

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.:157TEDG1500003-00	Page 1 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

Technical Specification For Earthing And Lightning

00	ISSUED FOR APPROVAL	M.KHAVARI	F.NIKNAM	A.MONFARED	1405/02/08
Rev.	DESCRIPTION	REVISED BY	CHECKED BY	APPROVED	APP DATE

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.: 157TEDG1500003-00	Page 2 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

TABULATION REVISED PAGES									
SHEET	Rev.00	Rev.01	Rev.02	Rev.03	SHEET	Rev.00	Rev.01	Rev.02	Rev.03
01	X				51				
02	X				52				
03	X				53				
04	X				54				
05	X				55				
06	X				56				
07	X				57				
08	X				58				
09	X				59				
10	X				60				
11	X				61				
12	X				62				
13	X				63				
14	X				64				
15	X				65				
16	X				66				
17	X				67				
18	X				68				
19	X				69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

	GOLGOHAR STEEL PROJECT Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.:157TEDG1500003-00 Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	Page 3 of 20

Table of Content

1.0	GENERAL	4
1.1	SCOPE	4
1.2	CONDITION OF OPERATION	4
1.3	Plant Location	4
1.4	Meteorological	4
2.0	STANDARDS AND CODES	6
3.0	Document priority	7
4.0	Site Conditions	8
5.0	Voltage Levels	8
6.0	EARTHING TECHNICAL SPECIFICATION	9
6.1	Earthing Design Summary	9
6.2	Earthing characteristics.	9
6.3	Earthing System Installation	12
6.4	Earthing Material.....	12
7.0	LIGHTNING TECHNICAL SPECIFICATION	13
7.1	Lightning design summary	13
7.2	Buildings Constructed of Non-Conductor Materials	15
7.3	Building with Metal Structures and Walls	16
7.4	Stack Lightning Protection and Grounding.....	16
7.5	Lightning system calculation	17
8.0	TEST & INSPECTION.....	19

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.: 157TEDG1500003-00	Page 4 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

1.0 GENERAL

1.1 SCOPE

This specification provides minimum requirements for the design of primary earthing and lightning system, and all accessories required for proper operation and describes the material that is proposed to use for the connection and installation of all cables to devices for earthing in soil for Golgohar Co.

DOCUMENT PRIORITY

In the event of any conflict between this specification, the requisition, codes and standards, the priority shall be given in the following order.

- Purchase order
- This specification
- Codes and standards

1.2 CONDITION OF OPERATION

All of the Electrical Equipment & Systems will be suitable for 24 hours, 7 days/week, and 365 days/year operation.

Site Conditions

1.3 Plant Location

The Site is located at Gol-E-Gohar Iron Ore Complex, situated in Sirjan, Province of Kerman in southern part of Islamic Republic of IRAN, approximately 285 km southwest of Kerman city and 335 km north of Bandar Abbas port, in a semi-desertic high plateau terrain, 1750 m above sea level, and flanked by mountains over 2500 m high trending northwest to southwest.

1.4 Meteorological

Ambient Temperature

Max. Temperature:	+40 deg. C (Recorded)
	+50 deg. C (Design)
Min. temperature:	-12 deg. C (Recorded)
	-10 deg. C (Design)
Average temperature:	+15.9 deg. C (Design)
Wet bulb design temperature (summer):	+25 deg C
Relative Humidity:	Max. 70%

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.:157TEDG1500003-00	Page 5 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

Wind Velocity

According to National Iranian Code (6th revision):

Basic speed data: 130 Km/h

Basic pressure data: 0.845 KN/m²

Correction factor:

0 - 10 m: 2

10 - 20 m: 2.2

20 - 100 m: 2.4

Rainfall

Yearly 120 mm (average)

Monthly rainfall 260mm (Max)

Barometric Pressure

820 milliards

Geological Conditions

This data is belongs to the existing palletizing plant location. For the engineering the contractor shall be study geotechnical conditions for the essential location according to the project plan.

Altitude: About 1,750 m above mean sea level

Soil bearing: approx. 20t/m²

Ground water level: approx. 60 m below ground level

Earthquake Load

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.: 157TEDG1500003-00	Page 6 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

Equipment in plant will be dimensioned including a safety calculation against earthquake according to the “Iranian Code for Seismic Resistant Design of Buildings – Publication No. S253-2nd edition, autumn 1999” (“Iranian Regulations 2800”) and “Minimum

Design Loads for Building and Structures” (Iranian Regulations 519).

