SECTION 6 - SUB-SECTION B

ELECTRIC SUPPLY SYSTEM DESIGN PRINCIPLES AND GUIDELINES

CONTENTS

1. Operational Requirement

1.1 The electric supply system of the building shall enable operation of all systems in a continuous, dependable and uninterrupted manner.

1.2 The planner will take into account the absolute dependence of the infrastructures and operational systems as well as of persons on the electric supply system

1.3 Important Points

1.3.1 All works will be implemented according to the updated Chapter 08 of MOD General Specification for Construction Works, latest Edition and according to the requirements specified in this chapter, including all applicable standards listed herein.

1.3.2 The electric facility will be comprised of sea atmosphere resistant systems and equipment (salt, corrosion, hot atmosphere, high humidity etc.).

1.3.3 Once installations are completed, the Contractor at his expense will call in the Electricity Board, Bezeq, SII and all other relevant organizations to carry out inspections of the various facilities.

1.3.4 Upon end of work, and before connecting electric power, the Contractor will call for electrical engineer's inspection. The examining engineer shall be endorsed by the inspector before his visit.

1.3.5 The electric system shall meet the new applicable Standard requirements at the time of work implementation.

2. Basic Assumptions

2.1 The facility shall be planned for a service life of at least 20 years.

2.2 Energy Saving: The systems shall be designed for maximum energy saving without affecting the performance of the various installations.

3. Electricity Supply System Design Principles

3.1 Redundancy

The electricity supply system shall be designed for high level of redundancy in terms of both the supply sources and the conduction paths. This feature will ensure the system has a high level of continuity in providing uninterrupted service in spite of various faults (for example, faults in the main board, distribution boards, zone boards, power outage, etc.), offering at least one guaranteed alternative for uninterrupted system operation (UPS / Option for connecting a mobile generator).

3.2 Reliability

The system shall be designed for high reliability (in terms of the selection of equipment, main breakers, etc.), taking into account the conditions of the workplace environment (dust, humidity, etc.).

In reference to site location and status of power supply the contractor shall incorporate all required means (stabilizer, etc.) in order to assure stable supply of the required power and to prevent equipment failures as result of power fluctuations.

3.3 Backup

The system shall comprise components intended to provide an alternative to the various assemblies in order of importance (for example, main electric board, zone board, etc.).

3.4 Maintenance

The system shall be designed to ensure that maintenance work on the system or on any of its parts shall not affect the service provided by the system or impair the efficiency of operation of the whole facility.

3.5 Control

The system shall constitute a complex capable of exercising control over the performance of the systems and the mode of system operation.

Moreover, the system shall enable command over system components performing a safety function.

3.6 Independence

The electrical system of the installation shall be designed as an independent, standalone system.

3.7 Flexibility

The distribution network shall be designed in accordance with the office room modularity principles so as to allow modifications in the layout of equipment in the building without having to make alterations in the network.

3.8 Reserve

Allowance shall be made for a spare space in each branch (circuit breaker, socket, feed box, etc.) of the network in quantitative terms.

3.9 Energy Saving

Energy saving shall be planned - but not at the expense of efficient operation.

4. Feed Sources

4.1 The main feed source shall be the transformer station connected to the national electric grid and located near site perimeter and operated by IAA. The power station shall include provision for 30% spare capacity for future applications.

4.2 The installation shall include an option for installation of a diesel generator for full backup of the whole installation, as backup for the electric grid or whole site electric network (radiography site as well as offices buildings).

4.3 Special base for the future generator will be planned and implemented. When considering a location for this future generator, attention shall be given to the generator noise, smoke/fumes emissions and wind direction.

4.4 The power station location, as part of the site's buildings or as part of the energy center near the main building, shall be determined during the detailed planning stage.

5. High Voltage System and Power Station Implementation Principles

5.1 The feed shall be connected to the national grid or the land owner's electric network. High Voltage station and transformer, including high voltage boards will be installed by the land owner. The Contractor shall perform all the coordination, planning and implementation work in order to connect to the high voltage station.

5.2 Switching between the main feed (land owners) and the future optional generator/s shall be planned and implemented by the Contractor by means of an automatic commutation system.

5.3 The commutation system shall be synchronized using the silent synchronization method in order to prevent interruptions during intentional commutation and tests.

5.4 The systems shall be built to enable a permit to be obtained immediately for use on completion of the construction work, regardless of their primary load feed.

