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No- RDSO-SIGEnB (GEN)/1/2020

Date- 30.06.2025

महाप्रबंधक (सि० एवं दू० सं०)	सि० एवं दू० सं० (निर्माण)	<u>GM</u> S&T S&T/CONST.
1. मध्य रेलवे, मुम्बई (सीएसटी)-01		Central Railway, Mumbai, CST-400 001
2. पूर्व रेलवे फेयरली प्लेस, कोलकाता-01		Eastern Railway, Fairlie Place, Kolkata -700 001
3. उत्तर रेलवे, बडौदा हाउस, नई दिल्ली-01		Northern Railway, Baroda House, New Delhi - 110 001
4. पूर्वोत्तर रेलवे, गोरखपुर-12		N.E. Railway, Gorakhpur - 273 012
5. उत्तर सीमान्त रेलवे, मालीगांव, गुवाहाटी-11		N.F. Railway, Maligaon, Guwahati -781 011
6. दक्षिण रेलवे, पार्क टाउन, चेन्नई-03		Southern Railway, Park Town, Chennai-03
7. दक्षिण मध्य रेलवे, सिकन्दराबाद-500 071		S.C. Railway, Secunderabad - 500 071
8. दक्षिण पूर्व रेलवे, गार्डन रीच, कोलकाता-43		S.E. Railway, Garden Reach, Kolkata -700 043
9. पश्चिम रेलवे, चर्चगेट, मुम्बई-20		Western Railway, Churchgate, Mumbai - 400 020
10. पूर्वीतट रेलवे, भुवनेश्वर-01		East Coast Railway, Bhubneshwar - 751 001
11. उत्तर मध्य रेलवे, इलाहाबाद-01		North Central Railway, Allahabad - 211 001
12. दक्षिण पूर्व मध्य रेलवे, बिलासपुर-01		South East Central Railway, Bilaspur - 492 001
13. दक्षिण पश्चिम रेलवे, हुबली-20		South West Railway, Club Road, Keshavpur, Hubali-580020
14. पश्चिम मध्य रेलवे, जबलपुर-01		West Central Railway, Jabalpur - 482 001
15. उत्तर पश्चिम रेलवे, जयपुर-01		North West Railway, Jaipur - 302 001
16. पूर्व मध्य रेलवे, हाजीपुर-01		East Central Railway, Hajipur - 844 101

**Sub:** Revised TAN on Earthing, Bonding, Surge & Lightning Protection System for S&T Installation

Based on the input from Zonal railways and audit of S&T installations by RDSO, existing TAN under subject with no. TAN STS/E/TAN/3006 Ver.3.0 has been revised.

This revised TAN STS/E/TAN/3006 Ver.3.1 is being issued with this letter for implementation of best earthing and bonding practices in S&T installations of Zonal Railways.

This has approval of PED/S&T.

DA: As above (17 pages)

Digitally Signed by  
 Triambak Tiwari  
 Date: 30-06-2025 13:35:29  
 Reason: Approved  
 (Triambak Tiwari)  
 Director/Signal II

Copy to: AM (Signal) / RB - For kind information please.

Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	1

<b>SN.</b>	<b>Description</b>
	<p>Effective protection of signaling equipment from lightning and surge-induced damages is crucial for ensuring safe and reliable railway operations. To address this, RDSO has issued specifications, Technical Advisory Notes (TANs), guidelines etc. on Earthing, Bonding, Surge and Lightning Protection. The initial TAN, STS/E/TAN/3006 Ver 1.0, was released on 02.11.2012 for the Earthing and Bonding scheme of Electronic Interlocking systems. Subsequently, RDSO, in collaboration with IISc Bangalore, developed a comprehensive scheme for the Lightning and Surge Protection of signaling equipment, leading to the issuance of TAN STS/E/TAN/3006 Ver 2.3, currently under trial in various zones.</p> <p>Based on inputs from zonal railways and audits of S&amp;T installations by RDSO, the existing TAN No.TAN STS/E/TAN/3006, Ver. 3.0 is revised to Ver. 3.1 for implementation of best earthing and bonding practises in S&amp;T installations. This revised TAN is based on RDSO Specifications RDSO/SPN/197 Ver 1.0, RDSO/SPN/144/2006 Rev 2, IEC Standard 62305, the National Building Code of India 2016, Guidelines for “Earthing, Bonding, Surge, and Lightning Protection” issued on 01.01.2025 etc.</p>
<b>1.</b>	<b>Earthing and Bonding System</b>
<b>1.1</b>	<b>Components of Earthing and Bonding System:</b>
	<p>The components of Earthing &amp; Bonding system are:</p> <ol style="list-style-type: none"> <li>Earth electrode</li> <li>Earth enhancement material</li> <li>Earth pit</li> <li>Equi-potential earth busbar</li> <li>Connecting cable</li> <li>Exothermic Weld Material &amp; Mould</li> <li>Copper or GI tape/strip and other associated accessories.</li> </ol> <p>The list of components to be procured for the Earthing and Bonding system is attached as <b>Annexure-I</b> and must be strictly adhered to.</p>
<b>1.2</b>	<b>Location for Earthing</b>
	<ol style="list-style-type: none"> <li>A flat area on natural soil close to the building or equipment is ideal for locating earth electrodes.</li> <li>Dry sand, lime stone, granite and any stony ground should be avoided.</li> <li>Earthing electrode should not be installed on high bank or made-up soil.</li> </ol>
<b>1.3</b>	<b>Installation of Earthing &amp; Bonding System</b>
	<ol style="list-style-type: none"> <li>The installation of the earth system shall be carried out as per the drawing attached in <b>Annexure-II</b>, ensuring the following: <ol style="list-style-type: none"> <li>No hammering shall be done on the earth electrode during installation.</li> </ol> </li> </ol>

Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	2

	<p>ii. All materials used for the installation of the earth system shall be anti-corrosive.</p> <p>iii. The earth pits shall be interlinked using a 25 x 2 mm copper tape /Solid copper round conductor of 8mm dia/GI tape of 50X6mm (for theft prone areas) with proper exothermic welding.</p> <p>iv. As per Para 8.4.2 (d) of RDSO/SPN/197, Ver. 1.0, the interconnecting conductor shall be buried at a depth of not less than 500 mm below the ground level. This conductor shall also be covered with approximately 30 kg of earth enhancement compound for every 3 meters of its length.</p> <p>b) The installation of Earthing and Bonding for <b>all S&amp;T installations</b>(EI, PI, RRI, Auto Hut, IBS, LC, Telecom hut etc.) shall be as per <b>Annexure-III (a) or (b) or (c)</b>. Separate earth is applicable for only those equipment's which work on earth return such as SGE Block Instrument.</p> <p>c) The procedure of Exothermic welding, as outlined in <b>Annexure-IV shall be followed.</b></p> <p>d) The <b>OEM shall be responsible</b> for complete supply, installation &amp; commissioning of the Earthing &amp; Bonding system.</p> <p>e) The <b>Pre-commissioning checklist</b> shall be followed during installation. This has been reiterated by this office letter no. RDSO-SIG0EnB(GEN)/1/2020dt. 18.07.2024 and also included in guidelines for earthing, bonding, surge and lightning protection issued on 01.01.2025.</p> <p>f) <b>OEM Certificate</b> shall be obtained from OEM, after the installation of Earthing &amp; Bonding system. Warranty of such system shall be <b>60 months from date of commissioning.</b></p> <p>g) The <b>Earthing &amp; Bonding plan</b> should be available at the Station.</p> <p>h) The overall Earth resistance value for the earth connected with MEEB shall be less than 1 ohm. If necessary multiple earth shall be provided in loop to achieve earth resistance less than 1 Ohm.</p> <p>i) The distance between two successive earth electrode shall be not <b>less than 3 meter and more than 6 meter.</b></p> <p>j) It is recommended that, multiple earth pits shall be installed around the perimeter of the building. However, at some locations, it may not be possible to form a perimetric earth around the Relay room, Power supply room and Station Master room. In such cases, ring earthing arrangements consisting of interconnected multiple earth electrodes may be installed in the available free space as close as possible to the station building. A Sample drawing is attached as <b>Annexure III</b> for reference.</p> <p>k) Earth pits shall be installed at least one meter away from building wall.</p> <p>l) Minimum 20 meter distance should be maintained between electrical and S&amp;T earth.</p>
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Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	3

<b>1.4</b>	<b>Measurement of Earth Resistance</b>
	<ul style="list-style-type: none"> <li>a) The individual earth resistance value shall be measured and recorded before equipotential bonding.</li> <li>b) After installation of the Earthing &amp; Bonding system, the final earth resistance value shall be measured at the MEEB or Equipment end.</li> <li>c) The earth value shall preferably be measured with Clamp Earth tester.</li> </ul>
<b>1.5</b>	<b>Other Important Points for Earthing and Bonding</b>
	<ul style="list-style-type: none"> <li>a) PVC insulated multi-strand single core 4 X 35 sq. mm copper cable or 2 nos of 25 X 2 mm copper tape to be used for connecting MEEB to nearest earth electrode.</li> <li>b) PVC insulated multi strand single core copper cable as per IS:694 shall be used and connected using tinned copper lugs with stainless steel nut and bolts as: <ul style="list-style-type: none"> <li>i. For individual equipment earthing to BRC - <b>10 sq.mm</b></li> <li>ii. For connecting BRC to MEEB or CTR to BRC - <b>16 sq.mm</b></li> <li>iii. For connecting Surge protection devices (SPD) to MEEB - <b>16 sq.mm</b></li> </ul> </li> <li>c) <b>Main equi-potential earth bus bar (MEEB)</b> Copper strip size of 300X25X6 mm (Min.)</li> <li>d) Main Equipotential Earth Busbar (MEEB) shall be installed not more than 0.5 m from LPD/SPD Box and preferably near the SMR rack of IPS.<b>(Annexure V)</b></li> <li>e) The Bonding Ring Conductor (BRC)/ Common Bonding Network (CBN) has the objective of maintaining the same reference potential. Hence, all equipment shall be connected to the nearest point on the BRC using bonding wires routed through the floor of the room. Routing through the floor ensures the shortest path and prevents the earth wire from running parallel to any power/data cables. It is mandatory that a complete close loop has to be formed for BRC.</li> <li>f) There should not be any loose connection between any earth conductors connected for earthing and bonding system.</li> <li>g) There should not be any Loop in earthing bonding conductor.</li> <li>h) The exothermic material used for exothermic welding must be UL-listed and consumed in the quantity specified by the OEM.</li> <li>i) Armour of all cables to be properly earthed at both ends.</li> <li>j) The Earth&amp; Bonding system shall preferably be safeguarded with suitable fencing.</li> <li>k) The checklist for earthing &amp; bonding, surge and lightning protection system shall be completed before commissioning to ensure proper installation.<b>(Annexure VII)</b></li> <li>l) The maintenance of the earthing system shall be carried out as per the schedule mentioned in IRSEM.</li> <li>m) Telecom ring earth shall be interconnected with Signal ring earth if telecom room is located in same building. In case of separate telecom building, telecom earth shall be connected with signal ring earth only when distance is 10 mtrs or less.</li> </ul>

Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	4

	<p>n) The MEEB is provided only in IPS Room for Signal installation and separately in Telecom room for Telecom installation.</p> <p>o) The connection between equipment and BRC shall be done using defined multistrand copper wire as per Annexure-I. The multistrand copper wire shall be exothermically welded with BRC at one end and connected with equipment using tinned copper lugs with stainless steel nuts &amp; bolts at other end. The tinned copper lugs shall be fixed by proper crimping and soldering.</p>
<b>2.</b>	<b>Lightning and Surge Protection System</b>
<b>2.1</b>	<b>External Lightning protection / Class A protection</b>
	<p>a) Latest guidelines issued by the RDSO/Railway Board shall be followed for Class A protection. As per NBC 2016, radioactive terminals, such as dissipation systems, ESE, or CSE air terminals, are not permitted.</p> <p>b) The down conductor shall consist of a 50 sq mm copper-bonded steel conductor, securely connected to the air terminal and the earth pit.</p> <p>c) The down conductor/ earth bonds/ Cables/ Wires shall be connected to the earth using the shortest possible path.</p> <p>d) Preferably, Isolated Spark Gap (ISG) of rating 100 KA shall be used to interconnect lightning arrestor earth pit to signal ring earth as per Annexure-III.</p>
<b>2.2</b>	<b>Surge Protection</b>
	<p>1. The appropriate rating of the SPD shall be provided as specified in the RDSO specifications and the Guidelines issued for Earthing, Bonding, Surge, and Lightning Protection dated 01.01.2025 or latest.</p> <p>2. If power supply /data / signaling lines (AC/DC) are carried through overhead wires or cables above ground to any nearby building or any location outside the equipment room, additional protection of Stage 2 (Class C) type shall be used at such locations for power supply lines and Stage 3 protection for signal / data lines.</p> <p>3. <b>Indicative type pluggable SPDs with Potential Free Contact (PFC)</b> Type I/Type II and <b>Indicative type pluggable/modular SPDs</b> with PFC contact Type III shall be used.</p> <p>4. Ensure the proper wiring &amp; validation of the Available PFC contact of SPD in Datalogger.</p> <p>5. The SPD/LPD box shall be installed in such a manner that the power cable from auto changeover panel serving as input to the IPS does not cross any other cable as per Annexure-V.</p> <p>6. The SPD and equipment shall be connected in the <b>shortest possible path</b>. Additional SPD (Type II) is provided in the equipment rack if the distance between SPD and Equipment is more than 10 meters.</p> <p>7. Test report of SPD's as per IEC standard shall be ensured.</p>

Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	5

<b>3</b>	<b>Segregation of electrically Dirty and clean wiring:</b>
<b>3.1</b>	Conductors entering the building could be carrying lighting currents or voltage transients and hence are considered to be "dirty". Internal conductors after the earth bonding point, and SPDs, are considered "clean". All such cables/conductors should be classified as " clean "or "dirty" and segregated accordingly.
<b>3.2</b>	All earth bonds, cables and wires classified as "dirty" must not run through cable trays carrying "clean "signaling and "clean" Power circuits.

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Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	6

**Annexure-I**

**Part List**

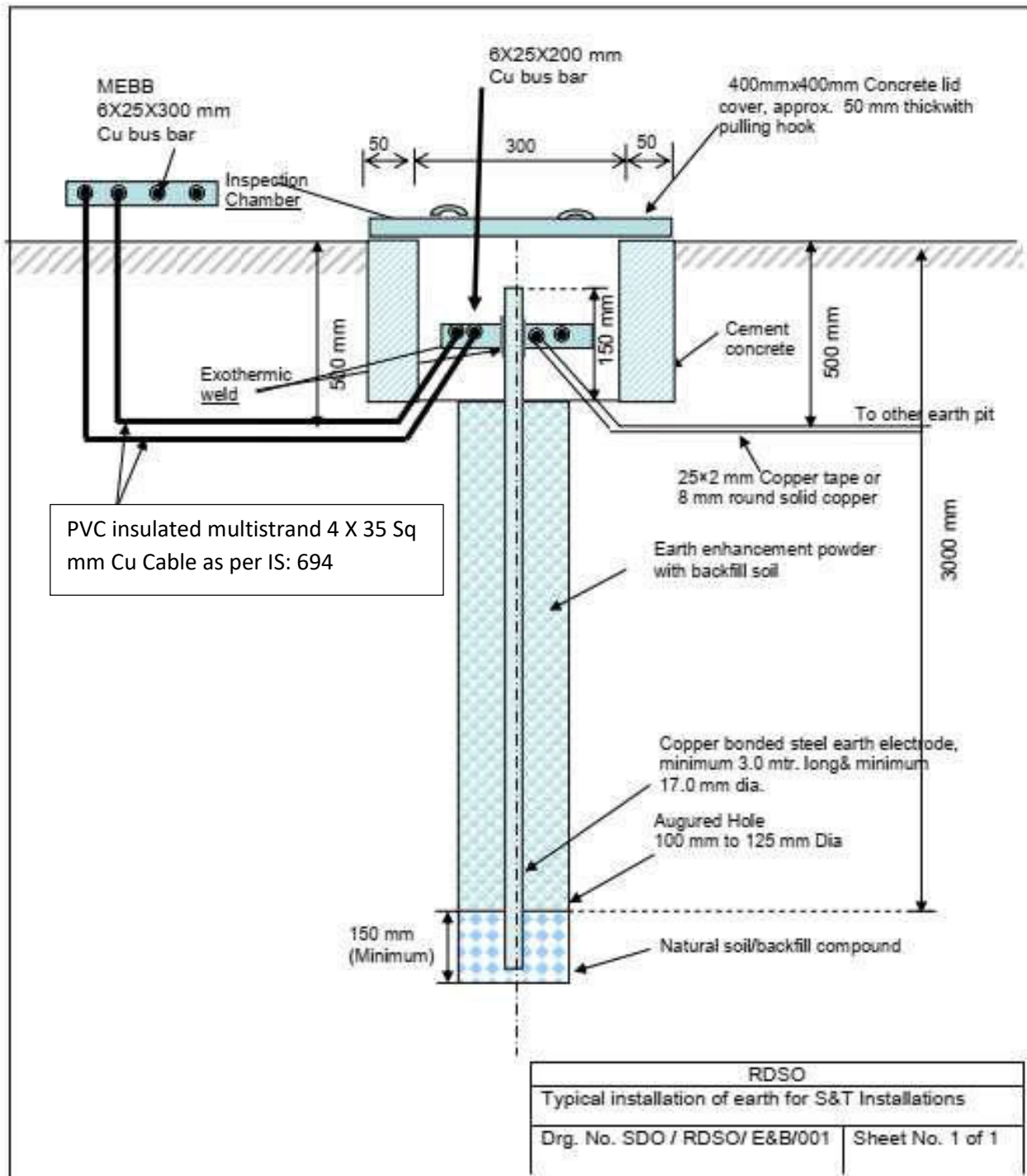
SN	Item/ Component	Size	Quantity
1	Earth Electrode	Dia- 17 mm Length- 3 mtr	As per site requirement
2	Earth Enhancement Material	30- 35 Kg	
3	Main equipotential earth busbar (MEEB)	300X25X6 mm (min.)	
4	Bonding Ring Conductor (BRC)	25 X 2 mm	
5	Multi-strand single core PVC insulated copper cable as per IS:694 used to connect individual equipment to BRC	10 Sq mm	
6	Multi-strand single core PVC insulated copper cable as per IS:694 used to connect SPD to MEEB or BRC to CTR	16 Sq mm	
7	Multi-strand single core PVC insulated copper cable as per IS:694 (4 Nos) used to connect MEEB to Main earth electrode	35 Sq mm	
8	Copper tape or solid copper round conductor used to connect Main earth pit to other earth pit in case of loop earth and Copper tape for connecting MEEB to Main earth electrode	25 X 2 mm or 8 mm dia and 25 X 2 mm (2nos.)	
9	GI tape used to connect Main earth pit to other earth pit in case of loop earth (For theft prone areas)	50 X 6 mm	
10	Copper strip to be exothermically welded to earth electrode	200X25X6 mm (min.)	
11	Exothermic Weld Material & Mould	-	

Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	7

## Annexure-II

### Drawing for Typical Installation of Earth

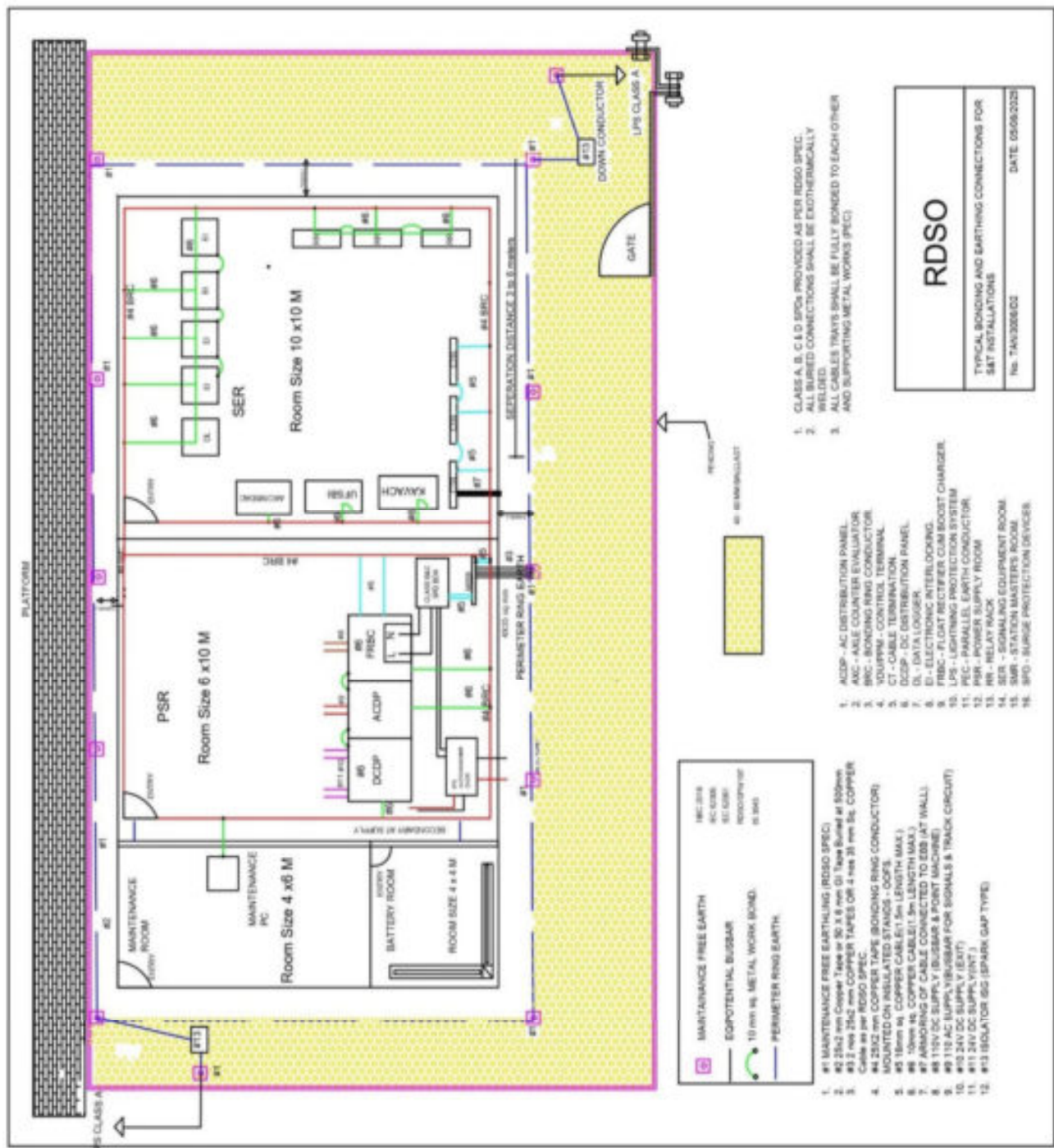
(Ref: RDSO/SPN/197 Ver 1.0)