- Design base acceleration: 0.3·g
- Classification of Buildings: Group 2
- Soil classification: soil type III-b

2.0 STANDARDS AND CODES

The equipment covered by this Specification, including all components and auxiliaries, shall be designed, manufactured and tested in accordance with the latest IEC Standards wherever they may apply, and in particular:

- IEC 60621-1 to 4- Electrical installation for outdoor sites under heavy conditions
- IEC 62305 Protection against lightning
- IEC 61557-5 - Resistance of earth
- IEEE 142-2007 – Recommended Practice for Grounding of Industrial and Commercial Power Systems
- IEEE80-2013
- NFPA 780
- BS 7430: 2011+A1: 2015 Code of practice for protective earthing of electrical installations.
- UL 467 Grounding and Bonding Equipment
- IEC 60364-5-54:2011 Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors
- IEC 62561 Lightning protection system components
- IEC 60228 Conductors of insulated cables

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.:157TEDG1500003-00	Page 7 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

- IEEE 837 Qualifying Permanent Connections Used in Substation Grounding
- BS EN 13601 Copper and copper alloys. Copper rod, bar and wire for general electrical purposes
- BS EN 13602 Copper and copper alloys. Drawn, round copper wire for the manufacture of electrical conductors
- BS EN 1982 Copper and copper alloys. Ingots and castings
- All Codes and Standards referred to here and elsewhere herein, shall mean the latest edition of said Code or Standard, including all amendments, annexes, etc.
- Any deviations or conflicts shall require prior approval from purchaser.

3.0 Document priority

Conflicting Requirements:

In the event of conflict, actual or implied, among documents relating to an enquiry or order, following order of precedence shall govern, unless agreed in writing by CLIENT.

- a) This technical specification and Data Sheet.
- b) Codes and standards referred to in the above documents, generally, the most stringent requirement.

The Vendor shall notify the CLIENT of any apparent conflict between this specification, the Codes and Standards and any other specification noted herein. Resolution and/or interpretation of precedence shall be obtained from the CLIENT in writing before proceeding with the design / manufacture.

All correspondence, Drawings and submittals shall be in English.

In case of conflict between documents, the priority shall be the stringent condition mentioned in the following documents:

This Specification,

Drawings and other documents,

I.E.C. standards,

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.: 157TEDG1500003-00	Page 8 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

Other standard and codes when I.E.C. publications have not yet been issued.

4.0 Site Conditions

Plant Location:

The detail information about project area classification has mentioned in the meteorology document. Any deviation from the below ambient climatic conditions shall be clearly mentioned in the vendor/contractor proposal.

Plant location The Site is located in West Azerbaijan province of Iran, 25 Km far from Urmia city. The elevation of the Project area is approximately 1500 M above sea level.

Meteorological Condition:

Temperature

Max. ambient air temperature	Recorded 40°C
	Design 40°C

Min. ambient air temperature	Recorded -16°C
	Design -16°C

Rainfall	Annual rainfall Max. 580 mm
	Ave. monthly rainfall 136 mm

Other	Max relative humidity (%) 63%
-------	-------------------------------

Geological Conditions:

Buildings, equipment foundations & structures shall be designed to resist earthquake forces in accordance with "Iranian Code of Practice for Seismic Resistant Design of Buildings (Standard No.2800)" latest edition & based on soil investigation report.

Design base acceleration	A=0.25g
--------------------------	---------

5.0 Voltage Levels

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.:157TEDG1500003-00	Page 9 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

- o Low voltage 400 V, 3 phase
- o Voltage tolerances $\pm 5\%$
- o Motors space heaters ($\geq 200\text{kw}$) AC 690 or 400 V, 3 phase
- o Motors space heaters ($< 200\text{kW}$) AC 230 V, 1 phase
- o Small consumers 230 VAC
- o Heaters, Lighting, socket system, repair boxes 400 / 230 V AC
- o Protection relay supply, Control system, Spring Loading, Motor (Supply Signaling, Circuit Breaker, MV Cubicle, Incoming and Bus tie of MCC, PC 110 VDC
- o Outgoing Feeders of PCC 230 VAC

6.0 EARTHING TECHNICAL SPECIFICATION

6.1 Earthing Design Summary

The earthing network is composed of primary and secondary earthing system. Primary system will be composed of different type of earth electrodes such as horizontal buried bare copper earth conductor forming earth grid or earth mesh and some driven earth rod. Heavy metal structure, Tank, building steel structure.... will be connected to primary earthing.

