300
- Police station	300
- Costumes and quarantine	300
- Post and telecommunications	500

- Restaurant	200
- Mosque	500
- Dispensary	500
- Trading offices	300
- Branch offices of banks	300
- Exhibition hall/control gate	300
Adabiya Industrial Estate (Main Center)	
- Branch office of Ministry	300
- Fire station	300
- Police office	300
- Post and telecommunications	500
- Restaurant	200
- Catering service center	400
- Mosque	500
- Dispensary	500
- Trading offices	300
- Branch offices of banks	300
Ataqa industrial Estate (Annexed Center)	
- Post and telecommunications	500
- Restaurant	100
- Mosque	500
- Trading offices	300
- Branch office of banks	300
- Branch office of Ministry	300
- Fire station/police station	300
- Street lighting	25

3) Grounding system

The grounding system consists of grounding rods connected to each other by copper conductors, clad-welded, to produce a looped network.
All non-current metal enclosures, structures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and piping systems are connected to the grounding network.

4) Lighting protection system

A complete lightning protection system is provided for each facility. The system consists of air terminals, down leads and interconnecting cables as required, and is connected to the grounding network.

The system is designed specifically in compliance with the requirements of NFPA-78 and UL-96A to meet UL master "C" label requirements.

5) Telephone system

A telephone terminal board and exchange are provided in each building. The telephone exchange consists of an electronic digital switching equipment based on time division multiplex principle with stored program control functions.
The wires are of two pairs to feed several outlets.

6) Fire and security detection and alarm system

The fire and security detection and alarm devices are designed to provide the following functions:

- Indicate activation of the device at fire alarm panel and the fire station to indicate the situation zone;
- Automatically shut down HVAC system within the zone;
- Automatically operate the appropriate fire doors.

The system consists of the following:

- Main alarm panel;
- Smoke detectors;
- Heat detectors;
- Manual break-glass alarm switches;
- Horns and bells.

(2) Design solutions

(a) Low voltage distribution system

1) Wires and cables

The wires and cables are of solid or stranded copper conductors in accordance with IEC-228. The insulation of all wires and cables are rated for at least 85 degrees C. for polyvinyl chloride (PVC) and 105 degrees C. for thermoplastic polyethylene (PE).
The identification by color coding for multi-core conductors in the wires and cables complies with IEC-446. Single and 3-phase cables and earth conductors are identified by the color coding.

- Wires for power, lighting and controls

The wires for power, lighting and controls are single-core or multi-core, insulated and sheathed conductors for light-duty indoor applications. The conductor, PVC-insulated and PVC-sheathed, are rated for a minimum of 300/500 V complying with IEC-189.

- Wires for communications

The wires for communications are single-core or multi-core, insulated and sheathed conductors for light-duty indoor applications. The conductors, PVC-insulated and PVC-sheathed, are rated for a minimum of 300/500 V in compliance with IEC-189. The copper conductor diameter is 0.6 or 0.8 mm. In multi-core wires, each group of 4 conductors are star-twisted. Shielding are provided as required.

- Cables for power, lighting and controls

The cables for power, lighting and controls are single-core or multi-core, insulated and sheathed conductors for indoor/outdoor use or for direct burial applications. The cables for indoor use are unarmored, with a separate earth conductor, or armored with galvanized steel wire. The cables for outdoor use are armored with galvanized steel wire or galvanized steel tape helix.

- Low voltage cables (less than 1,000 V)

The conductors, insulated and the sheathed by polyvinyl chloride (PVC), are rated at least for 450/750 V in compliance with IEC-227.

- Communication cables

The communication cables are multi-core, insulated, shielded and sheathed tinned copper conductor cables for indoor and outdoor installation in conduits, ducts or for direct burial. The conductors, insulated by polyethylene (PE), are rated for an operating voltage of approximately 150 V and a test voltage of 500/2,000 V core-core sheath. Each group of 4 conductors are star-twisted. The conductor diameter is 0.6 or 0.8 mm as indicated. The cables are provided with an aluminum shielding underneath the outer sheath.

- Cable splices

The cable splices are of the cast-resin type selected for the proper type and size of cables. Splices are weather-resistant against chemical influences. The conductors are connected with compression type connectors. Splices for power cables must be rated for at least 50 kA short-circuit current. The cable splices may only be used on long underground cable runs exceeding the maximum capacity of one cable drum.

2) Active protection devices

Devices for the protection against over-current for electrical power systems with voltages up to 1,000 Volts must withstand the fault current characteristic of the system. If the devices are not an integral part of a distribution panel, they must be enclosed in a steel or plastic enclosure with a protection code which suits the environmental conditions of the location of installation.

- Fuses

Fuses are of the type to ensure positive selective coordination complying with IEC-269. The following different types are used:

- High capacity blade type fuses: These fuses are of the 150-safety type with plastic protection cover of live parts except knives. The tripping characteristics are constant for ambient temperatures between -5 degrees C. to +45 degrees C. They are able to carry the rated fuse current at ambient temperatures up to +55 degrees C. and designed for extremely low operating losses. They shall be current-limiting and rated for a minimum of 100 kA interrupting capacity.

- Cartridge fuses: The cartridge fuses shall be rated for a short circuit current of a minimum of 50 kA. They must comply with IEC-269-1 and 269-3. The time current characteristics may have a tolerance range of a maximum of plus or minus 5%. They must be designed for extremely low operating losses.

- Switches

- Load breakers: Load breakers are of the molded-case type up to an ampacity of 630 A. Each load breaker of 100 A size and larger has facilities for fitting under-voltage or shunt tripping devices and an auxiliary switch with at least 1 each of NO and NC contacts. Load breakers with an ampacity of 1,000 A or larger are equipped with a motor-operated closing mechanism. All load breakers are designed to clearly indicate whether they are open or closed, and withstand short-circuit currents not

less than the maximum available short-circuit current at the supply terminals. Load breakers comply with IEC-408.

- Fused load breakers: Fused load breakers are either a combination of a fuse socket and a load breaker, or a specially designed fuse breakers which clear a short circuit by its fuses and have switching capacity of a load breaker.

- Circuit breakers

Circuit breakers of an capacity of up to 630 A are of the molded-case type. Trip-free circuit breakers are used with thermal and magnetic over-current tripping devices for each line. Adjustable thermal tripping devices have a range of adjustment between approximately 70% and 100% of the full load rated. The magnetic tripping devices are either fixed setting or adjustable type. Each circuit breaker, irrespective of its frame size, has facilities for fitting under-voltage or shunt tripping devices and an auxiliary switch with at least 1 each of NO and NC contacts. Circuit breakers of an capacity of 1,000 A or more are equipped with a motor-operated closing mechanism. All circuit breakers are capable of indicating clearly whether they are open or close with an interrupting rating not less than the maximum available short-circuit current at the supply terminals. The Circuit breakers comply with IEC-157-1. Interrupting current of each circuit breaker are at least equal to the bus bars interrupting current for every switchboard. The circuit breaker are selective for cascading tripping on the occurrence of short circuit.

- Miniature circuit breakers

Miniature circuit breakers are of narrow type for manual operation with trip-free release. They are equipped with a thermal over-current and a magnetic short-circuit tripping elements. The interrupting capacity of miniature circuit breakers are not less than 6 kA eff. (220 V AC) when cosØ is between 0.5 and 0.8.

- Earth fault protection circuit interrupters

Earth fault protection circuit interrupters are enclosed in a steel or plastic enclosure with a protection code which suits the environmental conditions of the location of installation.

3) Low voltage switchboards

All low voltage switchboards are factory-assembled. Switchboards are equipped with

voltmeters and voltmeter selector switches to meter the line to line and neutral to line voltages. The incoming lines are provided with current meters, measuring and indicating the momentary, the maximum current over 15 minutes and the peak current of the in-feeder. The minimum rated insulation level are 500 V AC. Switchboards are of sheet metal, enclosed with a protection of not less than IP 42. Outdoor switchboards have a minimum protection of IP 54. The sheet thickness is the manufacturer's standard, but is not less than 1.5 mm. The bus bars are 4 copper conductors with an insulated neutral bus bar. The bus bar sizes are selected in accordance with the tables entitled "Ratings of Copper Bus Bars". Switchboards withstands short-circuit currents required by the fault current contribution of the system. An adequate space, but not be less than 300 mm, is provided for the connection of cables. All cables are connected to terminals which are installed in the connection space. No direct connection of the incoming or outgoing cables to one internal component of the switch gear is permitted. Only one conductor may be connected to one terminal. Low voltage switchboards comply with IEC-439.

4) Branch circuit panel boards

Branch circuit panel boards are of recess or surface mounted type, constructed of sheet metals or other moisture resistant non-combustible materials, with lockable front doors, protection code not less than IP 42. All panel boards are of the dead front type. The minimum rated insulation level are 500 V AC. Bus bars are copper. A separate neutral and an earthing bus bars are provided. The neutral bus bar are installed and isolated from the enclosure, while the earthing bus bar is solidly connected to the enclosure of the panel board. All incoming and outgoing cables and conductors are connected to the terminals, but not to the components. Only one conductor is connected to one terminal. Adequate space for the connection of cables are provided.

5) Metering instruments

Metering instruments comply with IEC-51. The standard design is 96 x 96 mm square type, with scale length of 90 degrees, in plastic enclosure of IP 50 protection. All instruments are rated for 0 degree C. to +50 degrees C. operating temperature under tropical conditions. The mechanical strengths are for 15g (g=9.81 m/sec^2) impact and for 2.5g oscillating (frequency: 5 to 70 Hz).

6) Raceways

Raceway system and equipment include rigid conduits and tubes, flexible conduits, under-floor ducts, cable trays, cable channels, accessories, devices and other items

necessary for a complete and satisfactory installation and operation of all materials and equipment.

- Conduits

Only the following types of conduits and related fittings and accessories are used for the building installation :

- Rigid non-metallic conduits: Rigid non-metallic conduits including sleeves and elbows complying with NEC- 347. Conduits are of heavy duty type and flame resistant. Conduits are supplied in standard lengths.

- Rigid metallic conduits: Rigid metal conduits including sleeves and elbows complying with NEC-346. Conduits are supplied in standard lengths with threads at both ends and with a sleeve.

- Flexible non-metallic conduits: Flexible non-metallic conduits suitable for installation in conjunction with rigid non-metallic conduits by the use of the same fittings and connectors.

- Flexible metal conduits: Flexible metal conduits complying with NEC-350. Conduits are suitable for installation in conjunction with rigid metal conduits, by the use of the same fittings and connectors.

- Cable trays

Cable trays are of galvanized steel, bordered with edge protection. If cable trays with rungs are used instead of those with a perforated continuous bottom, the rung distance does not exceed 300 mm. The minimum load-carrying capacity are:

- 200 mm : 150 kg/m
- 300 mm : 175 kg/m
- 400 mm : 200 kg/m
- 500 mm : 230 kg/m
- 600 mm : 240 kg/m

The standard supporting distance is 1,500 mm. Elbows, T- and X- connectors must be of the same manufacture.

- Wireways

Wireways are of galvanized steel complying with NEC-362. The minimum load-carrying capacities are:

- 100 mm : 70 kg/m
- 150 mm : 90 kg/m
- 200 mm : 110 kg/m

The standard supporting distance is 1,500 mm.

- Boxes

Pull and junction boxes are suitable for use in conjunction with the selected raceway systems. Boxes installed in wet and/or outside are gasketed. Boxes comply with NEC-370.

Surface-mounted distribution boxes or cabinets are of sheet metal or heavy-duty plastic having a protection of not less than IP 43. Recess-mounted distribution boxes and cabinets are of sheet metal provided with a prime and finish coats. The front cover or doors are of the hinged type unlocked only with special tools or with a key. Terminal strips are provided for the conductor connections which are rigidly fastened to the box or cabinet by means of a profile rail. Distribution boxes and cabinets comply with NEC-373.

Outlet boxes for concealed installation are of plastic, fastened with screws of an adequate size. Those for exposed installation are either of sheet metal or heavy-duty plastic, mounted and rigidly connected to the conduit system by suitable bushings. Outlet boxes comply with NEC-373.

Termination in junction boxes, distribution boxes and outlet boxes are of the screwed type. Termination comply with NEC-110.

(b) Lighting and receptacles

1) Lamps, lamp holders and ballast

- Lamps

Tungsten filament lamps comply with SSA-33, SSA -4, IEC-64 and IEC-432.