5.5 The power switchboards shall be designed for supplying the energy necessary for the whole installation plus 30%.

6. Power Station

6.1 General

The power station shall consist of a number of subsystems as follows:

a. Main boards
b. Automatic commuting systems - Electrical Corporation / generator
c. Consumer distribution system

6.2 General Description

6.2.1 Infrastructure for Generator System

6.2.1.1 The Contractor shall plan and construct the entire required infrastructure for future implementation of a generator system.

6.2.1.2 The future diesel generator output power will be at least identical to the transformer station.

6.2.1.3 The station shall be provided with generator space in accordance with the stipulations above.

6.2.2 Installation Guidelines

6.2.2.1 The switchboards will not be located adjacent to rooms populated by site workers or visitors (this in order to minimize exposure to EM radiation).

6.2.3 Power Station Implementation Essentials

6.2.3.1 All boards shall be physically separated; however, it shall be ascertained that in the event of breakdown there shall be no damage to one system as a result of side effects such as fire, smoke, soot, etc.

6.2.3.2 In order to prevent fires from spreading among board parts, physical separation by means of partitions will be installed between components that do not have to be interconnected.

6.2.3.3 Dummy loads shall be installed, regardless of the actual initial load but rather according to the future and/or emergency load.

6.2.3.4 The means of connection of bus bars or cables to the boards or generator/s shall ensure resistance to vibrations and shall require minimal maintenance.

6.2.3.5 Cables and bus bars shall be laid in separate conduits in order to prevent simultaneous damage in case of a fault in the conduit itself.

6.2.3.6 During the division of boards into fireproof fields, measures shall be taken to ensure ventilation and heat dissipation in every separate field.

6.2.3.7 Every system shall have a conduit for the entry and exit of cables/bus bars, separately from all other systems.

6.2.3.8 All cables situated in the vicinity of motors or doors protected from radiation etc. will be shielded to prevent interference.

7. Power Backup Systems (UPS)

7.1 The power backup supply systems shall serve as the main feed source for all computerized systems: computers, WS and other equipment sensitive to interferences in the power supply, or for equipment that requires an uninterrupted power supply for operational reasons.

7.2 The UPS system shall be provided by a reputable firm, which has already supplied such systems in Israel. The firm shall have the approval of the Customer.

7.3 The power backup systems are based on a fixed feed from the grid or from a generator so that the battery bank serves as source of energy for backup during switching between feed sources.

7.4 In case of a prolonged power outage the battery bank shall be capable of providing backup for critical elements under full load in order to allow the equipment to be switched off as required. If during the detailed design stage it becomes apparent that the output power does not cover the critical components, the Contractor will be obligated to adequately increase the output power, including reserve, as required in the SOW.

7.5 The systems shall be combined with a Hot Tie type system (on-line) that allows backup in real time in case of outage or breakdown of the system.

Maximum recommended load of the power backup system shall be about 80%.

7.6 Projected Growth

In addition to the consumption analysis UPS shall supply the entire installation, a 30% spare capacity shall be planned for future additions of control and computer equipment.

7.7 Points of Emphasis

7.7.1 The power backup system may be bypassed by the silent MCB (maintenance circuit breaker) method to permit maintenance and partial fault elimination without putting the installation out of service.

7.7.2 System batteries will be dry, sealed type and will allow 15 minutes of full load backup for each of the UPS systems.

7.8 Emergency Fire Pushbutton

An emergency fire pushbutton will be installed outside the building. The pushbutton will be mounted in glass top box complete with hammer. Pushing the button will cut off UPS voltage to consumers.

7.8 UPS Powered Equipment

The UPS system shall power the following equipment:

a. Site Workstations sockets
b. Radiography system
c. Radiography system computers
d. Control systems
e. Cabinet feeds: telephone, communication, control, fire detection and suppression etc.
f. Dedicated equipment per Customer’s request (TBD at the PDR)

8. Working Voltage

8.1 The working voltage of the installation (the nominal standard for consumer connection in the State of Israel) will be as follows:

- 230 VAC
- within ± 10%
- 400 VAC.

8.2 The nominal frequency shall be 50 Hz, +0.5% / -0.6%.

9. Lighting System Design Data and Guidelines

9.1 The following guidelines apply to the planning of lighting.

9.1.1 Operation of the site (including radiographic installation and offices) should be planned to be continuous, 24 hours a day all year long.

9.1.2 The work of Image Operators, comprising of watching screens with minute details to be distinguished, is continuous and difficult and may involve stress and fatigue situations.

