IOM HEADQUARTER LEBANON

Lightning , Earthing and surge arresters systems

SITE : El-Jnah, Lebanon
STATUS REPORT

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POLARIS
AUTOMATION SYSTEMS SARL

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1.1 STATUS SUMMARY

1.1.A - EARTHING SYSTEM

Regarding the earthing system, below are the existing earth items and distribution:

1. 35mm² stranded copper cable installed at the electrical room, connected to a white clamp.

   The stranded cable is connected to the existing earth system at the outer garden area

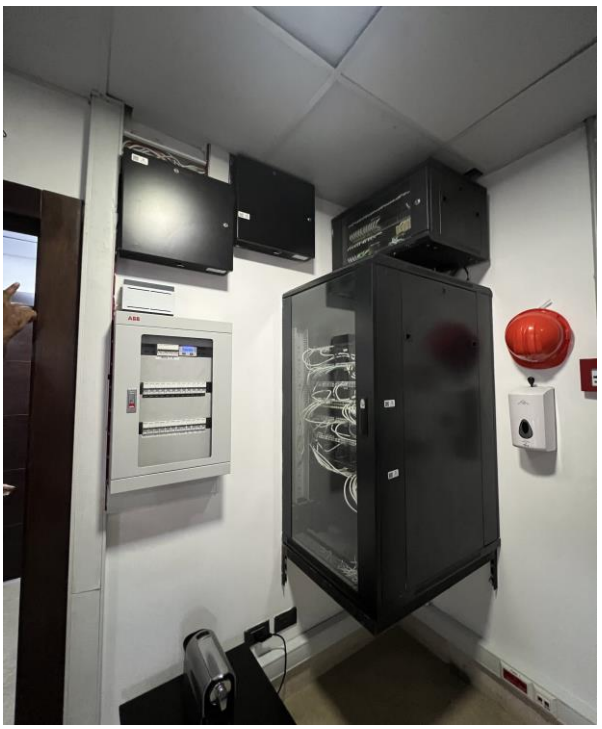
   (as informed by client personnel)

2. Two Green/ Yellow cables of different sections (10 and 8mm²) are connected to the white clamp.
   These two Green / Yellow cables are running inside along the cable trays.
   The opposite ends and connections of these cables are still unknown at that stage.

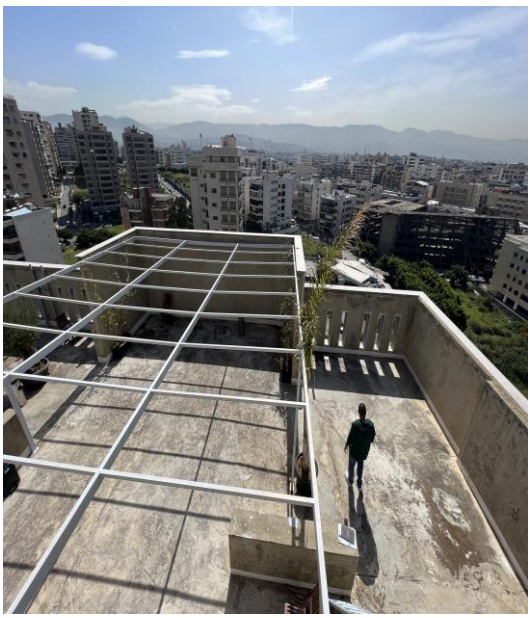
3. There are also two Green / Yellow cables of different sections (10 and 8mm²) at the UPS room connected only to the UPS