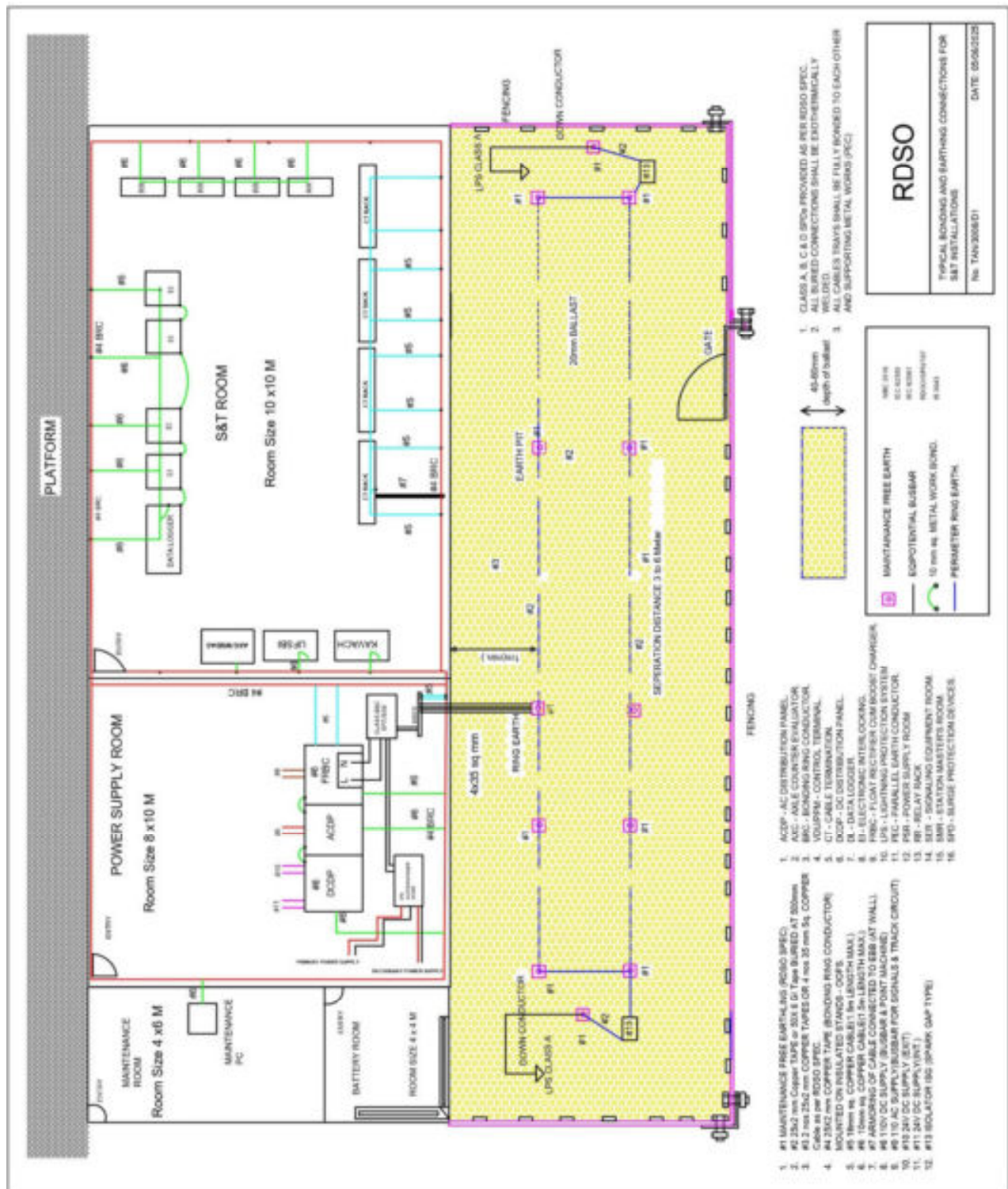
Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	8

## Annexure-III (a)



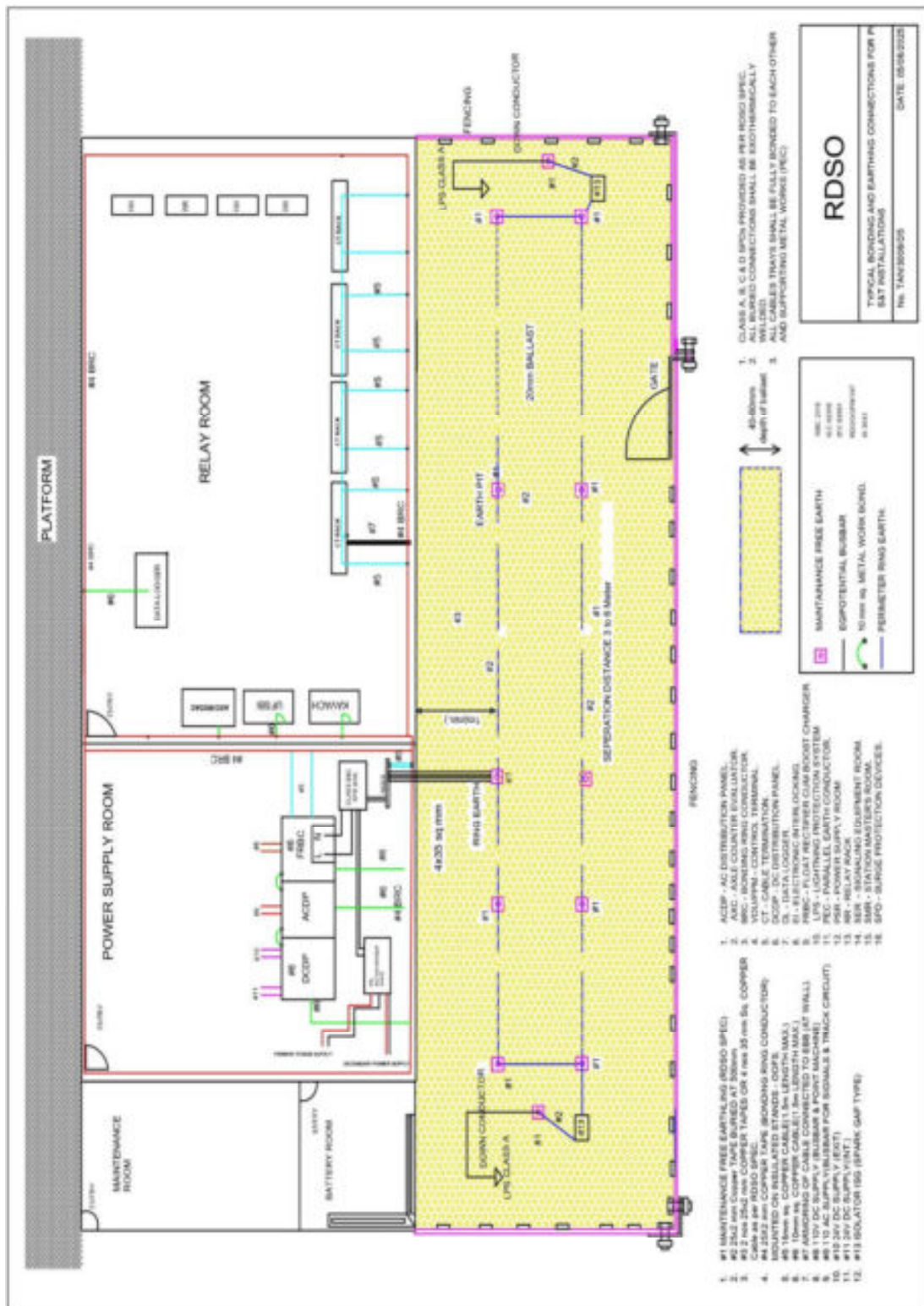
Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	9