Tubular fluorescent lamps comply with SSA-138, SSA-39, and IEC-81. Standard tubular fluorescent lamps for 20, 40 and 65 W with a tube diameter of approximately 38 mm are used. However, the low-energy type for 18, 36 and 58 W with a tube diameter of approximately 26 mm is preferred and used as far as practical. Rapid-start tubes are provided.

High pressure mercury vapor lamps comply with IEC-188. The manufacturer's installation recommendations are followed. Instant restart lamps are installed for security lighting, as required.

Halogen lamps are used where appropriate. The lamps are used without ballast for direct power supply connection. The installation position (angle) specified by the manufacturer is maintained.

- Lamp holders

Lamp holders for tungsten filament lamps comply with IEC-61 and 238. Lamp holders consist of heat-resistant plastic or porcelain Edison screw. Types E-14, E -7 and E-40 are preferred.

Lamp holders for tubular fluorescent lamps comply with IEC-400, and for standard two-pin tubular lamps. The locking angle is approximately 30 degrees to both sides. Lamp holders are of heat-resistant plastic.

- Ballast and accessories

All ballast are of integrated power factor corrected with integral temperature protection. Ballast for fluorescent lamps complies with IEC-82. Ballast are of sheet metals with a protection of IP 20, and the coil is cast-resin impregnated. The temperature rating is at least 130/55/125, which means:

130 = 130 degrees C. maximum coil temperature;
55 = 55 degrees C. temperature rise of coil at normal operating conditions;
125 = 125 degrees C. temperature rise of coil at abnormal operating conditions.

Ballast for high-pressure discharge lamps comply with IEC-188. Integrated ballast are used for discharge lamps which include the ballast coil and the power factor correcting capacitor in a sheet metal enclosure with a protection of IP-53. The coil is cast-resin impregnated. The ballast is with two or three taps for voltage adjustments.

Starters for fluorescent lamps comply with IEC-155. Starters are provided in a plastic enclosure and are rated for an ignition temperature range from 20 to 80 degrees C. The universal type are provided to allow for start of lamps in the range of 20 W to 65 W.

Capacitors for lighting fixtures comply with IEC-566. Capacitors are installed for fluorescent lamps for power factor correction to a cosØ of approximately 0.95 to 1.0. The capacitor is provided in an aluminum enclosure and have a M8 fastening bolt for installation at the lighting fixture. The terminals are for snap-type connectors.

2) Lighting Fixtures

Fixture parts are made of either aluminum, brass, copper, steel or plastic. Metals are of composition and temper required by the manufacturing process involved and most suitable for the duty and function of the particular fixture part. Materials and accessories, whether specifically mentioned or not, are of the highest grade of manufacture. All fixtures comply with IEC-598.

- Fluorescent lighting fixtures

The housing of recess-mounted lighting fixtures is suitable for installation in the ceiling systems by only modifying the fastening devices. Fixture housing is constructed from heavy gauge, cold rolled steel with solid top. The steel is formed and braced for maximum rigidity. Seams are constructed to prevent light leakage. Frames and socket plates are of heavy-gauge steel formed and braced to hold lamp sockets rigidly in place during lamp replacement. The housing is for individual or continuous row mounting. All brackets, clips, spacers, etc. necessary for proper installation are furnished as parts of fixtures.

The housing is coated with a rust inhibitor and a finish coat of white stove enamel. The finish coat has a reflectivity of not less than 85%.

The reflector is of high polished aluminum completely enclosing the control gear and wiring extending the full length of the fixture, and forming a wireway for circuits through the fixture. Reflector is securely connected to the fixture body, but removable for access to the control gear and wiring without the use of tools other than a screwdriver. Suitable ventilation is provide for heat discharge from the control gear to the outside so as not to overheat the lighting fixture.

The louvers are constructed of regress extruded aluminum or of white stove enamel

sheet metal, as appropriate, and are of precision fit or gasketed to prevent light leakage. Louvers are hinged from either side, easily movable without the use of special tools, but held in the closed position without external projection.

Diffusers are of a 100% virgin prismatic or opalescent plexi-glass as appropriate, completely framed into the fixture housing to prevent light leakage. All diffusers are formed from one piece with rigid corners.

An earthing screw is provided at the fixture housing close to the power connection terminals. All metal parts of the fixture including the louvers are incorporated into the earthing protection system by proper means of connectors and hinges.

Lighting fixtures with open louvers have a minimum protection of IP 20, and fixtures with diffusers have a minimum protection of IP 40.

- Surface-mounted lighting fixtures

Surface-mounted lighting fixtures are suitable for wall or ceiling mounting.

The housing of surface-mounted lighting fixtures is either of sheet metal as described above or of rigid reinforced glassfiber plastic made from one piece, and solid along its entire length. The housing has sufficient knock-outs for convenient mounting by normal methods.

Other items are the same as those set forth for recess-mounted lighting fixtures.

Lighting fixtures for interior installation in dry locations have a protection of at least IP 40, and lighting fixtures for installation in wet or outside locations have a protection of at least IP 55.

- Open-type lighting fixtures

Open-type lighting fixtures are in general comply with above-described requirements. The housing is form a channel to enclose the control gear and the wiring. Where a reflector is specified, the reflector is designed for direct attachment to the channel cover with suitable threaded fittings and is constructed of either heavy gauge aluminum or steel white enamel. The reflector is for asymmetric or symmetric distribution as specified. Fixtures are for continuous rows or for individual mounting for chain, pipe, or messenger cable hangers. The fixture is provided with tube retention devices to prevent lamp dropout due to shock or vibration.

- Incandescent lighting fixtures

Recess-mounted fixtures (downlights) are of low-brightness, 45 degrees lamp shielding, open reflector downlight. The housing is made of steel, ventilated, with baked-on mat black finish. The fixture is produced with an auxiliary junction box attached to the side mounting frame and pre-wired to the fixture porcelain medium base socket.

Wall or ceiling-mounted fixtures are bracket, watertight, die-cast aluminum with screw-in white opal enclosing globe and heat-proof neoprene gasket. The fixture is satin chrome-finished. A cast aluminum wire guard is produced with the fixture where indicated.

Exit and emergency lighting fixtures are surface or stem-mounted exit lighting fixtures having a housing constructed of die-formed or press-down steel, die-cast aluminum or one-piece extruded aluminum with precision mitered corners. The fixture is of the incandescent type. Doors are of aluminum. The finish is either satin anodized aluminum or backed-on satin aluminum for steel fixtures. The fixture has an acrylic prismatic or white opal glass lens for down lighting. At least two suitably located E-14 type sockets are furnished in the fixtures. All wiring are not less than 1 mm^2 with a minimum temperature rating of 150 degrees C. and are concealed in the wireway in the fixture. Exit signs are of ceramic fired glass, acrylic plastic or fiberglass and have white letters on a red background.

- Lighting fixtures for discharge lamps

High-intensity floodlights have one discharge lamp. The housing construction is heavy-gauge cast aluminum designed for maximum head dissipation. The fixture is adjustable horizontally up to 350 degrees and vertically up to 180 degrees. The fixture reflector is textured aluminum and is adjustable. The socket is made of a high-temperature, metal encased, spring-loaded porcelain. Industrial type fixtures have a porcelain enameled seamless steel dome-like reflector having a ventilated hood and a wiring terminal outlet. Pendant and wall-mounted fixtures have connectors for rigid steel conduit. Connectors contain a set screw or other method to prevent the fixture from turning on the conduit. Pendant-mounted fixtures are provided with a swivel suspension. Reflector is provided with a swivel suspension. Reflector and socket are easily detachable as a unit without the use of special tools, but are so arranged that the socket and reflector cannot come loose because of vibration. Ventilation openings in the neck of the fixture are in accordance with the

manufacturer's published standards. Fixtures are wired with not smaller than 1.5 mm^2 conductor having a minimum temperature rating of 150 degrees C.

- Lighting Pole

The foundation for poles suits the type of poles, fixtures and soil conditions. The foundations are provided with steel conduits for cable penetration to the pole.

Brackets are in principle formed as one part of the pole, unless otherwise mentioned, and not separately bolted to the poles. Bracket shape is straight with an angle of 10 to 20 degrees, elliptical or parabolic. Only poles for floodlight or for special purposes are equipped with separately bolted or welded bracket arms to suit the type and quantity of fixtures.

3) Switches and receptacles

- Lighting switches

Lighting switches are rated for the specified ampacity and voltage. Snap switches are of the AC general type for flush or surface mounting in single or multi-gang spacing. Switches are suitable for use for incandescent or fluorescent lighting circuits and are of the flush tumbler-toggle type. Cover plates are either of white plastic, stainless steel or gold bronze as appropriate. Switches are provided with neon pilot lights where required. Wiring terminals are of the screw type or of the solderless pressure type.

Remote lighting control switches are of the push button type, of the same plate size and finish as the snap switches. They are operated through lighting control relays mounted in the lighting panel.

Air conditioner or water heater switches are marked with "Water Heater" or "Air-Conditioner" and are provided with a slim line neon indicator.

Type and finish of cover plates are selected as appropriate. Cover plates of one type are installed in one room or area.

Receptacles are rated for the required ampacity and voltages. Where receptacles for different voltage levels are installed in one system, the pin arrangement or shape for each voltage level differs from others, to ensure uninterchangability among them.

Single and duplex receptacles are of two-pole, three-wire, earthed type for flush or surface installation. Cover plates are either of white plastic, stainless steel or gold bronze. Bodies are of phenolic compound supported by mounting straps having plaster ears.

Switched single and duplex receptacles are provided with a relay switch.

Weatherproof single and duplex receptacles are mounted in a box with a gasket, weatherproof cast-metal cover plate and cap over each receptacle openings. The cap is permanently attached to the cover plate by a short length of bead chain or is provided with a spring-hinged flap.

Cooker controls are of two-pole, three-wire, earthed type complying with BS 4177. Cover plates are similar to those described herein before. The control unit is provided with a neon indicator, and is for flush or surface mounting in a gang standard box. The matching cooker outlet is supplied with identical front plates with a support plate and a clamp for general wiring cable including slotted three-way terminals for the connection of a 3-core flexible cable. Terminals are protected by a plastic cover.

Type and finish of cover plates are selected as appropriate. Cover plates of one type are installed in one room or area.

(c) Grounding system

All equipment including distribution boards, transformers, conduits, motors, and other apparatus, are grounded to an independent grounding electrode.

1) Earthing sources

Each of the earthing points for the various electrical systems of each building consist of one or more earth pits type "A" located, constructed and equipped as described herein before.

2) Earthing connections

System earthing is achieved by connecting the neutral of the transformer secondary winding to appropriate earthing points.

Equipment protective earthing is made by connecting all non-current carrying metallic parts of the electrical and mechanical installation to the earthing sources. Non-current

carrying metal parts of the electrical installation include such items as metal conduits, raceways, outlet boxes, cabinets, exposed metal parts of apparatus, etc. as well as enclosures doors, grills, barriers, or the like for protecting or shielding electrical equipment from direct access by unauthorized personnel. Series in earthing of one piece of equipment to another is not be permitted. All equipment earthing connections are tapped from the applicable earth source. In principle, cable armor of both steel and aluminum is acceptable as earth continuity conductors. Earth continuity conductor, other than metallic conduits, trunking and cable armor, consists of a special green-colored insulated conductor of the same material and size of the associated branch circuit wiring.

3) Earthing loops

Mechanical equipment rooms and other special areas indicated on the drawings are provided with a main earthing bar or loop conveniently located in the designated spaces allowing two current return paths to the earthing points via test links. The earthing loops and bars are connected to the earthing points as appropriate.

4) General earthing requirements

The earthing system is in full conformity with the requirements of the relevant regulations and specifications. In general, all materials used for earthing are specially manufactured for the purpose. The complete earthing system is mechanically and electrically continuous to provide an independent fault current return path to the earthing source. In every main earth lead, a removable earth link is fitted to enable the electrode system to be disconnected for testing purposes. The link is installed in a conveniently accessible position and arranged to isolate the earth electrode system where open "Tee" and straight through joints in copper strip is made either by riveting and sweating, welding or brazing. Copper strip where used as a main earth lead to the earth electrodes or as earthing loop is 50 mm x 6 mm tinned copper strip. The copper strip is fixed with either copper or brass saddles and/or brass or copper screws. Where connections between dissimilar metals must be made, these are protected by painting with a moisture resisting bituminous paint or compound, or by wrapping with a protective tape to exclude moisture. The earthing resistance between any point in the earth continuity system and the main earth electrode does not exceed 0.5 Ohm. The neutral conductor is insulated throughout and is not be connected at any point to the equipment earthing system.