9.1.3 The intensity of lighting shall be consistent with visual exertion and in accordance with the principles of ergonomics as regards vision, according to last IS standard.

9.1.4 Proper measures shall be applied to prevent direct glare and dazzling from light sources and luminaries. In addition, reflections from bright surfaces on the screens shall be minimized to prevent dazzling.

9.1.5 Sparks and echoes causing electromagnetic interferences will be prevented.

9.1.6 The color of light sources shall be adjusted to the color system in the building, the floor, walls, furniture, etc. to create a pleasant effect.

9.1.7 There is a requirement for particular accuracy in color distinction in certain defined areas.

9.1.8 The direction of lighting shall ensure that the required light intensity is delivered not only to horizontal surfaces but also to sloped and vertical ones (boards, maps, etc.).

9.1.9 The lighting solutions provided shall include maintenance of the system with only minimal interference with the operations performed.

9.1.10 The lighting system shall allow full flexibility to accommodate changes in the position of equipment and workstations, and it shall be designed in accordance with the requirement for modularity (in the office buildings).

9.1.11 Contractor will propose at PDR for customer approval installing dimmers in various zones as necessary.

9.1.12 The lighting conditions in the passages, starting from the entrance from outside and continuing to the workrooms, shall be gradated. This gradation is necessitated by the adaptation of the eyes from the outdoors light intensity, which attains 150,000 lux in full sunlight, to the intensity of lighting in the inspection rooms and in the opposite direction on leaving the building.

9.1.13 Lighting in the working rooms, computer rooms and In the offices and ordinary working rooms shall be at an intensity of about 600 lux at the height of the horizontal working surface. In the corridors, the intensity of lighting shall be about 300 lux. In the electricity rooms and machinery rooms it shall be 300-400 lux.

9.1.14 The planning of lighting shall be based on fluorescent lamps with electronic chokes.

9.1.15 The waterproof fluorescent lamps shall be encased in polycarbonate and sealed to IP 65.

9.1.16 Emergency lighting shall be installed in all rooms, as well as in the corridors and at the openings, in the buildings and in the systems rooms, for orientation and guidance to escape openings.

9.1.17 The emergency lighting shall be LED type with local batteries for 1 hour, with automatic and manual operation.

9.1.18 The lighting shall be operated in a selective manner and shall be equally connected among the three phases to prevent stroboscopic effects.

9.1.19 The planning shall include whole site lighting as well as peripheral lighting on both sides of the fence along the perimeter of the installation.

9.2 Lighting System Planning Stress Points

9.2.1 Energy saving considerations shall be taken into account as follows in designing the lighting system:

9.2.1.1 Use of W28/W54 fluorescent lamps.

9.2.1.2 Use of metal halide or high-pressure sodium lamps.

9.3 Battery Room Lighting

9.3.1 The lighting shall be fluorescent, 600 lux, encased in polycarbonate sealed to IP65.

9.3.2 The lighting switches shall be mounted outside the battery rooms.

9.3.3 The lighting switches of the battery room shall be mounted outside the room.

9.4 Lighting System Operation Description

9.4.1 The system shall allow flexibility in determining the light switching setup in such a manner that requires no rewiring or infrastructure changes.

9.4.2 Lighting switches:

a. Switches for the toilets and washrooms shall be mounted outside any wet area.

b. In the corridors and other areas accessible from more than one side, switches and/or pushbuttons shall be installed at several places, at least two.

c. In closed areas such as the parking area, the lighting shall be switched on by means of a photoelectric cell installed outside the building.

10. Grounding

10.1 The installation and buildings shall be grounded by means of foundation grounding conforming to the Israeli standard, with suitable calibration of the system.

10.2 The grounding shall be implemented at the foundations of the building.

10.3 Grounding Bus

10.3.1 Grounding bus shall be mounted in a box in the electricity rooms of the building.

10.3.2 The grounding bus shall be made of copper with the following minimum dimensions: thickness 4 mm, width 40 mm.

10.3.3 The bus shall be provided with a protective cover.

10.3.4 The following items shall be connected to the grounding bus:

a. Foundation grounding electrode
b. Electric Corporation main grounding conductor
c. Main electric board grounding conductors
d. Generator grounding conductors
e. Metallic water pipes
f. Metallic drain pipes
g. Compressed air piping
h. Dedicated grounding (electronic)
i. Any metallic facilities of the building

10.4 Installation/Building Lightning Protection

Lighting protection shall comply with the Israeli requirements and standards.