4. There are multiple Green / Yellow cables at the server room but no Main busbar is located at the premises.

5. All the data cabinets at each floor have no connection to adequate earth terminals

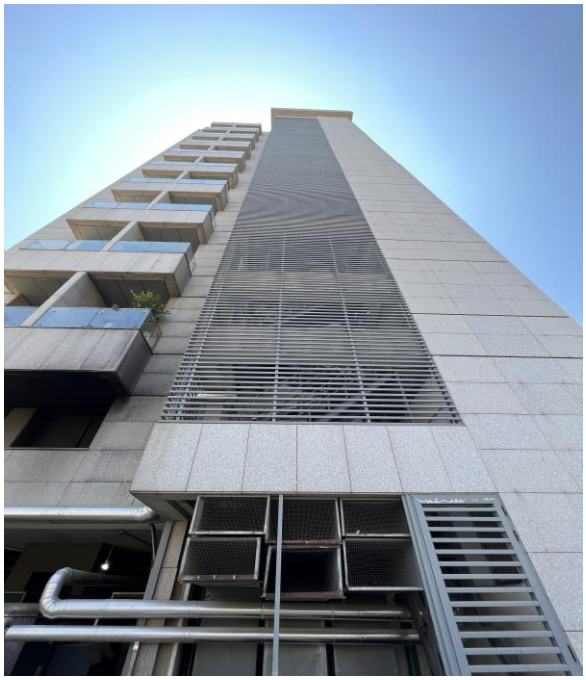


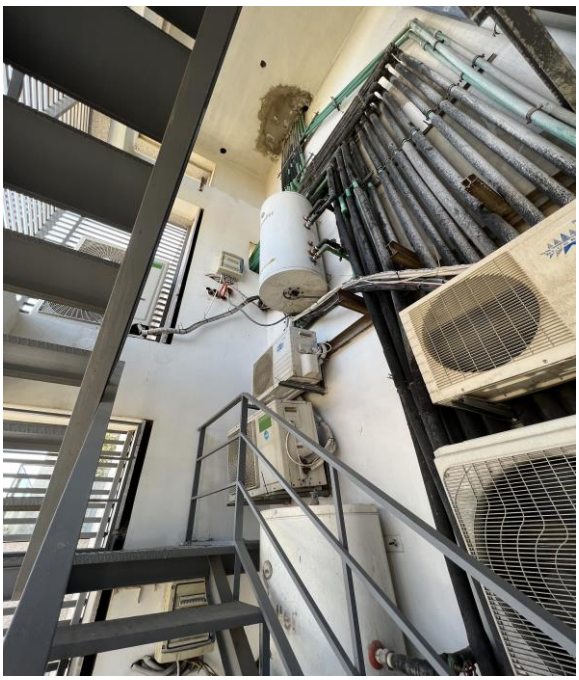
6. All the metallic structures at roof top have no connection to adequate earth terminals



7. All The generators have no connection to adequate earth terminals

8. Exit stairs, metallic façade structures and all the electrical equipments have no connection to adequate earth terminals



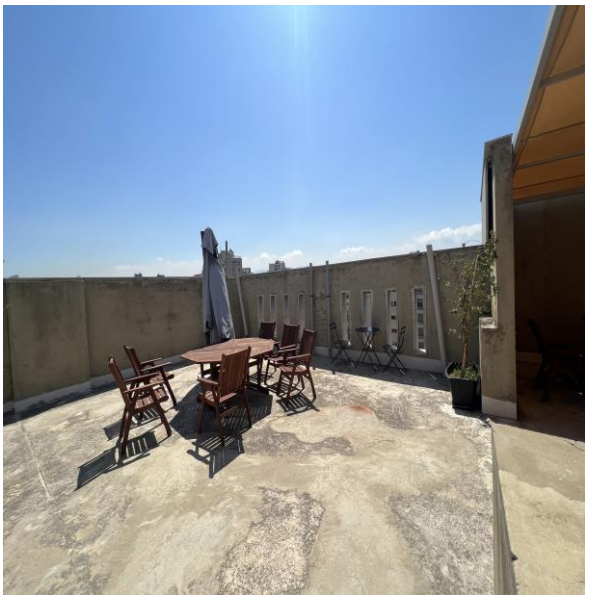


1.1.B – LIGHTNING PROTECTION SYSTEM

There is no lightning protection system installed at roof top level, thus presenting no protection from direct lightning strike hazard.