5) Earth pits

Earth pits of rod type are constructed and equipped in such a way that each pit contains at least one directly driven 3 m long copper clad-steel earth rod with the necessary bolted-type cable connectors. The earth rod can be extended by adding the necessary sections properly coupled.

6) Earthing of main distribution boards

Main distribution boards are earthed by connecting an earth continuity conductor from the earth pit to the special earthing lug or bus bars provided inside the boards' cabinets. The earth continuity conductor for the above application is a bare tinned copper strip having dimensions of 25 mm x 2 mm for boards protected by devices rated more than 200 A and that of 15 mm x 2 mm for the rest.

7) Earthing of panel boards

Panel boards are earthed by connecting an earth continuity conductor from the earthing lug or bus bar on the main distribution boards to the special earthing connector welded to the panel boards' cabinets. The earth continuity conductor is in compliance with the relevant regulations.

8) Earthing of socket outlets

Socket outlets are earthed by connecting a green-colored insulated conductor from the receptacles' earthing terminal to a special earthing lug or terminal provided in the outlet boxes. The earth continuity conductor is looped uninterrupted between all outlet boxes and the main earth terminal at the distribution in accordance with the relevant regulations.

9) Earthing of motors

Motors are earthed by connecting a green-colored conductor from an earthing bushing in the starter or isolating switch to the motor frame. The conductor is run together with the circuit wiring and terminated in the motor connection box, provided the latter is mechanically connected to the frame. Where this is not feasible, the earthing conductor is extended through an insulated and bushed opening in the connection box and connected to the motor base. Where an earth loop or earth bar is available, motor housing is additionally connected thereto directly by a stranded conductor of an adequate size.

(d) Lightning protection system

All buildings exceeding 10 m in height are equipped with a lightning protection system designed either to NFPA, or British Standard Code of Practice CP-326.

The system consists of air terminals, roof conductors, down conductors, test joints, and earth terminals for connection to the foundation earthing system.

Materials are either copper, aluminum or hot-dipped galvanized steel. Mixed use of different materials is not be permitted.

1) Materials

- Air terminal

Air terminal is a minimum of 10 mm diameter copper, aluminum or galvanized steel.

- Roof conductors

Roof conductors are of bare stranded copper of at least 35 mm^2 in sectional area or galvanized steel or aluminum of at least 8 mm in diameter .

- Down conductors

Down conductors as of same materials as the roof conductors.

- Connection material

Material for connections and bonding is copper, heavy cast bronze or malleable cast iron and is a standard product of a reputable manufacturer engaged in the production of lightning protection material.

2) Connection to system

All exposed metallic parts of buildings and structures, such as facing panels, window sills and window frames are bonded to the lightning protection system with approved bolted connections. Bonding connections are of the same size as the roof conductors.

(e) Telephone system

The proposed telephone system complies with the relevant Egyptian regulations and the

CCITT recommendations. The components and the installation comply with the applicable IEC recommendations and with NEC-800 or VDE-0800 and VDE-0804. The system configuration is adapted to the building and to the type of work and services provided by the personnel. The following descriptions specify general requirements.

1) Public exchange lines

The public exchange lines will be brought into the building and terminated at a main terminal box by the Telephone Company. The contractor installs the cable connection between the main terminal box and the main distribution frame.

2) System components

The main control gear includes the power supply unit, switching equipment, and main distribution frame. Based on the size of the system, these units are in one common cabinet, or are furnished in separate cabinets.

3) Power supply unit

Power supply unit is designed for a main power supply voltage as designated and includes a rectifier for the required DC-voltage. A back-up battery system shall be provided for 8 hours operation in case of main power supply failure.

4) Main distribution frame

All internal and external lines are connected to the main distribution frame. Connections are made by means of plugged twin terminals.

5) Operating console

The operating console performs common answering and call allocation for the purpose of caller service and information, and is equipped with display panel to indicate visually and audibly all switching and operating conditions, such as incoming and outgoing calls, extension status, etc. The number of operating consoles are selected in regard to the size of the system and the type of operation. They are linked to each other, to offer optimal service to the callers. Each console is equipped with a handset/headset which can be plugged into the console. An operator desk is furnished as required.

6) Extension features

Rotary dial or push button telephone sets connected to the extensions mainly enables the users to have access to each other and the operator, and to receive exchange calls via the operator console.

7) Sub-distribution panels

Sub-distribution panels are provided in each story of a building for adequate number of extensions, for the distribution of wires or cables between the main distribution frame and the extension outlets. Connections are made by means of plugged twin terminals or other approved methods.

8) Telephone sets

Telephone sets are of the rotary dial or push button type for desk or wall mounting as required by the clients. Special purpose telephone sets with a wide range of service features are provided where necessary.

(f) Fire and security detection and alarm system

Fire and security detection and alarm system is in general designed in accordance with VDE-0833, NFPA Volume 7. In addition, fire detection system complies with EN-54.

1) System description

Fire and security detection and alarm system is a communication system for a secure detection and alarming of danger to life or property. The system generates manually or automatically released alarm and detection signals, which are transmitted, processed and indicated through continuously supervised components. Their malfunction is prevented by special features provided.

The system consists of components for sensing, transmission, pronunciation and annunciation of signals, including the related power supply system. The system is classified as follows:

- Fire detection and alarm system is a system which serves the purpose of a direct emergency signal by manual or automatic release in case of fire.
- Burglar detection system is a system which serves the purpose of manual or automatic signal release is case of burglary.

2) Requirements for detection and alarm system

The components of the system comply with VDE-0804 and VDE-0833, and are designed for fail-safe function.

Transmission lines are continuously and automatically monitored for operational failures. If the transmission and annunciation of alarms is interrupted, indication signals and failures are annunciated at a central point and indicated separately. Where secondary indicator panels are provided, they include the same signal and failure indicating circuits as the main panel. The area of release is indicated. System having more than 50 alarm circuits is equipped with a registration recorder. Components which use the earth potential for transmission are electrically separate from those components which might be influenced by earth potential operation. Components are designed for safe function within the specified ambient conditions.

Contacts are protected against corrosion. A functional check of the system is possible by means of simulation equipment. The system has two independent power supplies. Only batteries for stationary operation, designed for trickle charging, are installed for back-up power supply. Interruption of one power supply, also through a failure will not interrupt the second supply. The interruption of a power supply is annunciated. The system continuously operates during transfer from one power supply to the other. The power supply of the system is not used to serve other systems. Both power supplies are sized so that each of them is able to operate the system on the basis that all indicators are in operation at the same time. Batteries are sized as follows:

Four (4) hour operation, where:

- an emergency power supply is available;
- spare parts are immediately available;
- the enunciator panel is installed at a central point, which is manned 24 hours a day;
- the maintenance personnel is continuously available.

Thirty (30) hour operation, where the annunciation will be noticed within 24 hours and the service personnel will be available within 24 hours.

Sixty (60) hour operation, where none of the 4 hour or 30 hour conditions can be maintained.

The battery charger is sized to operate the system and continuously charge the batteries within 24 hours to 80% of their rated capacity.

3) Central fire alarm control panel

The central fire alarm control panel complies with VDE-0804 Part I, VDE-0833, as well as the following requirements:

- to receive signals from the sensors;
- to monitor the transmission system;
- to indicate operating conditions automatically;
- to energize an alarm system;
- to register fire alarms (see Clause 3f) to energize fire fighting systems;
- to be interconnected with other communication systems including data processing, where required;
- to connect a parallel secondary annunciator panel;
- to receive signals from fire fighting systems (i.e. sprinkler system);
- to test or allow a limited interruption of an alarm circuit.

Automatic audible and visual indications are provided for fire and for failure alarms. The audible alarm is provided with a manual reset. The audible alarm is released again in case a second alarm is being initiated from another area.

Individual circuit indicators are red for fire and yellow or white for failure alarms. The reset of visual alarm indications is possible only when the reason for releasing the alarm has been clarified.

If incandescent lamps are used for indication. A lamp test is possible. Where diodes are used for indication, no lamp test is planned.

Visual signals are legible from a distance of 3 m, when the ambient illumination level is 100 lux. The sound pressure of the audible alarm signal is 60 dB(A) minimum at a distance of 1 m.

Even when one circuit fails (e.g. short-circuit), other circuits will not be affected. When a sensor of an alarm circuit is put out of operation, the other sensors of this circuit and the circuit itself remain in function.

The shut-down of one or more automatic sensors in an alarm circuit is indicated as a failure. It is possible to take each alarm circuit out of operation. This condition will be indicated.

Where fire detection and alarm control panels are utilized for the indication of other detection and alarm systems, it is planned that the fire alarm indication has priority and that those other systems are clearly separated from the fire alarm indications.

Control panels are equipped with solid state equipment where possible and practical, and the enclosure has a minimum protection of IP 43. Each panel is provided with a layout plan of the protected area, to indicate the location of sensors and to illustrate the zone where a fire alarm has been indicated.

4) Parallel secondary annunciator panel

Where the alarm signals must be indicated at other locations than where the central fire alarm control panel is located, parallel annunciator panels, containing the same signal and alarm indication systems as the main panel, are installed. The same safety criteria apply to these secondary panels as for the main panel.

5) Manual fire alarm stations

Manual fire alarm stations are for surface or for recess installation and have a protection of IP 54. The enclosure is red, and provided with a lockable door with an exchangeable glass window. A built-in push buttons is equipped with a double-throw contact. Initiation of an alarm is indicated by a diode. Push buttons are resettable only by opening the front door of the box. The contact rating is 6 V DC/250 V AC and minimum of 2 Amperes.

6) Automatic sensors

Automatic sensors are equipped with a test light and/or an alarm indication, as appropriate. Types of sensors are as follows:

- Ionization smoke detectors (ID)

The detector consists of two ionization chambers, an electronic evaluation circuit, and the protection cover. One ionization chamber (measuring chamber) is filled with ambient air and the other (comparison chamber) is hermetically sealed. The detector is fully functional after initiation of an alarm, without any maintenance. Enclosure protection is IP 23 minimum.

- Rate of rise heat detectors (RD)

The detector consists of solid state circuits including the evaluation circuit. The detector initiates an alarm within the following limits:

Rate of Rise of Air Temperature	Lower Limit of Releasing Time	Upper Limit of Releasing Time
degrees C. min.	min. sec.	min. sec.
1	29 0	
3	7 13	
5	4 9	10 30
10	30	4 2
20	22.5	1 30
30	15	1 00

From Table No. 1 of EN 54, Part 6): Tolerances may be plus/minus 5%.

The detector is fully functional after initiation of an alarm without any maintenance. Minimum protection of the enclosure is IP 21.

- Fixed temperature heat detectors (TH)

The detector consists of solid state circuits including the evaluation circuit. The detector initiates an alarm when the ambient air temperature reaches approximately +60 to +70 plus or minus 5 degrees C. in accordance with EN-54, Part 8. The detector is fully functional after initiation of an alarm without any maintenance. Enclosure protection is IP 21 minimum.

7) Horns

Horns for audible alarm consist of a plastic enclosure of protection IP 65, and contains tone generator, wave form generator, amplifier and loudspeaker. The frequency of the audible alarm is within a range of between 800 and 1,100 Hz. The horns has power supplied from the safe power supply of the system.

8) Bells

At locations where horns are not practicable, bells are installed. Bells are surface-mounted without enclosure.

3.6.5 Detailed HVAC Design

(1) Design conditions and criteria

The following design conditions and criteria were established for the detailed electrical design.

(a) Codes and standards

Following codes and standards were applied to the HVAC system and equipment designs.

- American Society of Heating, Refrigeration and air Conditioning Engineering (ASHRAE);
- American National Standard Institute (ANSI);
- American Society of Mechanical Engineers (ASME);
- National Fire Protection Association (NFPA);
- Sheet Metal and Air Conditioning Contractor's National Association (SMACNA);
- American Society for Testing and Material (ASTM).

(b) Design conditions

Following design conditions were applied to the design.