## Annexure-III (b)



Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	10

### Annexure-III (c)





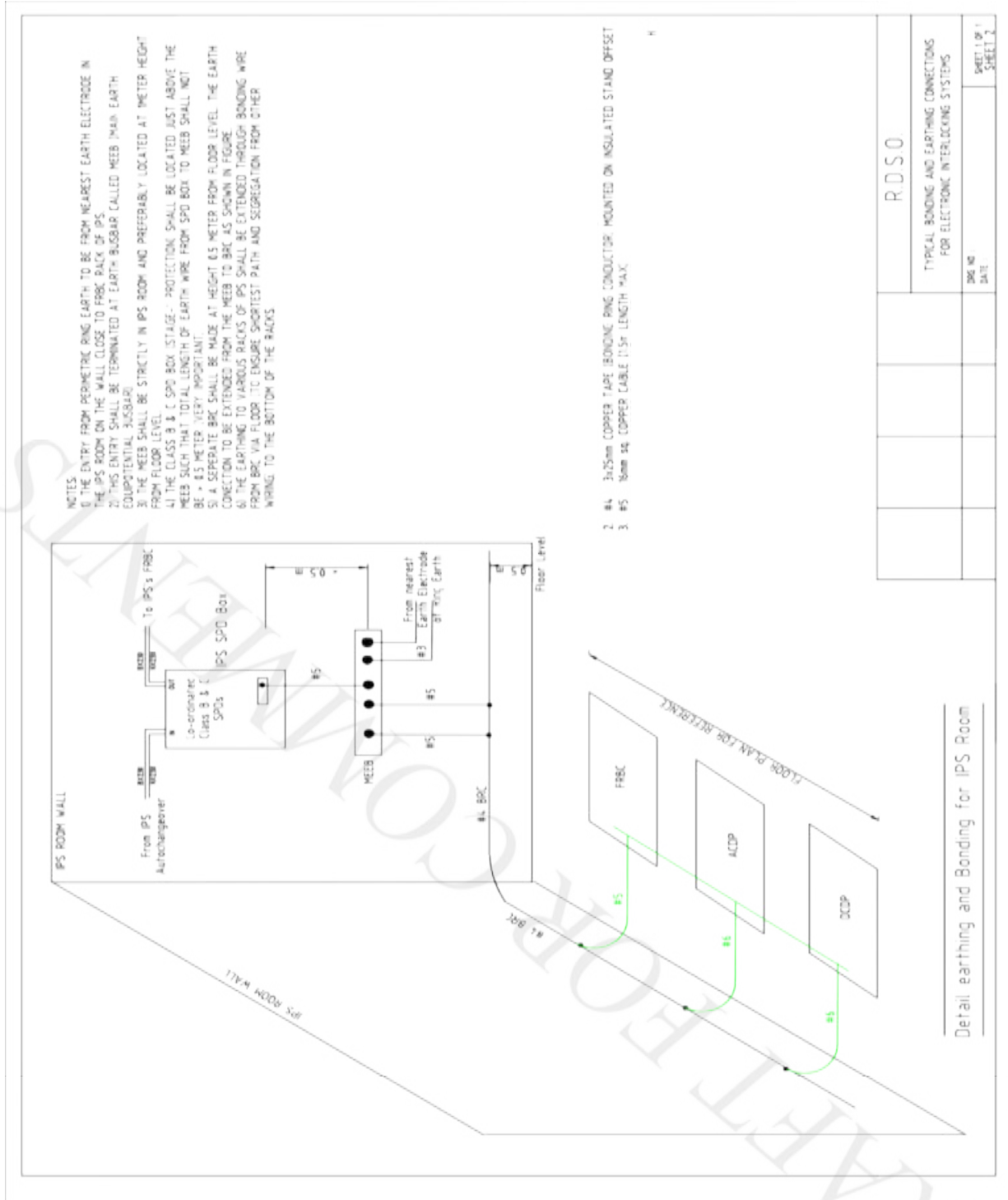
Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	11

**Annexure-IV****Precautions to be followed for Exothermic welding of connections for Earthing & Bonding System for signalling equipments:-**