Structural concrete building, shall be equipped with earthing system.

The general earthing resistance will be less than 2 ohms at any point in the plants.

Step and touch voltage and ground potential rise (G.P.R) concept also shall be considered according to IEEE80-2013. In such area earth grid may be changed to earth mesh. Transformer neutral shall be connected to primary earthing by earth rod conductor effectively. Secondary system will be composed of at least two riser branches from primary system up to ground level (in proper location and related to number of equipment) and earthing bus bar and finally copper wire connected to equipment.

The earthing system shall be so designed that sections can be isolated and earthing measurements taken for such sections after the completion of installation.

6.2 Earthing characteristics.

Primary earthing:

Earthing mesh:

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.: 157TEDG1500003-00	Page 10 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

The earthing conductor for the plants earthing network will be sized to carry maximum line to ground (L-G) fault currents for a time of 1 second and will be stranded copper annealed conductors with a minimum of 7 strands. The primary earthing conductor size will be 95 mm² minimum. Depth of buried conductors is among 50~100 cm below ground level.

Earthing rod:

The earthing rods shall be copper sleeved steel with a minimum of 16 mm diameter and 3-meter length. The primary earthing rods spacing will be 3 meters minimum.

Secondary earthing:

Where earthing conductor would be exposed the green/yellow PVC insulated earthing conductors suitable for a power frequency voltage to earth of 250 v (or conductor inside the plastic conduits shall be used).

All equipment frames and metal parts of indoor/outdoor apparatuses including main pipes, vessels crane tracks, Cable supports, etc. shall be earthed. It is sufficient to connect collective pipelines, main supporting system and tracks at interval of 20 meters.

The cross-section of earthing conductor shall be such as to safely carry the appropriate fault current for the necessary length of time.

Sensitive equipment using integrated circuits shall have their own earth system composed of insulated earthing rods connected to an independent ground mesh.

Equipment and structures shall be connected not less than 300mm above finished grade using bolted connectors. Connections to major outdoor equipment shall be looped to the main grid. Each structure column shall be grounded where required by placing earthing conductor on inside surface of structure legs on girder chord angles and supported neatly by bolt type connectors.

Metallic conduits shall be bonded at all mechanical joints and connected at intervals to main earth grid.

The marshaling plates will be connected to the main grid by two stranded copper wire with green/yellow PVC insulation, cross section 95 mm².

Insulated earthing conductor shall be used for connecting power transformer neutral point to the ground grid.

All secondary earthing system that will not run in the pipe or cable tray, must be shielded wire.

 شرکت توسعه آهن و فولاد گل گهر G.I.S.D.Co.	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.:157TEDG1500003-00	Page 11 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

The grounding connection between equipment metallic parts and the buried conductor described at point 3 will be made as follows:

Marshaling plates	2 x 1 x 70 mm ² Y/G copper / PVC
LV motors 23 kW to 55kW	1 x 35 mm ² Y/G copper / PVC
LV motors over 55 kW	2 x 1 x 70 mm ² Y/G copper / PVC
LV control station	1x 16 mm ² Y/G copper / PVC
Tanks	1x70mm ² or 2x1x 35 mm ² stranded bare copper conductor
Steel structures	1 x 70 mm ² stranded bare copper conductor
Pipe rack	1 x70 mm ² stranded bare copper conductor
Process pipe	1x 16 mm ² Y/G Copper / PVC
Ladder & stairways	1 x 35 mm ² Y/G copper / PVC
Lighting, outlet	phase cross section according table A
Conveyor	1 x 70 mm ² stranded bare copper conductor
- Metal fence	bare copper 16 mm ² wire
- Pipe (at extremity and every 20M)	bare copper 16 mm ² wire
- Metallic frame, doors, louvers, stairs	bare copper 16 mm ² wire
- Ladder, minor and secondary steel	
- Structures, metallic conduit	bare copper 16 mm ² wire
- Each cable ladder route must be earthed by a minimum of 35 mm ² earth cable and at a maximum of 15 m intervals.	
- Secondary earthing system will be connected to equipment, for the transformer and MV panel and power center, earth conductor shall be 120mm ² from two points.	