1) Exterior climate conditions

Summer dry bulb temperature	: 105 degrees F.
Summer wet bulb temperature	: 76 degrees F.
Winter dry bulb temperature	: 50 degrees F.
Winter wet bulb temperature	: 46 degrees F.

2) Interior room conditions

Summer dry bulb temperature	: 75 degrees +/- 1 degree F.
Summer relative humidity	: 50% +/- 5%
Winter dry bulb temperature	: 77 degrees +/- 1 degree F.
Winter relative humidity	: 45% +/- 5%

3) Fresh air requirements for ventilation

Fresh air must be supplied to the conditioned spaces at a minimum rates as set forth below.

- For conference rooms, administration offices, restaurants, other and comfort air-conditioned spaces, 15 to 20 CFM/person, or according to the extraction from the room without circulation, whichever is larger.
- Number of air changes shall be at least ten (10) times per hour for locker rooms, toilets, stores, workshops and substations, and thirty (30) times per hour for kitchens.

(c) Design criteria

Areas and spaces to be air-conditioned, mechanically ventilated or naturally ventilated were selected as listed below.

1) Areas and spaces to be air-conditioned

- Branch offices of Ministry;
- Dispensary;
- Trading offices;
- Branch offices of banks;
- Customs and quarantine;
- Social club;
- Exhibition halls;
- Restaurant;
- Post and telecommunication.

2) Areas and spaces to be mechanically ventilated

- Main toilets in the branch offices of banks;
- Main toilets in the trading offices;
- Maintenance shops;
- Spare parts stores;
- Grease and oil stores;
- Grain sacks stores.

3) Areas and spaces to be naturally ventilated

- Mosque;

- Police station;
- Fire station.

(2) Design solutions

(a) Design method

The spaces and areas of the buildings which require air-conditioning, mechanical ventilation or natural ventilation are selected as stated herein before.

The total internal and external thermal loads at the maximum ambient conditions are calculated by using the "Carrier load calculation program 2000". An air-conditioning load and the corresponding air flow volume are calculated for each room or space to be air-conditioned.

Since all the buildings are not so large, and are distributed in the centers, central air-conditioning system using a central chiller plant is not be technically and economically feasible for this project, therefore, air-conditioning system using direct expansion units are proposed.

The rooms and spaces are divided into zones according to its usage and its required facilities. Each of the zones is provided with an independent air-conditioning system.

For complex spaces which respectively compose of many rooms, ducts are used for air distribution, and the air outlets are selected to suit the types of the reflected ceiling and the lighting fixtures.

The fresh air requirements are taken into consideration in designing the air-conditioning system.

The air-conditioning units could be operated separately, and operation of a unit is possible for any space or room without giving effects to other spaces. Following are taken into consideration in selecting the equipment:

- The equipment are locally manufactured.
- The spare parts are available at any time from the local market.
- They don't need highly qualified maintenance staff or trained operators.
- They are low energy consumption.
- It must be easy to install, or dismantle any unit for maintenance, without special tools and equipment.

Various offices such as the directors', managers', and chiefs' rooms, and the clinic rooms are provided with window type or mini-split units which can be locally used.

(b) System employed for each building or space

1) Administration buildings

The administration buildings in the centers and in the port area are air-conditioned by use of direct expansion package units.

An administration building is divided to several zones. Each zone, which has the same nature of activities, is equipped with a central package unit, complete with an air-conditioner, installed on the roof.

Conditioned air is delivered and distributed to each room through a system of sheet metal ducts suspended above the suspended ceiling. The ducts have dimensions appropriate for the quantity of air passing through them at an ideal air velocity, friction rate, noise level, etc.

The conditioned air is distributed in each room or space through ceiling-mounted air diffuses. The diffusers selected are of shape and size to suit the ceiling tiles and the quantity of air to be supplied.

Return air is withdrawn through the space between the suspended ceiling and the concrete slab.

Volume dampers are provided to balance the quantity of air in each room.

2) Dispensaries

All rooms of the dispensaries of Centers A and C have been designed to be naturally ventilated spaces, except the doctor's room which has a split type air-conditioner.

Dispensary of Center B has more activities than the others, therefore, the air-conditioning will be provided as follows.

- The emergency operation room, preparation room, recovery room, clean room and sterilization room are air-conditioned by use of roof mounted package units equipped with necessary filters.

- The examination rooms are air-conditioned by use of window type or mini-split type air-conditioner installed in each room.

- Each room of the laboratory and X-ray rooms are air-conditioned independently by use of mini-split type units mounted on roof and the fan coil units suspended above the suspended ceiling.

- The pharmacy is air-conditioned by use of a split type air conditioning unit.

3) Restaurants

Restaurant halls are air-conditioned using the roof-mounted package type units. Ducts run in the space above the suspended ceiling. Ceiling diffuses of square type are used to deliver the conditioned air to the space. Return air is withdrawn by use of the area between the ceilings and slab as plenum. Return air grilles are ceiling-mounted to facilitate the return air movements.

Fresh air required is about 20% of the total supply air (1,200 CFM). Considering that the total area of the restaurant hall is about 200 m^2 and a unit floor area of 5 m^2/person, the estimated number of persons in the hall at a time is about 40. In this case the fresh air requirement for each person is about 30 CFM, which is more than the standard recommendations.

Kitchen is to be kept under negative pressure and only mechanical ventilation is required. Supply air fans with filters deliver air to the kitchen space and hood exhaust fans extract air inside the space, including grease-mixed air produced from the equipment, to the outside of the building.

4) Mosques

Mosques are treated as naturally ventilated spaces, therefore, provided only with circulating propeller fans. Ablution areas are equipped with exhaust air fans to discharge the toilet exhaust air to outside.

5) Power substations

Power substations in the Centers and in the port area are treated as compartments to be mechanically ventilated. The rooms are equipped with wall-mounted exhaust air propeller fans. The air volume is suitable for the number of air changes as set forth

herein before.

6) Police and fire stations

Police and fire stations in all Centers are naturally ventilated by air movements through windows. The only air-conditioned spaces are the chief's offices which are equipped with mini-split air conditioners. All toilets are provided with wall-mounted exhaust fans.

7) Social club

The gathering hall is air-conditioned by a central, air cooled, package type air conditioner, mounted on the ceiling. A series of sheet metal ducts with square ceiling diffusers is provided to distribute air to the hall. Return air is circulated through the space above the suspended ceiling by ceiling-mounted return air grilles.

Video room is air-conditioned by an air-conditioner on the roof. Ducts and ceiling diffuses are used.

Meeting room, manager room and cafeteria are air-conditioned using roof-mounted air-conditioners, separately provided for the respective spaces, and ducts and ceiling diffusers.

Kitchen is provided with mechanical ventilation through ceiling diffusers.

Roof-top exhaust air fans, ducts and exhaust air grilles are used for toilet ventilation.

8) Post offices

Post office in general is kept under natural ventilation through windows, however, the chief's office is air-conditioned by a mini-split unit.

9) Customs and quarantine offices

Custom and quarantine offices are air-conditioned by use of mini-split type unit air-conditioners. Toilets are ventilated by wall-mounted exhaust air fans.

10) Workshops, maintenance shops and stores

Workshops, maintenance shops, pump rooms, warehouses and stores are mechanically ventilated. Air is exhausted from each space by means of wall-mounted or roof-top exhaust fans. The make-up air enters to the space through the door type louvers. Volume of air exhausted is calculated for each space considering the space volume and the number of air changes as set forth herein before.

(3) Equipment design

(a) Air-conditioning units

The air-conditioning units are either packaged central types or mini-split type as mentioned herein before. Each unit of the central type unit has two separate circuits on two sealed compressors for reliability and efficiency. The units are provided with the following:

- Main low voltage cut-out switches to protect the electrical components;
- Independent high and low pressure cutout switches for protection of the compressors to prolong the equipment's service life;
- Readily cleanable air filters;
- Durable steel panels;
- Acoustic insulation.

The evaporator is either fixed on the condensing unit to form a package type unit or separated from the remote condensing unit to form a split type unit. Evaporators have centrifugal supply air fans, and the discharge can be through plenums or conventional ducts.

Condensing units have centrifugal fans. Condenser and evaporator fans are adjustable to suite the air volume and static pressure required.

A mini-split unit air conditioner consists of a condensing unit and a fan coil unit. The fan coil unit can be either of vertical wall-mounted type with cabinet or horizontal concealed type suspended from the concrete floor slab. The concealed type can be connected to concealed ducts and ceiling diffuses.

Each unit of the air-conditioners has an outlet for condensate water. The condensate drain pipe is connected to the nearest drainage in the building.

(b) Exhaust fans

Exhaust fans proposed are the following two types:

- Roof-top exhaust fans;
- Wall-mounted fans.

The roof-top exhaust fans are employed for the warehouses, pump rooms, workshops, etc. They exhaust air from the space directly. The fans are direct-coupled to the motors to form complete units.

The wall-mounted exhaust fans are used for toilets, substations and other areas requiring exhausting from sides of the buildings. The fans are direct-coupled to the motors, and the casing can be fixed directly in the building wall or in glass pane of the windows.

3.6.6 Detailed Plumbing Design

(1) Design concept

The following describes the concept of the plumbing design.

(a) Water supply system

The external water supply networks are of pressurized system. Pipes are either ductile iron pipes or PVC pipes complying with the relevant Egyptian codes and regulations. Domestic water supply system in the building is designed in accordance with the Uniform Plumbing Code or the relevant Egyptian plumbing codes. PVC or galvanized steel pipes are used for the domestic water supply.

(b) Sewerage and sanitary drainage system

Domestic sewerage is collected from various parts of the building by gravity. The sewerage flows from the buildings are collected in each Center individually and conveyed by gravity where possible, or by pumping, to the treatment plant via the external sewer mains.

(c) Irrigation system

The water for the irrigation use is potable water supplied from the external water supply system mentioned above. Type of irrigation system is selected depend on the type of plants to be irrigated.

(2) Design solutions

(a) External water supply system

The design flows depend on the type of network used for the water supply system. Following are the formulae for calculating the design flows for various types of network.

1) Tree or ring type network

$Q_{design} = Q_{av} \times P$

Where,

Q_{design} = Design flow

Q_{av} = Average daily water consumption

P = Factor depend on the type of area to be supplied with water, whether rural or urban; obtained from the following table.

No. of People	P	
	Urban	Rural
Up to 50,000	2.25	2.0
50,000 - 10,000	2	1.8
100,000 - 500,000	1.8	1.6
500,000 - 1000,000	1.4 - 1.6	-
More than 1000,000	1.2 - 1.4	-

2) Grid type network

- Transmission mains

  $Q_{design} = Q_{max.\ daily} + Q_{fire}$

- Main and secondary lines

  $Q_{design} = Q_{max.\ daily} + Q_{fire} = Q_{max.\ hourly}$

- Minor distributors

  $Q_{design} = Q_{fire}$

- Service collectors

  $Q_{design} = Q_{max.\ hourly}$

Where Q_{fire} can be obtained from the following table:

No. of People	Q_{fire} (Lit./Sec.)
Up to 10,000	20
Up to 25,000	25
Up to 50,000	30
Up to 100,000	40
More than 200,000	50

(b) External sewerage and sanitary drainage system

The design flow of the sewerage drainage network depends on the daily water consumption volume Q_{av}.

$Q_{av(sewerage)} = (0.8 - 0.9)\ Q_{av}$

In a combined sewerage drainage system, there are two different types of the flow depending on the sewerage flow and rain water flow as follows.

1) Dry weather flow (Q_{dwf})

Dry weather flow is the flow of sewerage water not including rain water flow.

- Minimum dry weather flow

$Q_{min.\,dwf} = (0.2 \times P)\ Q_{av(sewerage)}$
where,
$Q_{min.dwf}$ = Minimum dry weather flow
P = Number of people in thousands.

This flow is used to check the flow velocity in the sewer pipes which must not be less than 0.5 m/sec.

- Maximum dry weather flow
This is a maximum flow during summer season that has normally a maximum water consumption.

$Q_{max.\,dwf} = 14/((1+4+P^{0.5})\ Q_{av(sewerage)})$

2) Wet weather flow (Q_{wwf})

Wet weather flow is a flow consisting of the sewerage flow and the rainwater flow Q_{rain}.

- Minimum wet weather flow
$Q_{min.wwf} = Q_{min.dwf} + Q_{rain}$

- Maximum wet weather flow
$Q_{max.wwf} = Q_{max.dwf} + Q_{rain}$

3) Design flow

In a combined drainage system, collection and conveyance systems are designed taking into consideration the rain water flow.