All cable entrances/exits from the building shall be protected from voltage surges caused by lightning.

10.5 Grounding Junctions

10.5.1 Grounding junctions shall be installed at the various assemblies by means of 35 x 4 x 550 mm copper bars and bearing eight 3/8” bolts with wing nuts.

10.5.2 The equipment and data communication rooms shall be provided with copper bars around the room, forming an open ring, with wing nuts at 1 m intervals.

10.5.3 There shall be grounding junctions in Communication cabinets, as well as at every communication/ bridge board.

10.5.4 The grounding shall be installed at a height of 20 cm from the floor.

10.5.5 The grounding shall be implemented as specified in this document.

10.5.6 Bridging ladders shall be connected to the grounding.

10.6 Copper strips measuring 35 x 4 mm with equipment connection points every 3 m shall be installed underneath the raised floor along the floor. Every connection point shall be equipped with cadmium-plated bolts and nuts, size 3/8”, with wing nuts.

10.7 The above copper strip shall be connected to the building grounding bus and shall have a resistance of 0.5 - 2 ohm to the ground.

11. UPS and Battery Room

11.1 The UPS and battery room for the backup power supply (UPS) shall be designed as follows:

11.1.1 The room shall be designed and calculated so as to provide space for the UPS and battery cabinet according to the required layout of the backup power supply.

11.1.2 All preparations for the arrangement of batteries and feed lines for the power backup system, including the preparations of conduits, shall be made in advance and in coordination, according to the criteria of the backup power supply manufacturers.

11.1.3 The floor load shall be approximately 1,500 kg/m^2

11.1.4 Air evacuation and replacement in the battery cabinet shall be made according to the requirements for the equipment. The battery cabinet shall be provided with air intake and exhaust openings. The openings will be ducted to the building outside.

11.1.5 The entrance door shall be sheet metal plated on both sides.

11.1.6 Shelving compatible with the battery weights shall be provided.

12. Design Environmental Conditions

The environmental conditions are the same as those indicated for the entire installation.

13. Points of Importance

13.1 The main / zone boards shall be built in a modular manner.

13.1.1 The main board shall have a separate field for general essential loads:

a. Supply to firefighting pumps
b. Supply for orientation lighting in the staircases
c. Supply to the security and safety systems and fire detection systems.
d. Supply to dedicated equipment.

13.1.2 There shall be a possibility of disconnecting all the loads of the building.

13.1.3 All circuit breakers on the board shall be provided with thermal and magnetic protection. There shall be a capability for adjusting the protection values.

13.1.4 The board shall be provided with 3 ammeters, a voltmeter with selector, pilot lamps, missing phase relay, and phase inversion.

13.1.5 A set of bays shall be arranged for surge and transient protection.

13.1.6 All main breakers shall be equipped with 1-NO+1-NC auxiliary contacts wired to the terminal strip.

13.1.7 A system for improving the output factor shall be prepared in a separate compartment, with capacitors, contacts, protections, and a controller for the output multiplier. A signal showing the output multiplier shall be connected to the output multiplier gage on the board.

13.1.8 The main breaker of the board shall be provided with a red-painted handle, with a device for locking in the OFF position.

13.1.9 The board shall be equipped with a digital multimeter.

13.2 The zone and local boards shall be designed without panels using automatic breakers behind transparent covers. Non-modular automatic breakers shall be operated behind a door. Main breakers shall protrude out of the door.

13.2.1 Secondary boards shall be fed by means of feed lines from the main board. They shall feed the zone / local power and lighting circuits, including the corridor lighting, the public address system, and the communication.

13.2.2 The board shall be made of a metal structure subdivided into fields according to the load. The boards shall be fed also from the central UPS system.

13.2.3 The breakers for 3 x 63 A current or higher shall have thermal and magnetic protection. There shall be a capability for adjusting the protection value.

13.2.4 The other circuits shall be protected by means of miniature automatic breakers with “B” or “C” characteristics, depending on the destination.

13.2.5 All socket circuits (except sockets of the UPS system) shall be protected by means of 30 mA leakage current breakers.

13.3 Dismantling of the front panel shall be done without removing or disconnecting the automatic and other circuit breakers.