Phase Conductor Section S (mm ²)	Minimum Section of Earth Conductor Sp (mm ²)
---	---

 شرکت توسعه آهن و فولاد گل گهر G.I.S.D.Co.	GOLGOHAR STEEL PROJECT	 برسو مهندسی
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.: 157TEDG1500003-00 Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	Page 12 of 20

$S \leq 16$	$S_p = S$
$16 < S < 35$	16
$S \geq 35$	$S_p = S/2$

6.3 Earthing System Installation

- The steel structure of the plants will be made of steel columns which will be used also against atmospheric discharges by joining all elements via electrically welded connections.
- A number of lightning rods may be installed on concrete structure.
- Earthing ring around the building should be considered.
- Grounding conductor shall be connected to equipment by bolted connectors. Connector shall be copper or tinned copper were fitted to aluminum. Minimum contact area of the conductor to the connector shall be 10 cm².
- Earth conductors in the switchgear and relay room and plant area shall be run in cable tray where possible. Earth conductor shall be laid and clamped in the top power cable tray of each major cable tray run and other trays in the tier shall be bonded to this cable tray at every third section of cable tray, subsidiary tray runs shall be bonded between sections

6.4 Earthing Material

Copper Strip	Length X Width X Thickness (mm)
--------------	---------------------------------

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.:157TEDG1500003-00	Page 13 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

 This Copper Strip has to be holed according to requirements	(...) x 30 x 3
---	----------------

Stranded Copper Conductor, PVC Insulation (yellow/green), NYAF	Cross Section (mm ²)
	16
	25
	50
	95
	120
	150
	240
	300

Earth Bar	Length X Width X Thickness (mm)
Earth Bar Type "B"	300 X 50 X 6
Earthing Rod	Length X Diameter (mm)
Earthing Rod	1500 X 16

7.0 LIGHTNING TECHNICAL SPECIFICATION

7.1 Lightning design summary

Lightning protection system shall be connected to general earthing system as directly as possible and with the shortest possible lines.

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.: 157TEDG1500003-00	Page 14 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

Insulated cable or copper earth has supported on insulators shall be used for connecting lightning arresters to lightning arrester counters. It is not allowed to use the supporting metal structures or the machine enclosure conductors, but a 95 square millimeter shall be used as a minimum cross-section copper conductor and connected to the earthing system.

-It is necessary, that earth conductor, connect to triple rods are then connected to earth network.

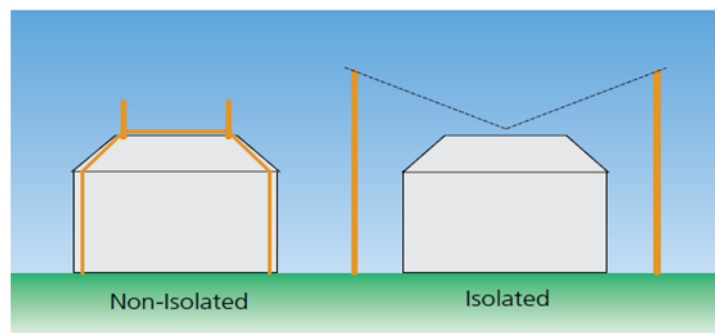
The connection shall be placed in an easily accessible point and insulated from the ground. In some locations, test joint shall be used.

Besides following the shortest possible route, the earthing conductor must not be placed inside steel or other magnetic material pipe, but must be suitably protected at least up to 3 meters from ground level.

Lightning protection systems typically follow two approaches:

- Non-isolated system – where potentially damaging voltage differentials are limited by bonding the lightning protection system to the structure
- Isolated system – where the lightning protection system is isolated from the structure by a specified separation distance. This distance should be sufficient that energy is contained on the lightning protection system and does not spark to the structure.

Isolated systems are well suited to structures with combustible materials such as thatched roofs, or telecommunication sites that want to avoid lightning currents being conducted on masts and antenna bodies.