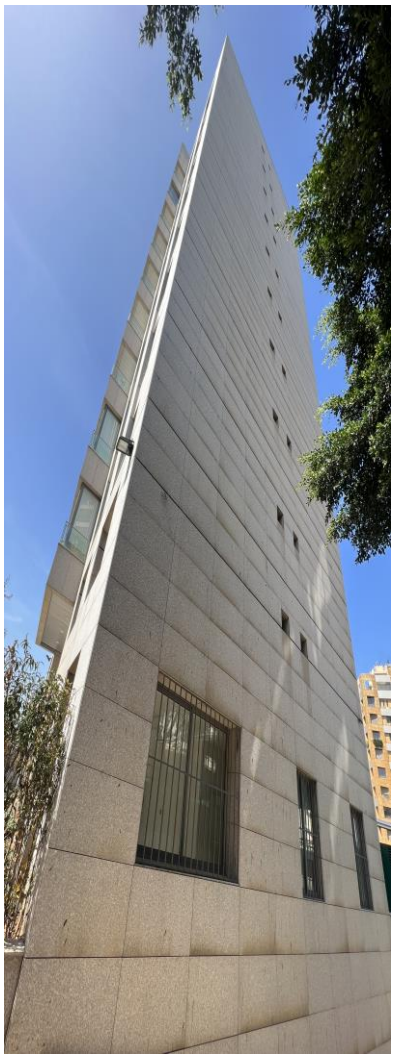
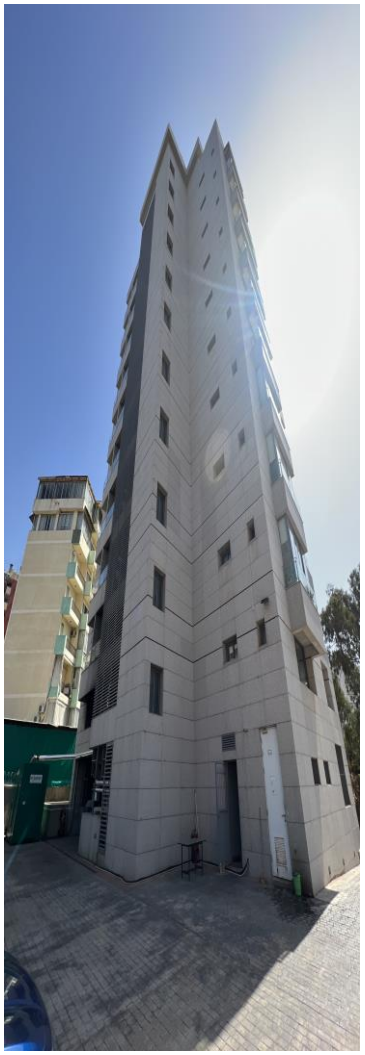
Below are the present status pictures of roof top:

1. No Early streamer is installed, hence no protection for the premises or roof top items from direct strike.



2. No down conductors over any façade is present at this stage in order to connect the lightning early streamer to adequate earth.

3. No separate lightning earth is installed for ESE discharge.


1.1.C – SURGE ARRESTER SYSTEM

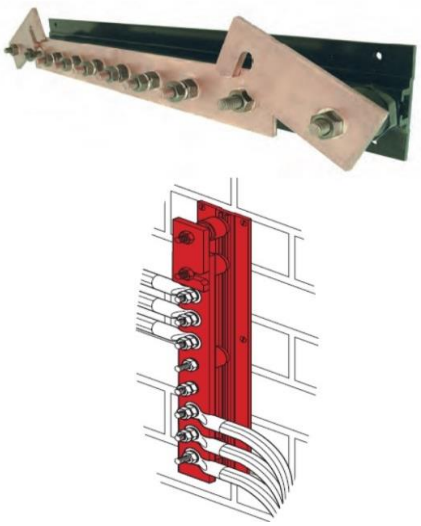
No surge arrester protections are installed at any level of the existing electrical equipment.

Meaning that power lines, data lines, Data cabinets, UPS inputs, Servers, MDBs and SDBs are all under no protection from indirect surge occurrence.

2- WORKS TO BE EXECUTED

2.1.A - EARTHING SYSTEM

1. The installed white connector clamp should be replaced by adequate multiway disconnecting link at the electrical room.



2. The existing electrical earth should be upgraded by adding four new rods at the outer garden area, then connect both new and existing earth via a disconnecting link inside the external manhole.
   (earth cables sections and rods details will be decided at a later stage)

3. As per our test using KYORITSU Earth Tester, the Soil Resistivity of the above garden is 74 OHMS; therefore, enhancement is required in order to obtain a value of less than 10 OHMS.
(Please check Paragraph 6.1 in NFC 17 102 for the required earth resistivity)

If earth location proves signs of saturation and cannot attain the needed value, earth plates and mixture enhancer should be applied.

6 Earth termination systems

6.1 General

All earthing system for a same structure should be interconnected

One earth termination will be provided for each downcoductor based on at least on two electrodes per earth termination.