13.4 The boards shall be built as follows:

13.4.1 Automatic and other circuit breakers shall be exposed and mounted at the head of the board.

13.4.2 Sockets shall be installed at the bottom of the board and shall be protected by means of a door.

13.4.3 Clamps shall be mounted at the bottom of the board and covered with a door.

13.4.4 At the center of the board there shall be a conduit allowing the passage of cables underneath the raised floor.

13.5 The various boards (air conditioning, electricity, control, etc.) shall be built in a uniform pattern.

13.6 The maximum voltage gradient of DC lines from the batteries to the connection boxes shall not exceed 1.0 V.

13.7 All automatic breakers shall terminate in clips.

13.8 The conduits shall be of the self-extinguishing type. The following color code for conduits shall be applied:

a.	Electrical systems	Green
b.	Fire detection	Red
c.	Telephone	Blue
d.	PA and intercom systems	White
e.	Building control	Grey
f.	Computers, data transmission	Brown
g.	Security	Yellow

In addition, the conduits shall be provided with signs indicating their category, the board number, and the circuit number.

13.9 Circuit breakers, miniature automatic breakers, leakage breakers, fuses, control equipment, receptacles, breakers, etc., shall be top quality. The types and models shall be agreed upon definitively with the client during the detailed planning.

13.10 The electrical installation shall be built mostly underneath the plaster or within plaster partitions inside conduits, according to the above color code. The cables and conduits shall be laid above the false ceiling in screen ducts or on trays of appropriate dimensions according to their destination. For systems requiring secured wiring, the cables shall be placed in sheet metal ducts.

13.11 The installations shall be exposed in the technical areas or in other areas to be specifically defined.

13.12 The passage of cables and conduits between floors and between fire protection wings of the same floor shall be sealed with an appropriate sealant for preventing the penetration of fire and smoke, such as Flamastic or equivalent. The sealing work shall be done by a Contractor specializing in such jobs.

13.13 Secured cables shall be shielded and shall be laid in steel conduits or galvanized sheet metal ducts, which shall be separate and at least 2.0 mm thick. From these ducts the cables shall extend in plastic conduits.

13.14 The cable ducts and shielding shall be connected to a separate protected grounding system. The duct conduits shall be marked by plywood signs according to the standard.

13.15 The galvanized sheet metal ducts will serve for the data transmission, telephone, and UPS cables. The cross sectional area of the sheet metal ducts shall correspond to double the quantity of wiring they actually carry (i.e. leaving a 100% reserve for future applications).

13.16 The numbers and distribution of sockets in the rooms shall be planned to provide maximum flexibility in the room layout allowing future changes in the function of the room, including an increase in the numbers of persons working in it.

13.17 Each workstation will be equipped with at least six sockets fed from the main and two sockets fed from UPS system. The UPS fed sockets will have red covers. Electrical sockets will be installed in an integral modular box.

13.18 Electrical sockets shall be separate from communication and telephone sockets.

13.19 Sockets in open offices and public areas shall be installed with spring covers.

13.20 The walls shall be provided with sockets for A/C Fan and Coil units in coordination with the air conditioning consultant. The circuit for these units shall be separate.

13.21 Every socket, circuit breaker and other accessory shall be provided with a sign indicating the board name and circuit number, using a plywood sign.

13.22 The installation shall be concealed underneath the plaster or inside industrialized partitions in all zones except the machinery rooms etc.

13.23 The division of circuits shall be in accordance with Electricity Regulations #4731- Final Circuits.

13.24 Every room shall be provided with at least one socket fed from a UPS circuit.

13.25 Sockets for UPS fed circuits shall be of a type different from the ordinary sockets in order to prevent the possibility of connecting nonessential equipment to them.

13.26 In the corridors and passages, sockets shall be installed for copiers, information stations, automatic vending machines etc. in accordance with a detailed functional planning.

13.27 The exact location of sockets in office rooms and other rooms (coordinates and levels in the deployment drawings) shall be determined in accordance with the detailed functional layout and internal architecture plan.

13.28 A secondary electrical panel shall be installed in the communication room, to feed the telephone board and the communication racks.

14. Markings and Signs

14.1 All markings shall be made in Hebrew.

14.2 All feed lines shall be marked according to the Israeli Standard.

14.3 All automatic and other circuit breakers and terminals shall be marked.

14.4 The various electrical boards shall be finished in a color that allows the identification of the board and its power supply.

14.5 The distribution boards and main electric board shall be marked with graphic signs indicating the flow of energy from the main circuit breakers to the distribution boards etc.

14.6 The method and form of marking shall be uniform in all electric boards in the building and shall be subject to approval by the Client / Supervisor.