

पूर्व मध्य रेल

**Office of the
General Manager/S&T
Hajipur**

No. ECR/S&T/MISC

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**Sr.DSTE/DNR, Sr.DSTE/DDU, Sr.DSTE/DHN,
Sr.DSTE/SPJ & Sr.DSTE/SEE**

Sub: Measures to be implemented for reduction of signaling failures due to lightning

This monsoon there have been many cases of signaling failures on ECR due to intense lightning strikes, despite having lightning protection system with earthing and bonding arrangement in place. Not only punctuality of trains was affected but also S&T equipment were damaged. Some of the failures and the action required for arresting such failures are enclosed. Based on these, the following measures are advised for implementation in the next three months.

1. Ring Earth/LA Earth

- a. At many old installations, the electrodes of earthing system are in L or U shape and do not form a ring. This needs to be made as a ring by connecting the two end electrodes us GI tape of 50x6 mm.
- b. A minimum distance of 3m between the LA earth and the earth conductor/electrode of the ring/perimetric earth must be ensured.
- c. One electrode of the LA earth and one of the ring/perimetric earth shall be connected through an Spark Gap Isolator.
- d. In case a Telecommunication Earth electrode is less than 10m from any of the earth electrode of the LA/Ring Earth, it must be connected to the LA/Ring Earth electrode through a Spark Gap Isolator. If the distance is more than 10m, the same need not be connected.

2. IPS Room

- a. The MEEB should be installed in the IPS room and shall be connected to only one earth electrode nearest to it using 4x35 sqmm multi-strand single core PVC insulated copper cable. In older installation where it has been installed in the relay room must be modified accordingly.
- b. The MEB shall be positioned such that the cable connecting the MEEB and the IPS SPD box is less than 0.5m. This connectivity shall be done using 16sqmm multi-strand single core PVC insulated copper cable. At those installations where this distance is more, the BRC or the LPD box may be shifted to achieve this. There shall be no coiling and minimal or no bending in this connectivity.

- c. All SPDs to be used for signaling system should have a potential free contact and this should be wired to data logger and monitored centrally. The PFC contacts of the SPDs in the LPD box should be immediately wired for monitoring through data logger. Exceptional report to this effect shall be prepared and monitored daily.
- d. If the SPD box is located at a distance of more than 10m from the IPS equipment rack, then another type-2 SPD shall be used in the equipment rack and it shall be monitored using its PFC contact through the data logger.
- e. Conductors entering the building could be carrying lighting currents or voltage transients and hence are considered to be **dirty**. Internal conductors after the MEEB and SPDs, are considered **clean**. All such cables/conductors should be classified as **clean** or **dirty** and segregated accordingly. All earth bonds, cables and wires classified as **dirty** must not run through cable trays carrying **clean signaling** and **clean power** circuits.
- f. In case the DC-DC converter is not protected on the output side, class C SPD shall be used to protect the DC-DC converters. Further, work must be proposed for early replacement of the IPS of 2004 specifications as they only have MOVs protecting the DC-DC converters.

3. EI VDU

- a. All the EI installation should be checked and power supply arrangement for VDU as per the latest EI TAN must be ensured. As the latest TAN, the 110V DC should be taken from IPS and inverted to 110VAC for supply to VDU instead of taking 230V AC power supply from IPS Inverter and converting it to 110V AC for supply to VDU.

4. SM's room

- a. Longer earth wire offers higher impedance to surges hence BRC similar to that in IPS and relay room shall be provided in SM's room to reduce the length of earth wire connecting SPDs to SEEB. The SEEB in the SM's room shall be connected to the MEEB in the IPS room using copper tape.

5. Relay Protection

- a. At all the lightning prone stations, CTR shall be provided with SPDs so that dirty conductors (from outside) are not directly connected to relay coils of RECR/HECR/DECR. This has been successfully implemented by DFCCIL. The interface circuit diagrams shall be accordingly modified.

6. HASSDAC

- a. The HASSDAC location box shall be protected using two maintenance free earth electrodes that should be connected with released catenary wire/GI Tape encircling the location box to keep both the earth electrodes at the same potential.
- b. Wiring of axle counter in location box has to be improved. Earth wires in daisy chain to be removed and direct connection of earth wire to be made with earthing busbar.
- c. Earth conductor from SPD to earth busbar should be as short as possible.

- d. Surge protected wiring must be physically separated from non-surge protected wiring. Earth wires are considered as non-protected wiring.
- e. If surge-protected wiring must cross non-surge-protected wiring then it must cross at right angles.
- f. SPDs to be replaced wherever these have not been changed in last 5-6 years. Similarly, the maintenance free earthing shall be planned for replacement every 5 years before the expiry of the OEM's warranty.

7. Telecom Installation

- a. SPD box similar to that used with IPS to be provided with SMPS Battery Charger of Telecom power plant.
- b. RF Coaxial lightning and Surge Protector for VHF shall be provided with all 25W VHF sets.
- c. The height of the VHF antenna shall be adjusted to ensure the communication requirement. The height of Air Terminal/Lightning Arrestor should be more than the VHF antenna.
- d. Dirty cables should be carried in separate trough and minimum 50mm distance should be maintained between dirty and clean wires.
- e. E1s from the STM should be terminated on krone modules and shall be protected using an IPM or SPD.

Divisions may get the stations complied as per the above in the next three months so that the lightning failures are arrested in the future.

DA: As above.

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(राकेश रंजन)

मुख्य सिगनल इंजीनियर-I

Copy to:

SSE/Signal/Control for maintaining a shared spreadsheet with station wise position of compliance of the above.