$Q_{design} = Q_{max.wwf} + Q_{inf.}$

(c) Domestic water supply system

1) Domestic cold water supply system

The domestic cold water system is designed for each individual building using the fixture demand method in accordance with the Uniform Plumbing Code 1988.

Supply of the domestic water to the buildings is from the external water supply network which is a pressurized system as described herein before. A stop valve and water meter assembly is provided in the domestic water supply line for each building at the branch from the main.

The incoming water supply line to each building is split outside the building for two systems; namely the domestic water supply system and the fire fighting water supply system. A valve is provided between the two systems.

A minimum terminal pressure of 450 kpa under peak day flow condition is maintained at the grade level of the buildings. This pressure is enough for distributing domestic cold water without using any booster pump.

Domestic cold water piping is galvanized steel pipes. The domestic cold water pipelines are subject to pressure tests after installation at a pressure of 10 bars for a duration of 4 hours.

The pipe sizes are designed based on the peak flow rate using the number of fixtures installed and the Hunter's curves. Maximum allowable velocity in the pipelines is limited to 25 m/sec., to avoid extreme friction loss and durability of the pipelines.

The following table gives the rate of flow and the minimum pressure desirable for normal types of fixtures. The minimum pressure is the pressure in the pipe desirable at entrance to the fixture.

Fixture	Flow Rate lit./sec.	Min. Pressure kpa
Lavatory	0.2	50
Bathtub	0.3	50
Shower	0.3	100
Shower (Temperature control)	0.3	50
Bidet	0.13	150
W.C. with flush valve	2.2	00
W.C. with flush tank	0.2	50
Sink	1.0	100
Drinking foundation	0.2	50
Hose bib	0.3	50
Dishwasher, residential	0.2	50

Table below gives the demand weights for various items of the plumbing fixtures.

Fixture or Group	Weight of Fixture Units	
	Private use	Public use
Lavatory	1	2
Bathtub (with or without shower)	2	4
Shower head	2	4
Bathroom group (flush valve for WC)	8	-
Bathroom group (flush tank for WC)	6	-
W.C. (flush valve)	6	10
W.C. (flush tank)	3	5
Pedestal urinal (flush valve)	-	10
Stall or wall urinal (flush valve)	-	5
Stall or wall urinal (flush tank)	-	3
Bidet	2	4
Kitchen sink	2	4
Service sink (office use)	-	3
Drinking fountain	-	2
Hose bibb or sill cock	3	5
Cloth washer	2	4
Lawn sprinklers	1	1
Dishwasher	2	4

Fixtures with cold water supply only have a full fixture unit load, while fixtures with

both cold and hot water supply have 3/4 of a full fixture unit load for both cold and hot water supply lines.

For supply outlets likely to have continuous demands, the estimated continuous supply is added to the total demand for the fixtures.

For the fixtures not listed in the above table, weights are assumed by comparing the fixture to a listed one, but in no case less than the following.

Pipe size	Weight for Private Use	Weight for Public Use
10 mm (3/8 in)	1	2
13 mm (1/2 in)	2	4
20 mm (3/4 in)	3	6
25 mm (1 in)	6	10

2) Domestic hot water supply system

Domestic hot water supply systems are designed for individual buildings using the fixture demand method in accordance with the Uniform Plumbing Code 1988.

Hot water demands are determined based on the figures shown on the following table and specifications of the manufacturer of the fixture or appliance.

Type of Buildings	Maximum lit./hr.	Maximum lit./day	Average lit./day
Food Service Full meal restaurants and cafeteria	5.5/max. meals/hr.	40/max. meals/hr.	9/ave. meals/day
Snack Shop	2.7/max. meals/hr.	23/max. meals/hr.	2.7/ave. meals/day
Apartment Houses (per apartment)			
Less than 20 apartments	45	300	160
From 20 up to 50 apts.	38	275	150
From 50 up to 75 apts.	32	250	145

The following table gives the hot water demand per fixture for various types of buildings in liters of water per hour per fixture and the maximum demand factors.

Fixture	Club	Office
Lavatory (private use)	7.5	7.5
Lavatory (public use)	25	25
Bathtub	75	--
Dishwasher	190 - 760	--
Kitchen Sink	110	75
Pantry Sink	35	35
Shower	280	110
Maximum Demand Factor		
Kitchen Sink	0.30	0.30
Factor	0.90	2.00

The above table is used to determine the size of the water heating equipment based on the number of fixtures. To obtain the probable maximum demand, the total quantity for the fixtures are multiplied by the demand factor.

The required heating capacity of the water heater is calculated using the following equation:

$$kw = \frac{4.184\ (L/HR)(t)}{3600}$$

where,
kw = Required heating capacity
(L/HR) = Probable maximum demand
(t) = Water temperature rise

By using the tables above, water flows can be calculated based on the number of fixture units. Hot water requirements for fixtures and outlets which have constant flows are added to the water flows thus obtained.

Hot water supply pipes shall be galvanized steel pipes with thermal insulation provided as appropriate. Size of each hot water pipe is calculated based on the demand weight of fixtures in the same way as that used for calculation of the cold water piping.

The following table gives hot water demand weights in terms of fixtures units for different types of buildings.

	Club	Office
Lavatory (private use)	0.7	0.75
Lavatory (Public use)	1.5	1.5
Bathtub	3.0	--
Kitchen Sink	1.5	--
Pantry Sink	2.5	--
Shower	3.0	--

(d) Domestic sanitary drainage system

The sanitary drainage systems within the buildings are designed in accordance with the Uniform Plumbing Code 1988.

All wet areas such as washrooms, janitors, kitchens, etc. are provided with floor drains. Floor drain are also provided in the mechanical rooms and laboratories. Industrial service areas are provided with dedicated waste water drainage system to the grease basin located on the grade level of the building.

Sanitary drainage water flows gravitationally to the exterior sewer mains. Sewage pumps are provided only where the gravity system does not work.

Cleanouts are provided not more than 15 meters apart from each other in the horizontal drainage lines of 100 mm (4 inches) nominal diameter or less, and not more than 30 meters apart for larger pipes. In addition, cleanouts are installed at each change of direction of the flow greater than 45 degrees. Cleanouts installed in concealed pipelines are extended through the structure and terminated flush with the finished wall or floor surface.

Cleanouts are of the same size as the pipes up to 100 mm in diameter and not less than 100 mm for larger pipes. Cleanouts on 75 mm (3 inches) or larger pipe are so installed that there is a clearance of not less than 50 cm for the purpose of rooting. A 30 cm clearance is, however, acceptable for cleanouts for the pipes smaller than 75 mm.

Sanitary drainage pipes are UPVC pipes. Drainage fittings are of PVC, of the same diameter as the drainage pipes.
The unit equivalent of plumbing fixtures shown in the following table are based on the size of the trap required.

Type of Fixtures or Group of Fixtures	Min. Size of Trap (mm)	D.F.U.
Lavatory	32	1
Bathtub(with or without overhead shower)	40	2
Shower, domestic	50	2
Shower (group per head)	-	3
Bathroom group with flush valve W.C.	-	8
Bathroom group with flush tank W.C.	-	6
W.C. with flush valve	75	6
W.C. with flush tank	75	6
Urinal, pedestal, flush valve	75	8
Urinal, stall or wall lip, flush valve	63	4
Urinal, flush tank	63	2
Bidet	40	2
Kitchen sink, domestic	40	2
Kitchen sink domestic with food waste grinder and/or dishwasher	40	3
Service sink (standard trap)	75	3
Service sink (p - trap)	50	2
Pot sink (industrial type)	63	4
Automatic clothes washer (50 mm stand pipe)	50	3
Drinking fountains	25	0.5
Dishwasher, domestic	40	2
Floor drain, with 50 mm waste	50	1
Dishwasher, domestic	40	2
Interceptors for grease, oil etc.	50	3
Interceptors for sand, auto-wash, etc.	75	6
Fixture not listed above:		
Trap size 32 mm or less	-	1
Trap size 40 mm	-	2
Trap size 50 mm	-	3
Trap size 63 mm	-	4
Trap size 75 mm	-	5
Trap size 100 mm	-	6
Intermittent Flow		
up to 0.50 lit./sec.		2
0.5 to 1.0 lit./sec.		2
1 to 2.0 lit./sec/		6

The minimum size of each vertical or horizontal drainage pipeline is determined based on the total number of fixture units served by the pipeline.

The produce of sizing a multi-story stack is first to size each of the horizontal branches connected to the stack. This is done by totaling the fixture units connected to each branch and determine the size of the branch. Next, total all the fixture units connected to the stack and determine the size. Then check and determine that the maximum allowed is not exceeded by any of the branches. If it is exceeded, the size of the stack as originally determined must be increased or the loading of the branches must be reduced so that the maximum is not exceeded.

The following table shows the maximum permissible length of the vertical pipes.

Pipe Size (mm)	Maximum Length (m)	Pipe Size (mm)	Maximum Length (m)
32	14	100	90
40	20	125	120
50	25	150	155
63	45	200	228
75	65		

The following table shows the maximum number of fixture units that may be connected to a sanitary sewer line of given slope and diameter of pipe.

Diameter of Pipe (mm)	Slope			
	0.7%	1%	2%	4%
50			21	26
63			24	31
75			42	50
100		180	216	250
125		370	480	520
150		700	840	1,000
200	1,400	1,600	1,920	2,300
250	2,500	2,900	3,500	4,200
300	3,900	5,400	5,600	6,700
375	7,000	8,300	10,000	12,000

(e) Drain venting system

Drainage venting system is designed in accordance with the Uniform Plumbing Code.

Vent pipe are UPVC pipes and vent pipe fittings are of PVC of the same diameter as that of the vent pipes which serve.

Size of the vent pipe depends on the fixture unit load connected to the drainage pipe stack.

The following table is used to determine size of the vent pipes.

Size of Soil or Waste Stack (mm)	Maximum Fixture Units Connected	Diameter of Vent required (mm)								
		32	38	50	63	75	100	125	150	200
		Maximum Length of Vent Pipe (m)								
32	2	9								
40	8	15	45							
50	12	9	23	60						
50	20	8	15	45						
50	24	5	9	30	120					
63	20		14	45	100					
63	42		9	30	90		Not Limited			
75	10		9	30	60	180				
75	30		5	18	60	150				
75	60		5	15	24	120				
100	100			10	30	80	300			
100	200			9	27	75	275			
100	500			6	20	55	210			
125	200				10	25	105	300		
125	500				9	20	90	275		
125	1,100				6	15	60	210		
150	350				8	15	60	210	395	
150	620				5	9	38	90	335	
150	960					7	30	75	300	
150	1,900	Not Permitted				6	20	60	210	
200	600					15	45	150	395	
200	1,400					12	30	120	365	
200	2,200					9	24	105	335	
200	3,600					7	18	75	240	
250	1,000						23	38	300	
250	2,500						15	39	150	
250	3,800						9	24	105	
250	5,600						7	75	75	

The sizing, arrangement and installation of the vent pipes are so designed as to limit air pressure variation in all fixture traps to a differential pressure not exceeding 25 mm of water column above or below atmosphere pressure.

The diameter of an individual vent is not less than one half the diameter of the drain to which it is connected.

(f) Fire fighting system

It is assumed to protect all buildings against fire by use of stand pipe fire water system.

The system is designed and selected in accordance with the National Fire Protection Association Code (NFPA 14).

All buildings which need to be protected with stand pipe system are designed in accordance with NFPA-14 "Standard in the installation of stand pipe hose systems" as a class III system. This system is provided with 65 mm hose valves and 38 mm reducers. Hose cabinets are located in corridors near the exit stairs in such a way that no portion of the floor is more than 30 m from the nearest cabinet.

Siamese connections are provided at the locations required by the Fire Department.

Water quantity per stand pipe supplied with 65 mm pipes is 31 lit./sec. for a period of at least 30 minutes where only one stand pipe is required. Where more than one stand pipes are required, the minimum supply will be 31 lit./sec. for the first stand pipe and 16 lit./sec. for each additional stand pipe, with the total supply not exceeding 158 lit./sec. for at least 30 minutes. The stand pipe systems in buildings without sprinkler system are provided with pumping system to maintain a residual pressure of 450 kpa in the most remote and highest outlet in the system (including outlet on the roof) with a 31 lit./sec. flow.

