Project #.....

**GROUNDING FOR ELECTRICAL INSTALLATIONS AND GROUNDING FOR LIGHTNING PROTECTION**.

**Grounding system for electrical installations.**

- According to Rules for arrangement of electrical installations item 1.7.70 it is recommended to use buried metal pipe lines of utilities (except for combustible liquids and gases) and metal and RC structures of buildings which have physical contact with earth as natural grounding system.

**Grounding protection from direct lightning strokes.**

- ➔ According to Instruction of arrangement of Lightning protection of buildings and facilities RD 34.21.122-87 Annex 2 Bautino region related to the territory with 20 hours of annual average duration of lightning storms that is appropriated to specific density of lightning strokes to ground 1 / $km^2$*year.
- ➔ According to table1 of abovementioned RD (table1 describes requirements to lightning protection according to annual average duration of lightning storms, fire resistance of the building structure and category of industrial buildings process fire danger) require to arrange lightning protection for Paint/Blast building (process fire danger V) and to propane and diesel tanks only.
- ➔ Other buildings and structures do not need grounding for lightning protection because of very small specific density of lightning strokes to the ground (1 / $km^2$*year), safe category of industrial buildings process fire danger and medium dimensions of the buildings (within 20-50m high and 100x100m for length and width).
- According to Instruction of arrangement of Lightning protection of buildings and facilities RD 34.21.122-87 item 2.26 require to use in all possible cases (refer to above mentioned item 1.7.70) metal and RC structures of buildings as grounding protection from direct lightning strokes.
- According to Instruction of arrangement of Lightning protection of buildings and facilities RD 34.21.122-87 item 2.11 Metal roofs of the buildings should be used as lightning stroke discharger.

**Combination of grounding of electrical installations and grounding protection from direct lightning strokes**.

- According to Instruction of arrangement of Lightning protection of buildings and facilities RD 34.21.122-87 item 2.26 in all possible cases (refer to above mentioned item 1.7.70) require to incorporate grounding conductor of protection from direct lightning strokes with grounding conductor of electrical installations.

**Requirement to the building structure.**

According to GOST 12.1.030-81 (*Electrical safety. Grounding Protection, neutral grounding*) item 1.4. and item of 1.8. of RD 34.21.122-87 (*Instruction of arrangement of Lightning protection of buildings and facilities*):

- Metal and RC structures should get continuous electric circuit on metal (welded connection of rebar to embedded parts) in case of using them as natural grounding system. In RC structure require to install embedded parts for connection of electric and the process equipment.

**Assessment of possibility of usage of RC foundations of Industrial buildings as natural grounding conductor for electrical installations and grounding conductor for protection from direct lightning strokes**.

According to GOST 12.1.030-81 (Electrical safety. Grounding Protection, neutral grounding) Annex 2 require to check possibility of usage of RC foundation of Industrial buildings as natural grounding system for electrical installations according to following formulas:

In case of usage of RC foundations of industrial buildings as earth the impedance R in Ohm should be calculated according to formula:

$$R = 0{,}5\frac{\rho_э}{\sqrt{S}}, \quad (1)$$

- where S – area limited by perimeter of the building, m2 ;
- ρэ - equivalent resistivity of earth (ground) Ohm *m .

For calculation of ρэ in Ohm *m require to use formula:

$$\rho_э = \rho_1\left[1-\exp\left(-\alpha\frac{h_1}{\sqrt{S}}\right)\right]+\rho_2\left[1-\exp\left(-\beta\frac{\sqrt{S}}{h_1}\right)\right]; \quad (2)$$

- where ρ1 - resistivity of the top ground layer, Ohm *m;
- ρ2 - resistivity of the lower ground layer, Ohm *m;
- h1 – thickness of the top ground layer, m;
- α, β - dimensionless coefficients which depend from relation of resistivities of ground layers.

If $\rho_1 > \rho_2$, α = 3,6, β = 0,1;

If $\rho_1 < \rho_2$, α =1,1×102, β = 0,3×$10^{-2}$.

**Calculation of impedance R for Fab. shop building:**

According to Proekt of TS finishing layer of Site up to -25.0 where buildings will be constructed is hard chips, thickness of layer 0.25m, lower layer is quarry run up to -25.25, see water level -27.0.

So industrial buildings foundations will be erected on dry quarry run layer.

We can use approximate data for resistivity of dry quarry run ρ1 ≈1000 Ohm *m; and wet quarry run (below see level) ρ2 ≈200 Ohm *m;

h1 = 1.75m – top layer of the quarry run till see water level;

$\sqrt{S}$ = 77.42 m.

e ≈ 2.72

$\rho_1 > \rho_2$, α = 3,6, β = 0,1;

Then according to formula (2) we get equivalent resistivity of earth (ground):

ρэ = 1000*(1-$e^{-3.6*1.75/77.42}$)+200*(1-$e^{-0.1*77.42/1.75}$) ≈268 Ohm *m

Now according to formula (1) we get impedance of RC foundation, Ohm

R=0.5*268/77.42 ≈ 1.7 Ohm

For installations with solidly earthed [solidly grounded] neutral system with voltage up to 1 kV of the specified grounding at interface voltage 220V, 380v and 660V should be not more than accordingly 8, 4 and 2 Ohm.

**Resume:**

We got impedance R≈ 1.7 Ohm which is within of acceptable limit, therefore RC foundation of Fab. Shop (and other industrial buildings on the Site) can be used as natural grounding system for electrical installations.