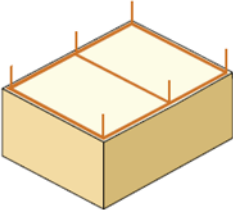
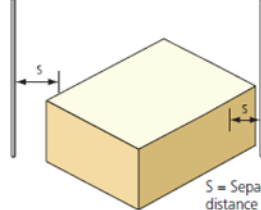
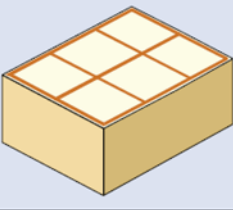
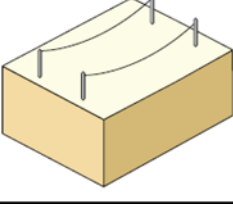
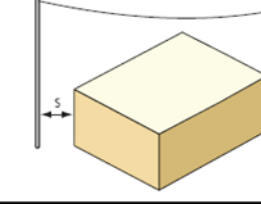
Permitted air-terminations are:

- Rods (including masts and free-standing masts)
- Meshed conductors (on building surface or elevated)

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.:157TEDG1500003-00	Page 15 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

- Catenary wires
- Natural components

The standard considers the three methods to be equivalent, while Rod air terminations of height in the region of 0.5 m are preferable to shorter rods or conductors on the building surface. The rolling sphere method, mesh method and protection angle method are used to determine the required positioning of the lightning protection air-terminations. Meshed conductors used as air-terminations should not be confused with the mesh method. Any of these methods can be used to determine placement of the air-terminations.

	Non isolated	Isolated
Air-terminations		 S = Separation distance requirement
Meshed conductors		Only practical for specific circumstances
Catenary wires		

7.2 Buildings Constructed of Non-Conductor Materials

These structures, if not surrounded by other higher nearby buildings, must be equipped with a lightning protection system on their highest points.

To protect high non-metallic buildings/ structures from lightning, Franklin lightning rods shall be used, but for ordinary non- metallic building/ structures Faraday cage method.

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.: 157TEDG1500003-00	Page 16 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

Connections to the earthing system shall be made by means of copper conductors with area cross section according to BS6651.

The aerial terminals shall be at least equivalent in weight and thickness to a 6 mm copper with walls 0.8 mm thick.

The lightning top point must be more than 25 cm above the top of the structure to be protected, but the rod length must not exceed 1.5 meters.

At least two earth conductors shall be placed, usually at the building corners, symmetrically with respect to the building itself, they must have a low impedance and must be installed without narrow curves or acute angles.

Connections to the earthing system shall be made as prescribed for dischargers.

When a building has metal structure, this can be used as an earthing down conductor, (only for lightning protection purpose).

7.3 Building with Metal Structures and Walls

It is unnecessary to install protection against lightning since these buildings are sufficiently self-protected.

7.4 Stack Lightning Protection and Grounding

The stack lightning protection shall be in accordance with the recommendations of the latest edition of NFPA-780 "Lightning protection codes".

A smoke or vent Stack shall be classified as heavy duty if the cross-sectional area of the flue is greater than 500 in² (0.3 m²) and the height is greater than 75 ft. (23m).

Heavy-duty metal stacks having a metal thickness of 4.8 mm or greater shall not require air terminals or down conductors. They shall be grounded by means of at least two ground terminals located on opposite sides of the stack. If the stack is an adjunct of a building or located within the side flash distance, It shall be interconnected to the lightning protection on the building, If the stack is located within the perimeter of a protected building, two connections shall be made between the stack conductors and the nearest main building lightning conductors at or about the roof level.

Conductors for the lightning protection system and the down leads for the stack grounding shall be stranded, hard drawn copper.

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.:157TEDG1500003-00	Page 17 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

Stack ground rods shall be at least 3 meters long, 16 mm diameter steel copper clad rods. All ground rods shall be bonded together and the cable bonding all ground rods shall be installed around the perimeter of the stack base and shall be buried to a nominal depth of 1/2 to 3/4 meter below grade.

7.5 Lightning system calculation

A risk assessment is generally undertaken to determine the level of risk for a specific structure, in order to make a comparison with a pre-determined value of “acceptable risk”. Protection measures, at an appropriate lightning protection level (LPL), are then implemented to reduce the risk to or below the acceptable risk. The lightning protection level determines the spacing of the mesh, radius of rolling sphere, protective angle, etc. The main outcome from this risk assessment is to determine if lightning protection is required and if so, to select the appropriate lightning class. The lightning class determines the minimum lightning protection level (LPL) that is used within the lightning protection design.