3.6.7 Detailed Landscaping Design

(1) Design criteria

As a principal design criteria, it is decided that extensive landscaping must be avoided for this project in desert environment, to reduce irrigation cost, and the following landscaping criteria are proposed.

- The estate entry road, the main collectors and the foot paths, and the bicycle tracks are to be lined with trees to provide shade along the routes.

- Landscaped open areas are provided for sports and recreation at a rate of 2% of the total development area. It is also planned that at least one such area is located in or near each of the Centers, however, such areas are designated in the development plan but excluded from the scope of the design this time.

- For purposes of the architectural and landscape studies, it is considered that up to a total of 1 % of the gross estate area is to be used for amenity landscaped area.

- Prime material for the landscaping should be those produced from gravel and stones obtained from Ataqa mountain.

- The design must reflect the Egyptian heritage without loosing contrast to the modernism.

(2) Grading

Levels of outdoor spaces are carefully determined to avoid risk of flooding, to ensure positive drainage, to enhance continuity of appearance, and also to differentiate specific areas from each other where desired.

(3) Roads and parking

Spaces dominated by vehicles have obvious differences from those intended primarily for pedestrians, because of the different requirements of sight clearance line and the speed. Therefore, clear separation is provided between the vehicle-dominated areas and the pedestrian paths.

Parking spaces are provided in the areas close to the entrance of building complex.

(4) Planting and pedestrian walkways

The segregation between the pedestrian and vehicle movements is considered as described above. Planting is proposed to facilitate the segregation.

To provide shades and visual interest are the main concerns in selection of species of plants along the pedestrian walkways.

Street trees and shaded parking areas are important for enhancing the image of the sites as well as providing amenity to motorists.

(5) Landscape elements

While the shape and location of the buildings establish the primary landscape within the site, the outdoor areas are to be structured and linked by landscaping elements in such a way to provide a variety of useful and interesting spaces suitable for proposed use of the site. The following are taken into account in selecting the landscaping elements.

- Minimum use of lawns to reduce irrigation water consumption;
- Use trickle system or other slow irrigation method for watering trees over a long period, than flooding;
- Use automatic irrigation timer system;
- Watering only when needed;
- Shrubs and trees should be watered by drip or trickle system;
- Plant rows are located close to each other;
- Use of vegetation as windbreaks to reduce evaporation losses;
- Provide water basins around trees and shrubs to hold water near the root;
- Landscaping to achieve desired functions (space separation, shades, etc.) and selecting plants to achieve minimum water application requirements;
- Use of native plants as much as possible in landscaping;

- Vary water applications based on growth of the plants, season, soil condition, grade slope, and position of the plants within the site;

- Use of mulches or plastic films to hold moisture in soil;

- During water shortages, giving watering priority to more drought-sensitive trees, and making special effort to control insects and stress.

3.7 WATER SUPPLY SYSTEM

3.7.1 GENERAL

(1) Outline of Water Supply System

Location and general layout of the water supply facilities is shown in Fig.1.1-WS.

(a) Raw Water

The water source of the system is the Suez Sweetwater Canal. This raw water is originated from the Nile River. The water of the Nile River, firstly, flow into the Ismilia Canal, then branches off to the Suez Sweetwater Canal. The distance between the Nile River and the intake point (traced along canals) is approximately 230km.

(b) Water Supply Facilities

The water supply system to be constructed under this project consists of the Intake, Aqueduct, Water treatment plant, Treated water distribution pipeline and Draw-off water distribution pipeline.

The treated water production capacity of the system is 100,000 cu.m per day.

(c) Intake Facilities

The Intake facilities are located at about 3 km up-stream from the end of Suez sweetwater canal in the Suez city. The raw water is collected from the Suez Sweetwater Canal at rate of 100,000 cu.m per day as maximum, then pumped up to the water treatment plant to be constructed at the Ataqa Industrial Estate through the Aqueduct Pipeline.

(d) Aqueduct Pipeline

The raw water to be conveyed to the water treatment plant through the aqueduct is about 19.5 km distance with 85.3 m of elevation differences. The pipeline route runs from the intake pump station, through the Suez Railway Station, the North-West desert, El Zaytla road, the Suez Thermal Power Plant, Carbon factory in Ataqa, then reaches to the water treatment plant. This route is kept away from the urban area of the Suez City, to facilitate construction and land acquisition. This pipeline route includes two railroad crossings, one aque-bridge and road crossings.

(e) Water Treatment Facilities

The water treatment plant (WTP) is located in the Ataqa Industrial Estate. Design treated water production capacity is 100,000 m3/day in all. The treatment system is divided into 4 series of production lines. Each series has a production capacity of 25,000 m3/day. This division is due to consideration of expandability for the production capacity in accordance with the growth of water demand. The water treatment plant consists of water treatment facilities, sludge treatment facilities, operation and maintenance facilities and power supply facilities. As a major feature of the plant, the sludge treatment facilities have a function to recycle the sludge water for plantation purpose.

(f) Distribution Pipeline

The treated water is distributed to the service area by gravity flow from the WTP. The service area is about 437 ha, including Ataqa Industrial Estate East, West and Coastal (Ataqa I.E.East, West and Coastal), Adabiya Industrial Free Zone (Adabiya I.F.Z.), Ataqa Port (Bulk cargo terminal, Grain silo and Railway facilities) and Wastewater treatment plant. Other than the above service areas, Ataqa I.E.Expantion and ancillary residential area as the future expanding projections, also includes to the elements of the production capacity. However, the distribution system of these future projection are excluded from this design. The treated water distribution pipeline network includes from trunk line (main) to secondary / tertiary lines, but house connection system is not covered in this design. As well as the treated water, the draw-off water will also be distributed to the service area through the draw-off water pipeline network for the irrigation and planting purpose.

(g) Maintenance of Sludge Draw-off (Recycling)

The sludge draw-off water generated in the treatment process is partially recycled. The draw-off water is collected in the draw-off water reservoir, and separated with super-natant and sub-natant. The super-natant, which is expected to be SS 50 mg/l, is distributed for the above mentioned purpose. The remaining sub-natant is dewatered in the sludge drying beds by evaporation and disposed at the surrounding desert. According to the demand calculation, the draw-off water supply quantity is scheduled at 3,200 m3/day. The service area of draw-off water is the project area except for the Ataqa port and the wastewater treatment plant.

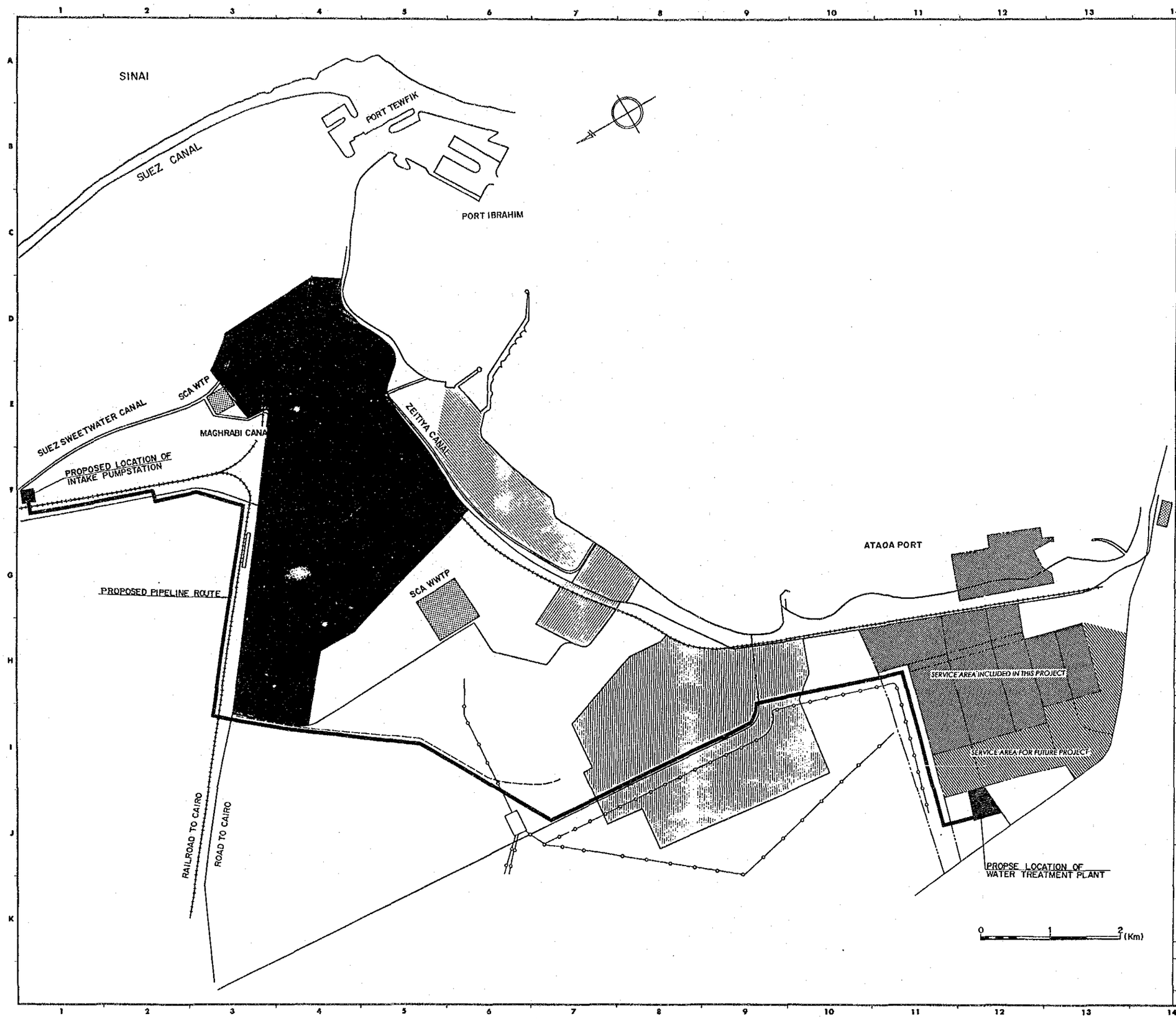
(h) Power Supply System

The water supply facilities use two individual power supply lines. The first one is for the intake pumping station which receives 11KV from supply line, and the other is for the

water treatment plant which receives 22 KV from supply line. The source of power is fed by the regional electric company/authority. In the both power sub-stations, emergency generator units are installed. The generator units provides 50% power of Maximum operation, when an emergent power stops.

(i) Authorization of Design Concept and Criteria by Egyptian Technical Committee

All design works herein were discussed and accepted by the National Organization of Potable Water and Sanitary Drain (NOPWASD) and Suez Canal Authority (SCA) on behalf of the Ministry of Development, New Communities, Housing and Public Utilities (MODANC).



GENERAL NOTES

LEGEND

- URBAN AREA
- INDUSTRIAL AREA(existing)
- INDUSTRIAL AREA(PROJECT AREA)
- ELECTRIC TRANSMISSION LINE
- EMBEDDED PIPELINE

DESCRIPTIONS	DWG. NO.
REFERENCE DRAWINGS	

NO.	DATE	DESCRIPTIONS	BY	APP'D

REVISIONS

ARAB REPUBLIC OF EGYPT

MINISTRY OF DEVELOPMENT,
NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN
OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

FIG. 1.1-WS

LAYOUT
OF
WATER SUPPLY FACILITIES

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

SUBMITTED	APPROVED	SCALE	REV. NO.
		1:50000	
DATE OCT. 1993		DWG. NO. A2-2.1-1-1	

3.7.2 DESIGN CONDITIONS

(1) Service Area

(a) Treated Water Distribution

The treated water service area covers to the entire project area. (see FIG. 2.1-WS) The service area comprises following sub-zones:

Ataqa I.E. East and West	:	294 ha
Ataqa I.E. Coastal	:	61 ha
Adabiya I.F.Z	:	58 ha
Wastewater Treatment Plant	:	4.5 ha
Center A	:	2.1 ha
Center B	:	9.2 ha
Center C	:	8.3 ha
Residential Area (Future Expansion)	:	132 ha
Ataqa I.E. Expansion (Future Expansion)	:	106 ha
Total		675.1 ha

(b) Draw-off water Distribution

The Draw-off water supply network almost covers the project area which are Ataqa I.E. East and West, Ataqa I.E. Coastal, Adabiya I.F.Z. Suez-Adabiya Coastal Road and Public utilities (9.5 ha) and Green area located East of the Ataqa I.E.East (57.5 ha). The road length covering the draw-off water supply is about 33.5 km.