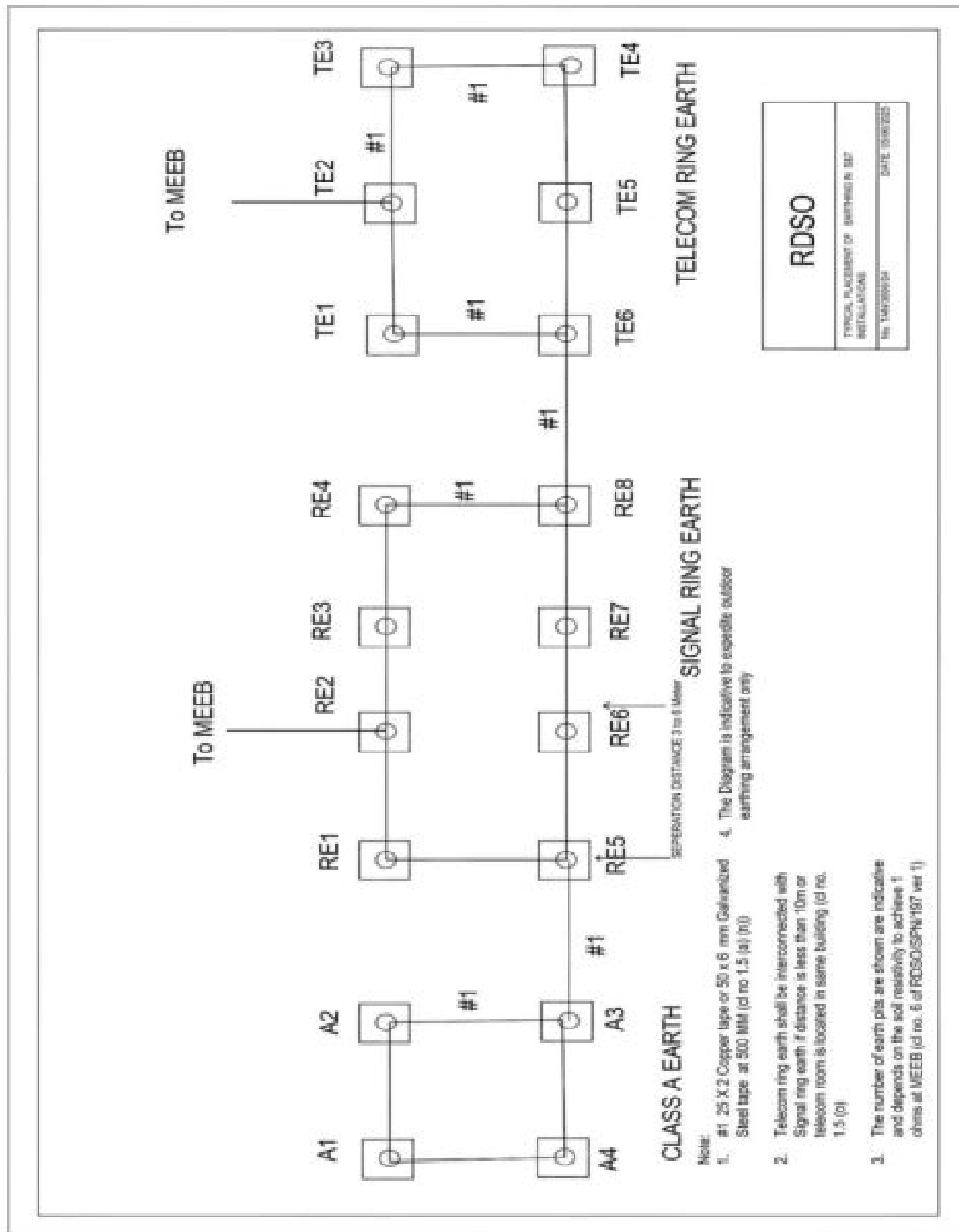
**(Ref: Annexure-II of RDSO/SPN/197 Ver 1.0)**

1. Clean the surfaces of the various components i.e. earth electrode, cable, copper bus bar, copper tape and mould etc. with the help of card cloth brush before performing exothermic welding to ensure that surface is free from oil & dust.
2. Pre heat the welding surfaces of various components to ensure that the surface is free from moisture.
3. Mould used should be correct for the component size and application. Do not use worn out or broken moulds which could result in leakage of molten weld metal.
4. Ensure that handle clamp is attached to the mould and properly adjusted.
5. Ensure that all the components to be jointed properly fit into the mould and the mould is in level position.
6. Place the correct size of steel disc into the mould crucible and make sure the disc sits well at the base of the weld metal cavity.
7. Pour recommended size of weld metal powder into the mould crucible.
8. Check for leaks, make sure that weld metal do not enter into the weld cavity.
9. Ignite the weld powder at the lid opening. Use only firm's recommended igniter. Make sure that no inflammable items are around the mould.
10. Once welding is completed, wait for two minutes before opening mould to allow metal to cool.
11. Gently scrap off the un- wanted slag from the crucible with a mould scraper.
12. Clean the crucible and the weld cavity with a mould cleaning brush.
13. Welding should be carried out only by the well trained staff of the supplier.

Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	12

**Annexure V****SPD arrangement at Input of IPS**

Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	13

**Annexure VI****Placement of Earthing at S&T Installation**

Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	14

**Annexure VII**

**Checklist for Installation of Earthing & Bonding and Lightning Protection System**

SN.	Description	Remark (Yes/No)
1.	Earthing system to be installed on a flat area on natural soil close to the building or equipment <b>at least 1 meter</b> away from the wall of the building.	Distance:
2.	Earthing electrode should not be installed on high bank or made-up soil.	
3.	Dry sand, Limestone, granite and any stony ground should be avoided.	
4.	Minimum <b>20 mtrs</b> distance should be maintained between electrical and S&T earthing system.	Distance:
5.	UL marking, Manufacturer's name or trade name, length, diameter, catalogue number must be punched on every earth electrode. (Size of earth electrode: Diameter-17mm, Length-3mtrs.)	
6.	Quantity of Earth Enhancement Material required per earth electrode: 30 kg(approx.) (i.e. 1 bag is of 10kg, so 3 bags are required per earth electrode.)	
7.	The distance between two successive earth electrode (shall be not less than 3 meter and more than 6 meter).	Min dist: Max dist:
8.	No hammering should be done on earth electrode during installation.	
9.	Exothermic welding material shall be UL listed and NABL/ ILAC member labs tested in Earthing and Bonding system.	
10.	Precautions to be followed for Exothermic welding of connections for Earthing & Bonding System as per <b>Annexure-IV</b> .	
11.	Copper strip exothermically welded to each earth electrode of size <b>200 X 25 X 6 mm</b> (min).	
12.	Connection of Main earth electrode to other earth electrode in ring: Copper tape or solid copper round conductor of size <b>25 X 2 mm or 8 mm dia or 50 x 6 mm GI tape</b> .	Size:
13.	The earth electrode interconnecting copper tape shall be buried at depth <b>not less than 500mm below</b> the ground level.	Min depth: Max depth:
14.	The earth electrode interconnecting tape shall also be covered with approx. 30kg of earth enhancing compound for each 3mtrs length.	
15.	Size of Main equipotential earth busbar (MEEB): <b>300X25X6mm</b> (min).	

Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	15

<b>SN.</b>	<b>Description</b>	<b>Remark (Yes/No)</b>
16.	Size of Bonding Ring Conductor (BRC): 25x 2 mm Cu.	
17.	Connection of MEEB to Main earth electrode: a) Multi-strand single core PVC insulated copper cable as per IS:694 (4 Nos) of size <b>35 Sq mm.Or</b> b) <b>2 nos, 25X2mm</b> Copper tapes.	
18.	Connection of MEEB to SPD: Multi-strand single core PVC insulated copper cable as per IS:694 of size <b>16 Sq mm.</b>	
19.	Connection of Cable Armour at CTR with (Bonding Ring Conductor) BRC: Multi-strand single core PVC insulated copper cable as per IS:694 of size <b>16 Sq mm.</b>	
20.	Connection of individual equipment with (Bonding Ring Conductor) BRC: Multi-strand single core PVC insulated copper cable as per IS:694 of size <b>10 Sq mm.</b>	
21.	No knot and coils loop exists in the connecting cable between MEEB and Main Earth Electrode.	
22.	No loose connection exists in any earth conductors in earthing and bonding system.	
23.	The down conductor/earth bonds/cables/wires should be connected with the shortest path to earth electrode.The main earth pit shall be located as near to the MEEB in the equipment room as possible.	
24.	All connections i.e. routing of bonding conductors a) from Equipments to BRC, b) from BRC to MEEB. shall be as short and as direct as possible with min. bends and separated from other wirings.	
25.	BRCs/MEEBshall be insulated from the building walls with low voltage insulator spacers of height 60mm.	
26.	The BRCs/MEEB shall be installed at the height of 0.5m from the room floor surface for ease of installation & maintenance.	Height from floor:
27.	Main Equipotential Earth Busbar (MEEB) shall be installed <b>not more than 0.5 m</b> from LPD/SPD Box.	Length of cable:
28.	The distance between SPD and equipment to be protected shall be as minimal as possible but shall not exceed 10mtrs. If length is more than 10mtrs, then additional SPD (type II) shall be provided inside the equipment rack.	Length of cable:
29.	The SPD/LPD Box are installed close to IPS (preferably near FRBC panel of IPS).	
30.	The 230V AC from CLS panel should enter in LPD/SPD box from top left & 230V AC from LPD/SPD box should leave from top right, so that there shall be no mixing of dirty & clean supply.	



Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	16

<b>SN.</b>	<b>Description</b>	<b>Remark (Yes/No)</b>
31.	It is mandatory that a complete close loop must be formed for BRC.	
32.	BRC of all the rooms are to be connected.	
33.	Electrical cable and S&T cable shall enter the EI building at different location.	
34.	Only one Entry is ensured for the building for the connection of MEEB and Main Earth Electrode.	
35.	Inspection chamber: a) The dimension of the chamber will be of 300X300X300mm(inside dimension) of RCC with 50mm thick.	
	b) The dimension of RCC cover is 400X400X50 mm with pulling hooks.	
36.	Name of RDSO approved vendor for Earthing and Bonding system.	
37.	The installation of Earthing and Bonding system is carried out by the OEM or an OEM authorized representative.	
38.	The Pre-commissioning checklist is jointly signed by officer level with OEM engineer.	
39.	The OEM installation certificate for Earthing and Bonding is available.	
40.	The drawing for Earthing and Bonding is painted on the outside wall of building for easy identification with date of measurement and earth value.	
41.	The as build approved Earthing and Bonding drawing of station are made available at Station.	
42.	The MEEB is provided only in IPS Room for S&T installation and in Telecom room for Telecom installation.	
43.	Indicative type SPDs with PFC contact are provided for the electronic equipments.	
44.	Available PFC contact of SPDs are wired in the Datalogger.	
45.	Test report of SPD's installed as per IEC standard is ensured.	
46.	Physical connections and wiring of SPDs are ensured.	
47.	The Dirty and Clean wires are properly segregated.	
48.	The down conductor of Class A is connected with the shortest path to earth using 50 sq mm down conductor.	
49.	The earth for Class A and Perimeter /Ring Earth are equipotential bonded. Isolated Spark Gap (ISG) of rating 100 KA has been used to interconnect lightning arrestor earth pit to signal ring	
50.	Separate earth is applicable for only those equipment's which work on earth return such as SGE Block Instrument.	

Subject	TAN on Earthing, Bonding, Surge and Lightning Protection System		
Document Number	STS/E/TAN/3006	Version	3.1
Dated	25/06/2025	Pages 17	17

<b>SN.</b>	<b>Description</b>	<b>Remark (Yes/No)</b>
51.	All earths installed as a ring earth or perimetric earth should be protected through suitable TIE-BAR fencing or boundaries with ballast over the area.	
52.	Date of commissioning of Earthing & Bonding system.	Date:
53.	The warranty of Earthing & Bonding system shall be 60 months from date of commissioning. <i>(During this period, any failure of earthing system due to improper materials &amp; bad workmanship shall be attended free of cost by the OEM.)</i>	Warranty Validity Date:
54.	Earth value shall be less than 1 ohm.	Earth value:

**Signature of Railway Representative**