Due to the impulsional nature of lightning current and in order to enhance the current draining to earth thus minimizing the risk of dangerous surges inside the protected volume, it is important to consider the shape and dimensions of the earth termination system as well as the value of its resistance.

A certain contact surface with the soil shall be assured in order to facilitate the lightning current dispersion in a short time.

Earth termination systems should meet the following requirements:

- the resistance value measured using a conventional equipment should be the lowest possible (less than 10 Ω). This resistance should be measured on the earthing termination insulated from any other conductive component.

- earth termination systems having a single excessively long horizontal or vertical component (> 20 m) should be avoided in order to minimise the inductive voltage drop.

The use of a single vertical termination system deeply buried to reach a humid layer of soil is thus not advantageous unless the surface resistivity is particularly high and there a high conductivity layer far below.

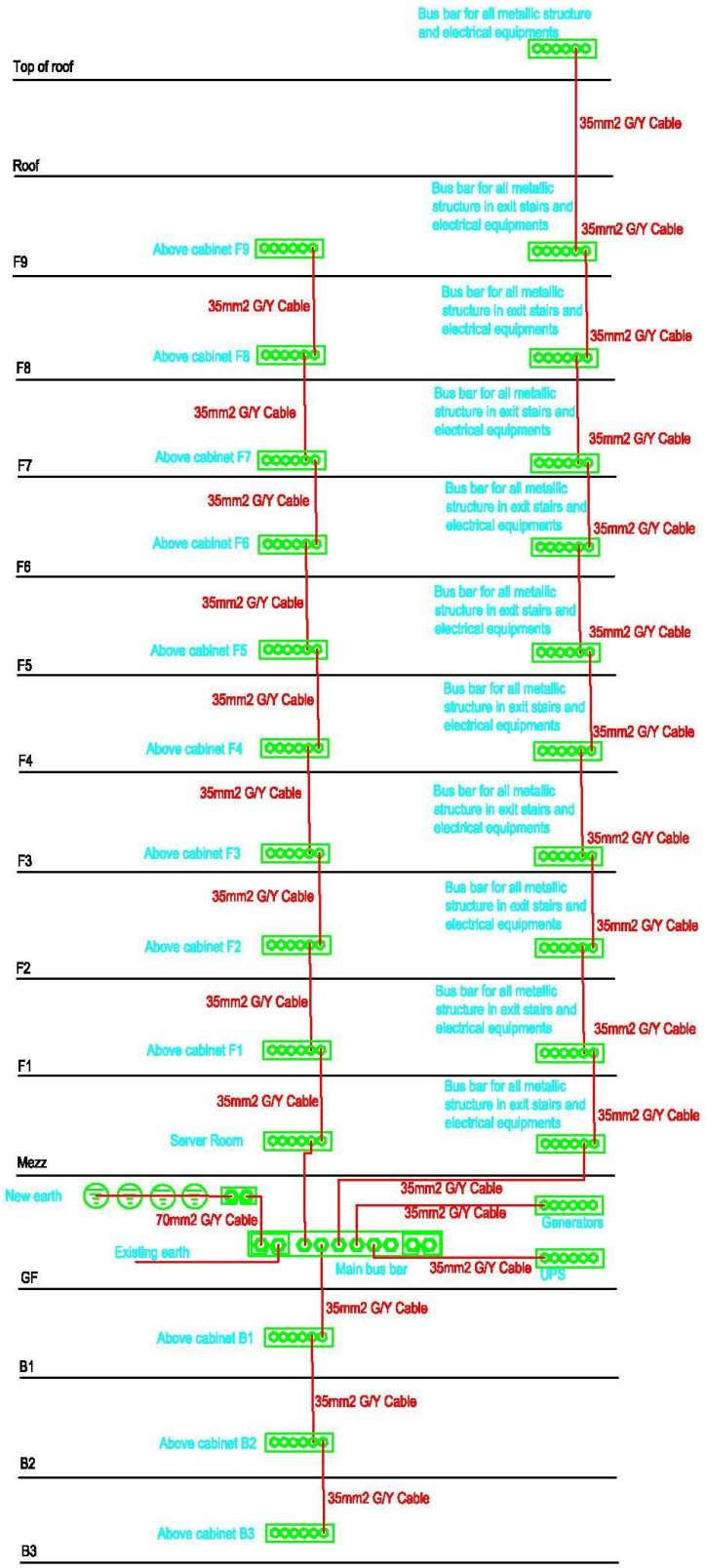
However it should be noted that such drilled earth termination systems have a high wave impedance when the depth exceeds 20 m. Then a greater number of horizontal conductors or vertical rods should be used, always perfectly electrically interconnected.
Earth termination systems should be made and laid out as stated above.