According IEC Standard, the rolling sphere method, mesh method and protection angle method are used to determine the required positioning of the lightning protection air-terminations. While the mesh method requires the use of surface mounted meshed conductors (a grid) to protect flat surfaces, the rolling sphere and protection angle method can also be used to determine protection provided by elevated meshed conductors to protect a variety of compound surfaces. The rolling sphere method generally provides the most optimized design and the vertical air-terminal is far more effective at capturing lightning flashes than mesh conductors installed upon, or just above structure surface. While there are limits on the application of the protection angle and mesh methods, generally the standard considers the three methods as equivalent. The rolling sphere method is recommended as the most universal method, while the mesh method is more suitable for the protection of flat surfaces. The protection angle method can only be used with limited vertical distances. Different design methods can be applied to different regions of a single lightning protection system, provided the zones afforded by each method overlap to protect the entire structure.

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.: 157TEDG1500003-00 Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	Page 18 of 20

The number of dangerous events per year is primarily based upon the structure dimensions, length and type of service and the ground flash density. The physical dimensions of the structure and service are used to calculate the effective lightning capture area, and the ground flash density is used to determine the probable number of events per year. The probability of damage is obtained from the given tables in the standard, with some simple calculations being required.

It is important to understand the sources of damage, types of damage and types of losses as the procedure to assess the risk evaluates various combinations considering structure, contents, services and environment with the source and type of damage.

The risk analysis follows the general process of:

Identifying the structure to be protected and its environment.

Evaluating each loss type and associated risk (R1 to R3)

Comparing R1 to R3 to the appropriate tolerable risk RT to determine if protection is needed

Evaluating protection options so $R1 \text{ to } R3 \leq RT$

Lightning protection is required such that R1, R2 & R3 are all equal or lower than the respective tolerable risk (RT).

The risk of each loss is then compared to a tolerable risk:

If the calculated risk is equal or less than the respective tolerable risk (RT), then lightning protection is not required

If the calculated risk is higher than the tolerable risk then protection is required. Protective measures should be evaluated to reduce the calculated risk to be equal or less than the tolerable risk.

Critical values of required efficiency E, of the LPS, as a function of the direct lightning frequency Nd to the structure. And accepted lightning frequency of flashes Nc are show in figures.

It is necessary to calculate the level of lightning protection systems in accordance with IEC 61024-1-1 standard formula should be used.

$$Ec=1-Nc/Nd$$

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.:157TEDG1500003-00	Page 19 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	

Only if $N_d \leq N_c$, Protection is not needed.

Lightning protection zones (LPZ) are used to define the electromagnetic environment. The zones may not necessarily be physical boundaries (e.g., structure walls). The zones are areas characterized according to threat of direct or indirect lightning flashes and full or partial electromagnetic field. LPZ 0 (Zero) is considered the “lowest” zone, LPZ 1, 2, 3, being respectively “higher”.

Lightning Protection zone (LPZ)	Exposure threats		
	Lightning flash	Lightning current or induced current	Electromagnetic field
LPZ 0A	YES	Full	Full
LPZ 0B	NO	Partial	Full
LPZ 1	NO	Limited	Partial
LPZ 2	NO	Reduced Below LPZ 1	Reduced Below LPZ 1

8.0 TEST & INSPECTION

All equipment shall be subject to inspection and witness testing by client or his representatives in accordance with the relevant standards. Minimum requirements, for all facilities (before backfilling) shall comprise:

- Measurements of earthing resistance of each earth rod.
- Check continuity of equipotential loop, protection conductors and generally all earthing & bonding conductors.

After backfilling:

- Measurement of earthing resistance of the grid

Should any conductor need to be embedded in concrete, contractor shall notify employers representative in writing as soon as installation is completed and at least 24 hours before embedding in concrete so employer s representative may inspect quality of work.

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing And Lightning	
REV: 00	Barsoo Document No.: 157TEDG1500003-00	Page 20 of 20
	Client Document No: S-SM01-D-BOP-WWTP-S PC-EL-003	