(2) Water Consumption and Design Demand

(a) Average Daily Water Consumption

The water consumption is divided into three categories, which are Domestic use, Commercial use and Industrial use. The water consumption of each category is determined as follows:

Item	Consumer	Unit Rate	Consumption
Domestic Use			
Residential Area	35,000 capita	190 l/cap/day	6,650 m3/day
Commercial Use			
Center Zone (A,B,C)	588 capita	285 l/capita day	167 m3/day
W.W.T.P.			400 m3/day
Ataqa Port			1,624 m3/day
Industrial Use			
Ataqa I.E. East/West	294 ha	107 m^3/ha/day	31,471 m3/day
Ataqa I.E. Coastal	61 ha	107 m^3/ha/day	6,571 m3/day
Ataqa I.E. Expansion	106 ha	107 m^3/ha/day	11,363 m3/day
Adabiya I.F.Z.	58 ha	107 m^3/ha/day	6,221 m3/day
Ataqa Port (Bulk,Grain)			1,580 m3/day
Total			64,467 m3/day

(b) Design Water Demand

The design demand as basis of the system design is determined as follows:

a. Maximum Daily Factor(= Max. Day Demand/Ave. Day Consumption)

Domestic use : 1.30 Industrial use : 1.20

b. Peak Hourly Factor

(= Peak Hour Demand/Ave. Day consumption) : 2.00

c. Unaccounted for Water (per Maximum Day Demand)

Leakage in Pipeline : 15 % Process water for treatment process : 10 %

e. Design Capacity

i. Intake, Aqueduct, Water Treatment Plant

Design Capacity = Maximum Day Demand + Leakage in Pipeline + Process water for treatment process

ii. Treated water Distribution

Design Capacity = Peak Hourly Demand

According to the above condition, the design demand are calculated as follows:

i. Design Capacity for Intake, Water Treatment Plant = 97,609 m3/day

÷100,000 m3/day

ii. Design Capacity for Treated (in total) = 4,818 m3/hr

Detailed calculation for Maximum Daily Demand, Peak Hourly Demand, Design Capacity are summarized in Table 2.1(2)-WS

(c) Draw-off water supply for irrigation and planting

Based on the planting schedule in median and pedestrian of the road, green belt and utility zones, the water demand for irrigation and planting purpose is calculated 3,200 m3/day. Equalizing this estimated demand, the design supply capacity of draw-off water is determined at 3,200 m3/day.

(d) Other Design Conditions

Temperature	: Ave. 23 deg.C, Min. 9 deg.C, Max. 36 deg.C.
Humidity	: 50 %
Rainfall	: Ave. 24 mm/yr, Max. 50mm/24 hrs
Evaporation	: 8 mm/day (=300 mm/yr)

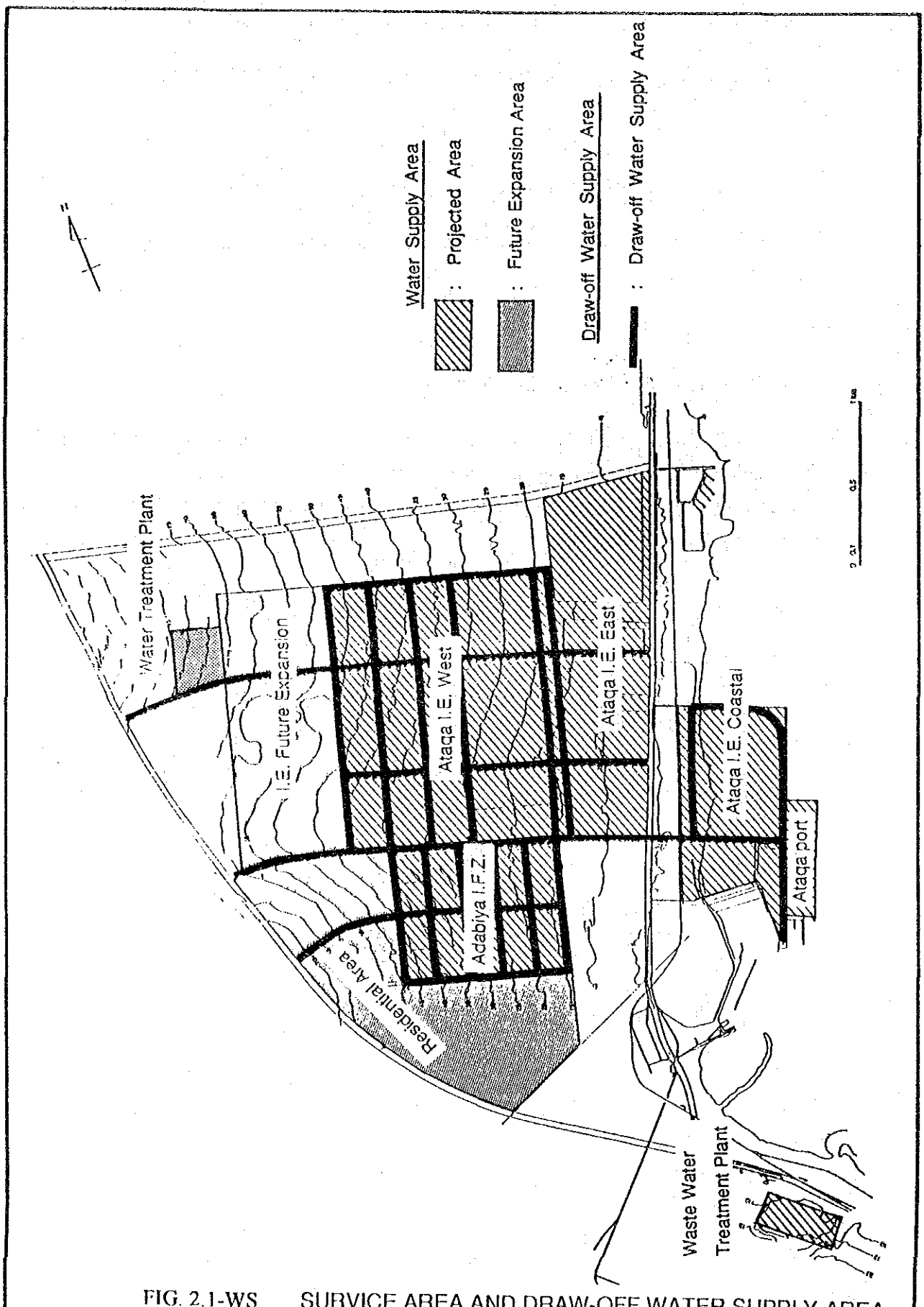
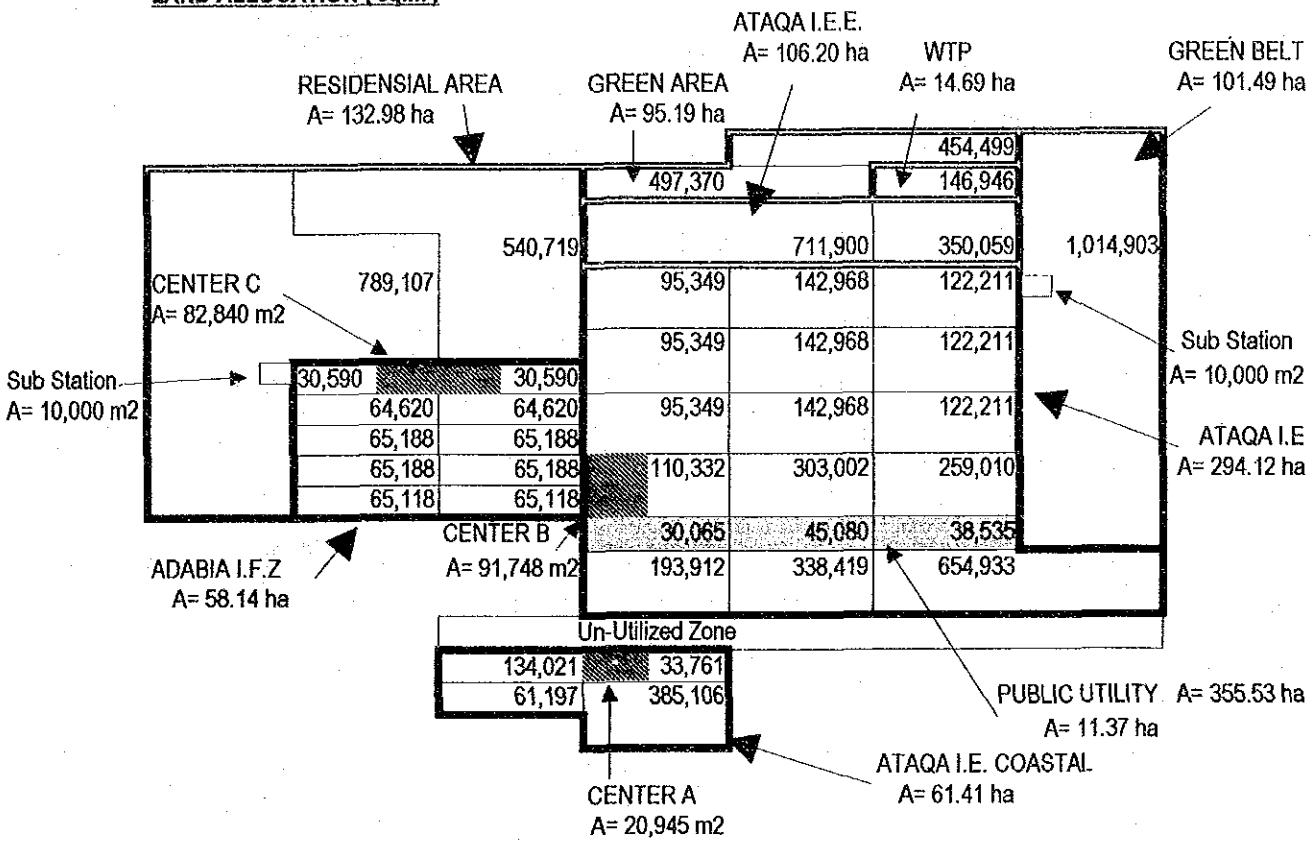


FIG. 2.1-WS SURVICE AREA AND DRAW-OFF WATER SUPPLY AREA

TABLE 2.1 (1) Design Water Demand

LAND ALLOCATION (sq.m)



WATER CONSUMPTION AND DEMAND

a. Water Consumption (Average Day Demand)

Category	Quantities (unit)	Unit Demand cu.m / unit / day	Consumption cu.m / day
(Domestic Use)			
Residential Use	35,000 capita	0.190	6,650
Commercial and Public Use			
Center A	110 capita	0.285	31
Center B	253 capita	0.285	72
Center C	225 capita	0.285	64
Grain Terminal	155 capita	0.285	44
W.W.T.P	1 lot		400
Sum. of Domestic Use			7,262
(Industrial Use)			
Ataqa I.E.	294 ha	107	31,471
Ataqa I.E.C.	61 ha	107	6,571
Ataqa I.E.E.	106 ha	107	11,363
Adabiya I.F.Z.	58 ha	107	6,221
Ataqa Port	1 lot		1,580
Sum. of Industrial Use			57,205
Total of Average Day Consumption			**64,467**