4. The existing 35mm² cable connecting the existing and new earth systems inside the manhole should be replaced by 70mm² stranded copper cable.

5. Multiway busbars should be installed at each of the below locations, in order to ensure the proper connection terminals for all electrical items.

- Server room
- UPS room
- Generator room
- Cabinets in each floor
- Exit stairs in each floor
- Top of roof

6. Below the descriptive schematic drawing of these locations:


Bus bar for all metallic structure and electrical equipments
Top of roof
35mm2 G/Y Cable
Roof
Bus bar for all metallic structure in exit stairs and electrical equipments
35mm2 G/Y Cable
Above cabinet F9
F9
35mm2 G/Y Cable
Bus bar for all metallic structure in exit stairs and electrical equipments
35mm2 G/Y Cable
Above cabinet F8
F8
35mm2 G/Y Cable
Bus bar for all metallic structure in exit stairs and electrical equipments
35mm2 G/Y Cable
Above cabinet F7
F7
35mm2 G/Y Cable
Bus bar for all metallic structure in exit stairs and electrical equipments
35mm2 G/Y Cable
Above cabinet F6
F6
35mm2 G/Y Cable
Bus bar for all metallic structure in exit stairs and electrical equipments
35mm2 G/Y Cable
Above cabinet F5
F5
35mm2 G/Y Cable
Bus bar for all metallic structure in exit stairs and electrical equipments
35mm2 G/Y Cable
Above cabinet F4
F4
35mm2 G/Y Cable
Bus bar for all metallic structure in exit stairs and electrical equipments
35mm2 G/Y Cable
Above cabinet F3
F3
35mm2 G/Y Cable
Bus bar for all metallic structure in exit stairs and electrical equipments
35mm2 G/Y Cable
Above cabinet F2
F2
35mm2 G/Y Cable
Bus bar for all metallic structure in exit stairs and electrical equipments
35mm2 G/Y Cable
Above cabinet F1
F1
35mm2 G/Y Cable
Bus bar for all metallic structure in exit stairs and electrical equipments
35mm2 G/Y Cable
Server Room
Mezz
New earth
35mm2 G/Y Cable
35mm2 G/Y Cable
Generators
70mm2 G/Y Cable
Existing earth
Main bus bar
35mm2 G/Y Cable
UPS
GF
35mm2 G/Y Cable
Above cabinet B1
B1
35mm2 G/Y Cable
Above cabinet B2
B2
35mm2 G/Y Cable
Above cabinet B3
B3

2.1.B – LIGHTNING PROTECTION SYSTEM

The Lightning Protection system should be installed as per the French norm NFC 17 102.

1. As per paragraph 5.3, two down conductors should be installed.

In our case, there is only one possible option to install them parallel with a distance higher than 2 meters as illustrated with the below descriptive drawings.

5.3 Down-conductors

5.3.1 General principles.

The function of the down-conductors is to conduct lightning current from the air terminal to the earth termination system. They will be placed preferrably at the external part of the structure.

Each of the down-conductors will be fixed to the ESEAT by means of a connection system placed at the mast. The latter will comprise a mechanical adaptation element that will assure a permanent electrical contact.

When the down-conductor is placed on a wall made of combustible material, and not being a copper one, then at least one of the following conditions should be satisfied in order to avoid any dangerous temperature rise:

- the separation is at least 0,10 m;
- the conductor section is at least 100mm².

To be considered as 2 independent downconductors, they should not run in parallel (parallel means that there is a distance along a straight line higher than 2 m between downconductors). To take care of any practical problem that may be encountered, a tolerance of 5% of the total length of the shorter downconductor can run along the same path.