TABLE 2.1 (2) Design Water Demand

b. Maximum Day Demand

Category	Ave. Day Cons. cu.m / day	Ave. / Max.	Max. Day Demand cu.m / day
(Domestic Use)			
Residential Use	6,650	1.30	8,645
Commercial and Public Use			
Center A	31	1.30	41
Center B	72	1.30	94
Center C	64	1.30	83
Grain Terminal	44	1.30	57
W.W.T.P	400	1.30	520
Sum. of Domestic Use			9,440
(Industrial Use)			
Ataqa I.E.	31,471	1.20	37,765
Ataqa I.E.C.	6,571	1.20	7,885
Ataqa I.E.E.	11,363	1.20	13,636
Adabiya I.F.Z.	6,221	1.20	7,465
Ataqa Port	1,580	1.20	1,896
Sum. of Industrial Use			68,647
Total of Maximum Day Demand			78,087

c. Peak Hour Demand

Category	Ave. Day Demand cu.m / day	Peak Factor	Peak Day Demand cu.m / hour
(Domestic Use)			
Residential Use	6,650	2.00	554
Commercial and Public Use			
Center A	31	2.00	3
Center B	72	2.00	6
Center C	64	2.00	5
Grain Terminal	44	2.00	4
W.W.T.P	400	2.00	33
Sum. of Domestic Use			605
(Industrial Use)			
Ataqa I.E.	31,471	2.00	2,623
Ataqa I.E.C.	6,571	2.00	548
Ataqa I.E.E.	11,363	2.00	947
Adabiya I.F.Z.	6,221	2.00	518
Ataqa Port	1,580	2.00	132
Sum. of Industrial Use			4,767
Total of Peak Hour Demand			5,372

d. Maximum Day Demand by Areas

Order	(Area)	Domestic Use	Industrial Use	Leakage	Process W.	**Total**	**Accum.**
1	Ataqa I.E.	94	37,765	5,679	3,786	**47,323**	47,323
2	W.W.T.P (1)	260		39	26	**325**	47,648
3	Adabiya I.F.Z.	83	7,465	1,132	755	**9,436**	57,084
4	W.W.T.P (2)	260		39	26	**325**	57,409
5	Ataqa Port	98	1,896	299	199	**2,493**	59,902
6	Ataqa I.E.C.		7,885	1,183	788	**9,856**	69,758
7	Residential Area	8,645		1,297	865	**10,806**	80,564
8	Ataqa I.E.E.		13,636	2,045	1,364	**17,044**	97,609
Total		**9,440**	**68,647**	**11,713**	**7,809**	**97,609**	

3.7.3 RAW WATER

(1) Water Source

The water source of the project is the Suez Sweetwater Canal which is originated from the Nile river. The canal is almost running abreast of the Suez Canal and extend to Suez city through several flow control gates. The end of the canal is closed by weir at 3.8 km far from Suez Bay.

(2) Water Quality of Suez Sweetwater Canal

The design raw water quality is decided as presented in Table 3.1-WS, which is compiled with the water quality record of the SCA WTP (May '92) and JICA team's laboratory test data (May '92), . The sampling point of SCA data is at the intake point of SCA water treatment plant, and the sampling point of JICA team's data is at 3km downstream from proposed intake point.).

The major characteristics of the raw water quality are described below:

Total Dissolved Solid (TDS)

The laboratory test results of raw water shows relatively high TDS value (733 mg/l). As the post maximum, TDS of 900 mg/l was recorded in the SCA. Since the limit of TDS in Egyptian standard for treated water is 1,500 mg/l, the water of the Suez Sweetwater Canal is accepted to use for potable water.

Major elements of this TDS are assumed to be constitutions of Total Hardness and dissolved Chloride compounds. Miner elements remained are supposed to be other materials like Silica (SiO_2), Sodium (Na^+), Sulfate (SO_4^-), Potassium (K^+), etc. However, heavy metal or toxic matter such as mercury, arsenic, cyanide are not detected in the raw water.

Chloride ion

The chloride ion value of 172 mg/l is well below the Egyptian potable water standard of 600 mg/l.

Ammonia Nitrogen and Nitrate Nitrogen

Ammonia and Nitrate Nitrogen pollution is usually due to various human and animal (livestock) activities of washing and bathing in the canal. The laboratory test results of the water of Suez sweetwater canal shows low concentration of Ammonium-N (0.1 mg/l : JICA team's data, nil : SCA data). This value can be resolved by the pre-Chlorination of the treatment system. The results of the break-point Chlorination test (by JICA team, 4 May, '92) is shown in FIG. 3.2-WS.

Agricultural Chemical (Insecticide, Pesticide, Weedicide)

It was observed in the field study that agricultural water including chemicals mostly penetrated to ground and did not return to the Canal, because of arid area. Accordingly the agricultural chemicals were not detected in the raw water in the laboratory tests. However, increase in agricultural chemicals use in future, may occur chemical pollution of the Suez sweetwater canal. A suitable monitoring system to control agricultural pollution is recommended.

Turbidity

Turbidity of Raw Water is indicated at 15 NTU. It is exceeding the treated water quality 5 NTU. According to Jar Test results of Raw Water (by JICA Team at Suez Canal University, 2 May '92), it is understood that an adequate dosing of Aluminum Sulfate can reduce Turbidity of raw water (see FIG. 3.3-WS).

(3) Flow Quantity of Suez Sweetwater Canal

Ismilia Canal

The Ismilia canal and Suez sweetwater canal are administrated by Ministry of Public Works and Water Resources. The flow capacity of Ismilia canal is reported between 8,500,000 to 11,000,000 m3/day. The Ismilia canal diverges to the Suez sweetwater canal and the Portsaid canal in the Ismilia city. Remaining water is consumed in the Ismilia city.[1]

1 Suez Water Facilities Master Plan, Volume 2, Technical Report, P7-2, June 1979, Pirnie-Harris International associated with Eng.Marshai Morsi A.Morsi and Dr. Hassan Ismail

Suez Sweetwater Canal

The discharge from the Ismilia canal to the Suez sweetwater canal is estimated at 2,600,000 m3/day[2].

Water allocation of the Suez sweetwater canal is shown in Table 3.2. At the scheduled intake point, the flow quantities is estimeted at rate of 400,000 m3/day[3] with about 0.3 m/s of flow. In Table 3.2, 100,000 m3/day of the unidentified water of 209,600 m3/day will be allocated to this project.

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2 Calculation : 2 gate (W2.5m x H2.0m) x 3 m/sec=2,600,000 m3/day

3 Calculation : W16m x H1m x 0.3m/sec = 406,000 m3/day

TABLE 3.1-WS Design Raw Water Quality

Items	Unit	Design Max.	Design Min.
Color	degree	3	2
Turbidity	NTU	18	15
Total Hardness as CaCO3	mg/l	224	-
Total Dissolved Solid	mg/l	733 (900) *	-
Total Alkalinity	mg/l	174	-
Ammonium-N	mg/l	0.2	0.1
Nitrate	mg/l	0.05	nil
pH		8.27	8
Cyanide	mg/l	trace	nil
Mercury	mg/l	trace	nil
Arsenic	mg/l	trace	nil
Iron	mg/l	nil	nil
Manganese	mg/l	nil	nil
Potassium	mg/l	59	-
Magnesium	mg/l	21	-
Chloride	mg/l	500	172
Phenol	mg/l	nil	nil
Calcium	mg/l	160	-

* Total Dissolved Solid : 773 mg/l is data of May 2 1992. 900 mg/l is the past maximum value in the record of SCA/NOPWASD.

TABLE 3.2-WS Present Allocation of Water in Suez Sweetwater Canal (as of May '92) between Proposed Intake Point to End of the Canal

Items	Source Canal	Water Consumption (m3/day) as Max. Day Demand
1. Inflow from Ismilia Canal (*1)		400,000
2. Specified Discharge		
• SCA WTP (*2)	Suez Sweetwater Canal	160,000
• Fertilizer Factory (*3)	Maghrabi Canal	15,000
• Suez Oil petroleum Co. (*3)	Maghrabi Canal	3,400
• Suez thermal Power P (*3)	Maghrabi Canal	6,000
• Al Nasr Petroleum Co. (*3)	Maghrabi Canal	6,000
Sum of Specified Discharge		190,400
3. Unidentified		
Sum of Unidentified		209,600

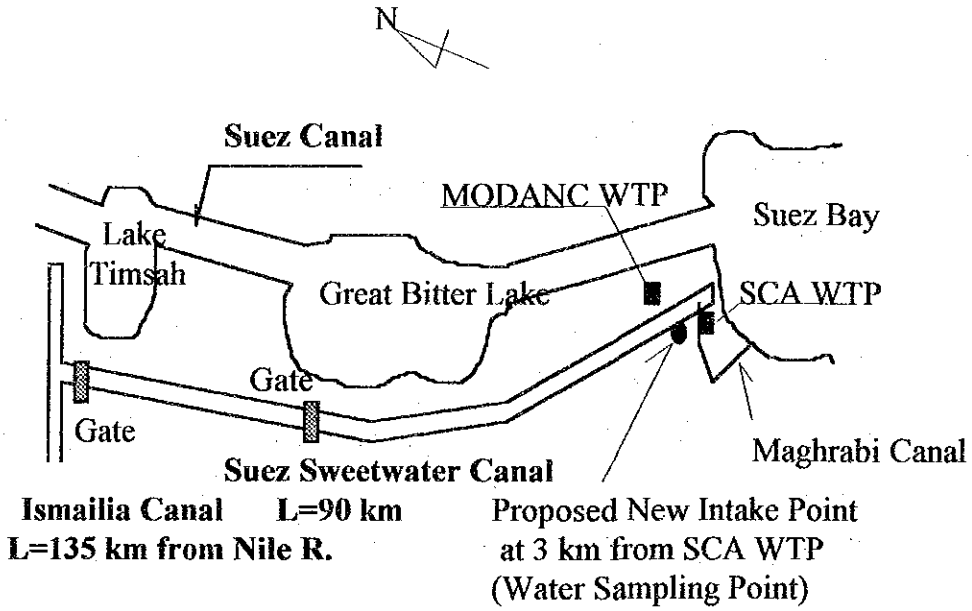
(*1) Field Investigation Results, refer to footnote 1

(*2) SCA data in 1991

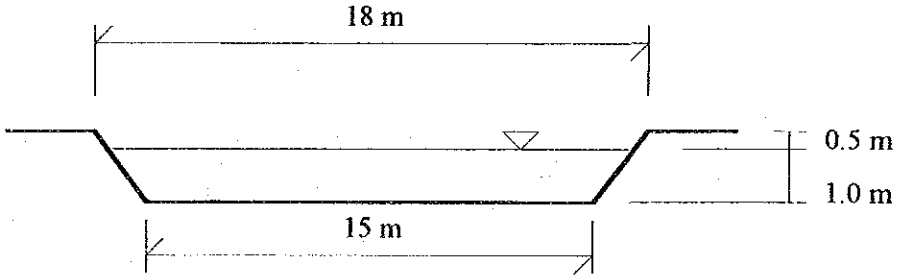
(*3) after "Suez Water Facilities Master Plan, Vol.2 Technical Report, MODANC, Pirnie-Harris International, June 1976

FIG. 3.1-WS SUEZ SWEETWATER CANAL

(Sketch 1) Suez Canal and Suez Sweetwater Canal



(Sketch 2) Cross Section of Suez Sweetwater Canal at Intake Point



note : Dimension of section is approximate.
Detailed dimension will be surveyed by JICA study team.

FIG. 3.2-WS CHLORINATION TEST

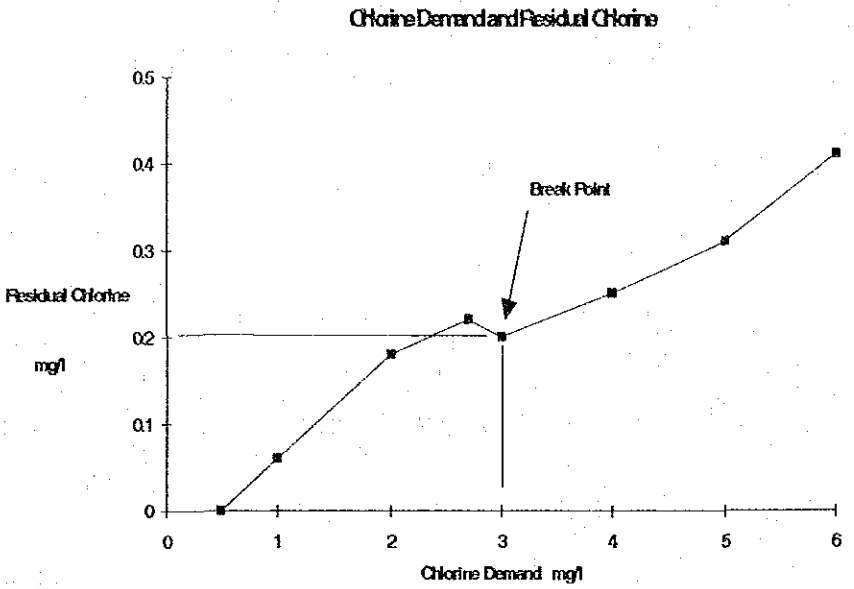


FIG. 3.3-WS JAR TEST