Descriptive drawing for down conductors

2. As per Paragraph 5.3.3, The routing should be straight as direct as possible and the fixation should be each 33cm and we should install test link and guard tubes at least 2m above the ground

5.3.3 Routing

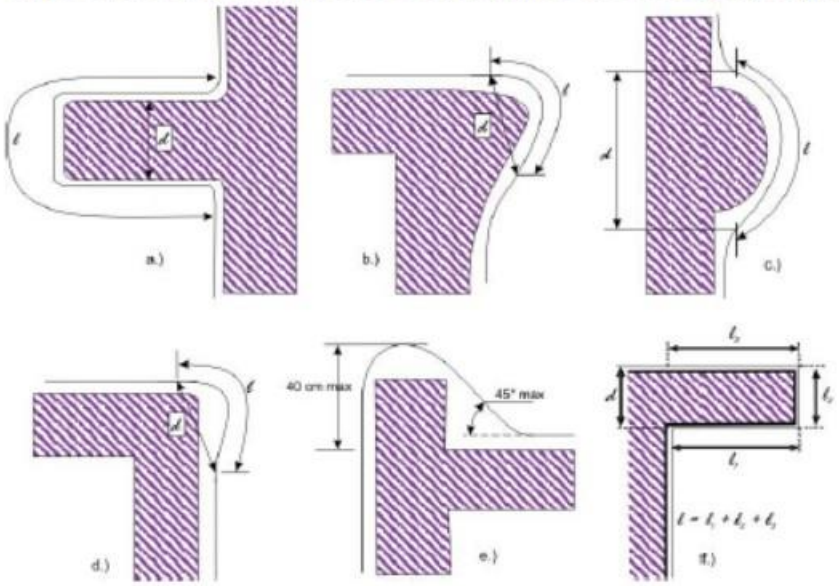
The downconductor should be installed in such a way that its path is as direct as possible. The routing of the down-conductor should be as straight as possible, following the shortest path, avoiding sharp bends or upward sections. The bend radii should not be less than 20 cm (see figure 4). For down-conductors, bends formed edgewise should preferably be used.

The down-conductors should not be routed along or across electrical conduits.

Routing round parapet walls or cornices or more generally obstacles should be avoided. Provisions should be made to ensure that down-conductor paths are as direct as possible. However, maximum height of 40cm is permissible for passing over an obstacle with a slope of 45° or less (see figure 4 case e).

Alternatively, the calculation of the separation distance, according to 5.6 with $l = l_1 + l_2 + l_3$ depending on case f below-cited, allows to determine the minimal bend radius.

In figure 4, case d, the condition $d > l/20$ is always fulfilled since $d = l/\sqrt{2}$ for any length l.



l: length of the loop, in meters
d: width of the loop, in meters
The risk of any dielectric breakdown is avoided if the condition $d > l/20$ is fulfilled.

Figure 4 – Down-conductor bend shapes

The distance between downconductors and possible interconnecting ring conductors are correlated with the separation distance.

The fixings of the down-conductors should be attached on the basis of three fixings per meter (every 33 cm). These fixings should be suitable for the supports and their installation should not alter the roof water-tightness. The fixings should allow for possible thermal expansion of the conductors. Systematic drilling through the downconductor in order to attach it to the support is forbidden.

All the conductors should be connected together with clamps of the same nature, using rivets, soldering or brazing.

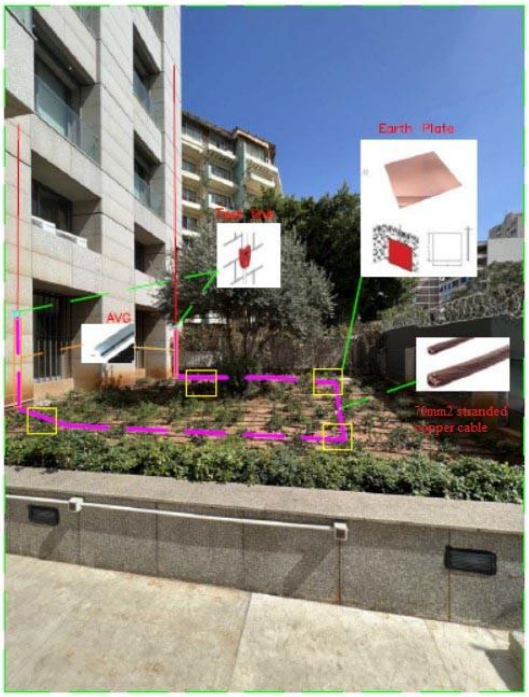
Down-conductors should be protected against the risk of mechanical impact with guard tubes up to a height of at least 2m above the ground level.

NOTE: To avoid touch voltage, see Annex D.

3. One lightning counter should be installed at one of the two conductors.

4. Earthing system should be independent from electrical earth, and preferably embedded using earth plates and mixture enhancer for preservation of humidity.

   Indicated with the below picture with natural soil mixed with Bentonite or Terrafill mixtures and the location of the electrical earth at the second outer garden location.



5. The top of the ESE (Early streamer) should be installed at least 2 m over the protected area, including aerials, refrigerating towers, roofs, tanks, etc.

   Meaning that the tip of the ESE is at least 2 meters higher than any tip, object or equipment located at roof top

5.2.5 Installation

The top of the ESEAT shall be installed at least 2 m over the area that it protects, including aerials, refrigerating towers, roofs, tanks, etc.

When designing the ESESystem, it is recommended to take into account the architectural spots that are adequate to place an ESEAT. These locations are high structural points like:

- rooms on the terraces;
- ridge;
- masonry or metallic chimneys.

6. The location of the mast should be as per the below picture and the mast elevation should be minimum 10m

7. Concrete base and mast design should withstand natural elements, and high resistance to corrosion and harsh weather conditions.

2.1.C – SURGE ARRESTER SYSTEM

The Surge arresters devices have one role to protect the electrical devices form the indirect strikes.

The works can be divided into two phases:

Phase 1:

Protection of the following:

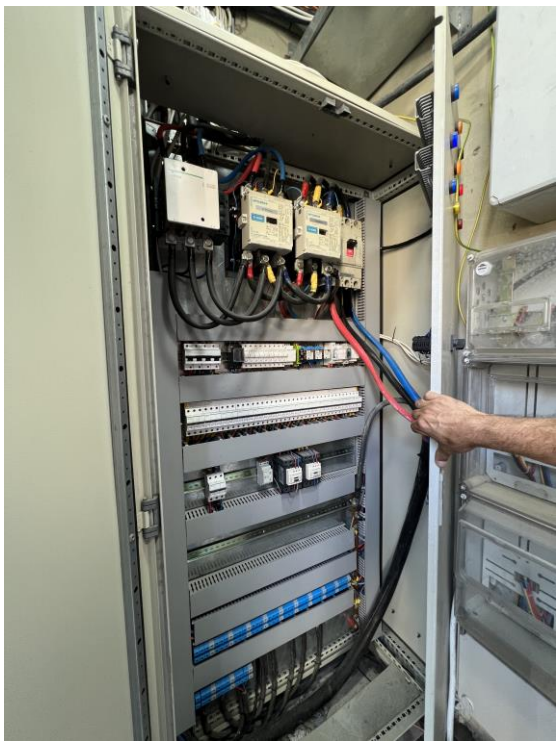
1. Main MDB (Main distribution panel) in the electrical room (we should put surge arrester 3 phases B+C to the common output after the ATS)

2. EDL lines (one surge arrester 3 phases B+C to the main fuses).

3. Generators Lines (Four surge arresters 3 phases B+C: one inside each generator and one for the common generator cable connected at the electrical room).

4. Two Microwave links at the top of roof should be protected with Class D surge arrester.

5. Telephone lines should be protected with Class D surge arrester



Phase 2:

Protection of the following:

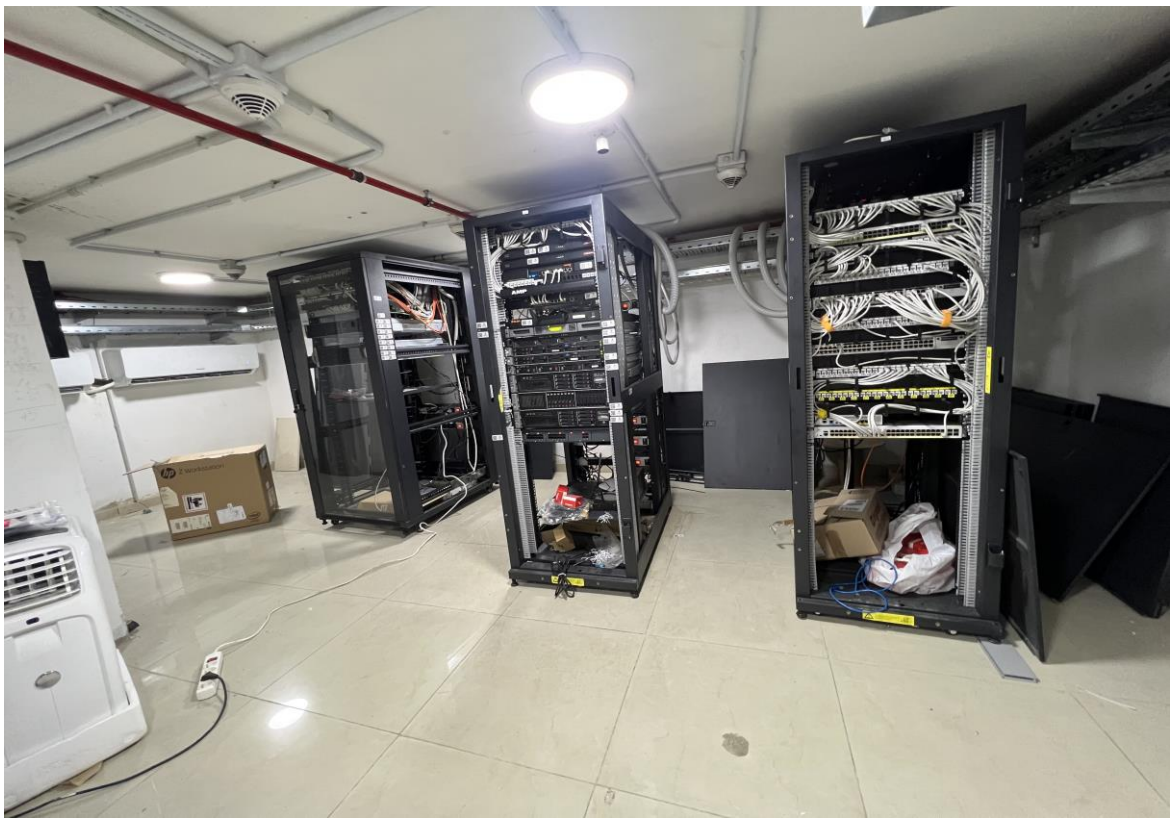
1. SDB (Secondary distribution panel from 1st floor to 9th floor (One surge arrester 3 phases B+C to the main breaker at each floor)

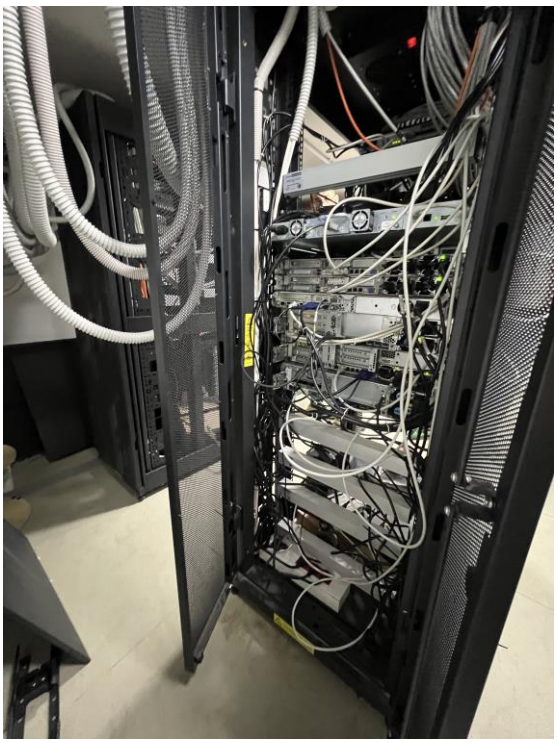
2. UPS panel from 1st floor to 9th floor (One surge arrester 3 phases C for the main breaker at each floor)

3. Cabinet including two switches from 1st floor to 9th floor (One surge arrester multiple socket class D at each floor)

4. UPS Room (Two surge arresters 3 phases B+C for the Input and output of the UPS)

5. Server Room (One surge arrester 3 phases B+C for the SDB with 9 multiple sockets surge arrester class D)





6. Basement 1 (Two surge arresters 3 phases B+C for the SDB with 3 multiple sockets surge arrester class D)

7. Basement 2 (Two surge arresters 3 phases B+C for the SDB with 1 multiple sockets surge arrester class D)