Lightning Failure Analysis

SN	Observations	Action to be taken
	Lightning Protection System	
1.	<ul style="list-style-type: none"> At Paraiya, where Kyosan EI cards and DC-DC Convertors were affected due to lightning, it was observed that the distance between earth pit connected to Lightning Arrestor and earth pit of Ring earth was 1.5 m. At most of the stations Ring earth is sufficiently away from the IPS room and earth pit to which Lightning Arrestor (LA) is connected is provided behind IPS room. Distance of more than 3 m between LA earth pit and the earth conductor connected to System Ring earth is not maintained due to which there are chances of lightning surges inductively coupling to the Ring earth conductor entering IPS room and further surges passing in to the BRC. In all the existing installations LA earth is directly connected to Ring earth. 	<ul style="list-style-type: none"> If the LA earth pit is behind IPS room it should be shifted so that a distance of more than 3m can be maintained between this earth pit and the earth conductor of Ring earth entering IPS room. LA earth and Ring earth will be connected through an Isolated Spark Gap. The earth electrodes should be preferably located in mother soil and not in made-up soil.
2.	In some older installations earth connection from Ring earth is entering Relay room.	<ul style="list-style-type: none"> Any earth conductor coming into the Relay room from outside should be removed and only one earth connection should come from outside Ring earth to the IPS room.
3.	It is observed that MEEB has not been provided at many installations.	<ul style="list-style-type: none"> MEEB should be provided at all installations in IPS room. Length of earth Conductor from SPD to MEEB should be 0.5m or less. MEEB should be connected to the outside Ring earth through 4x35sqmm multi-strand copper cable.
	Integrated Power supply	

4.	<ul style="list-style-type: none"> At some stations SPDs without potential free contacts have been provided in SPD box at 230V input of IPS. In some older installations only 1 no. Class B and 1 No. Class C SPDs have been provided. 	<ul style="list-style-type: none"> In the SPD box provided at the input of 230V supply IPS, 2Nos. Class B and 1 No. Class C SPD having potential free contacts to be provided for proving their status in Data Logger.
5.	At Bakhtiyarpur Link cabin, only those DC-DC Convertors which were not having SPD at the output were damaged and other DC-DC Convertors were unaffected.	<ul style="list-style-type: none"> All DC-DC Convertors of IPS which are not having class C SPD at the output shall be provided with the same. IPS of 2024 specs have MOVs and not SPDs at the output of DC-DC Convertors hence these should be planned for replacement. (works to be proposed)
	Power supply to VDU	
6.	<ul style="list-style-type: none"> It was observed at Karnauti and Bakhtiyarpur Link cabin that 230V AC taken from IPS Inverter was being used for giving supply to VDU and also 25 W VHF set. At these stations, Class C SPDs were provided in VDU power supply circuit but the earth wire connecting SPD to SEEB was more than 2m due to small SEEB strip (SM's room). 	<ul style="list-style-type: none"> As per latest TAN 110V DC should be taken from IPS and inverted to 110VAC for supply to VDU instead of taking 230V AC power supply from IPS Inverter and converting it to 110V AC for supply to VDU. Longer earth wire offers higher impedance to surges hence BRC similar to that in IPS room shall be provided in SM's room to reduce the length of earth wire connecting SPDs to SEEB.
	Relays	
7.	At Telo, Dokra, RKJE, TET, GRBH, RJBE stations of Dhanbad division there have been cases of RECR/DECR/HECR getting defective due to lightning.	<p>In all lightning prone stations of Dhanbad division Class C SPD should be provided on CTR so that dirty conductors (from outside) are not directly connected to relay coils of RECR/HECR/DECR. Other divisions facing similar failures can also provide SPD for RECR/HECR/DECR.</p> <p>DFCCIL has been providing SPD on Cable Termination Rack for all dirty cables entering Relay room.</p>

		
	HASSDAC	
8.	<p>There have been many signal failures because of cards of CEL & GGTronics make HASSDAC getting damaged during lightning.</p> <ul style="list-style-type: none"> It is observed that two independent earth electrodes have been provided near Location box housing axle counter equipment i.e. 1 conventional earth for earthing cable armour & body of location box ($> 1 \text{ ohm}$) and the other Maintenance Free earth for earthing of axle counter ($< 1 \text{ Ohm}$). These two separate earth electrodes less than 3m apart are creating ground loops. At some stations Class C & Class D SPDs have not been changed in last 7-8 years. Earth wires of SPD are running parallel to the surge protected wires going to equipment cards. 	<ul style="list-style-type: none"> Both the earth electrodes should be MF type and connected with released catenary encircling the location box so that both the electrodes are at the same potential. Wiring of axle counter in location box has to be improved. Earth wires in daisy chain to be removed and direct connection of earth wire to be made with earthing busbar. Earth conductor from SPD to earth busbar should be as short as possible. Surge protected wiring must be physically separated from non-surge protected wiring. Earth wires are considered as non-protected wiring. If surge protected wiring must cross non-surge protected wiring then it must cross at right angles. SPDs to be replaced wherever these have not been changed in last 7-8 years.
	Telecom SMPS charger	
9.	<p>At some Telecom installations only MCB has been provided at 230V AC input of SMPS Battery Charger.</p>	<p>SPD box similar to that used with IPS to be provided with SMPS Battery Charger of Telecom power plant.</p>

	Lightning protection system in Telecom system	<ul style="list-style-type: none">
10.	<p>At Bihta station there was failure of VDU due to 25 W VHF set burnt during lightning.</p> <ul style="list-style-type: none"> VHF antenna was taller than air terminal and dirty cable of VHF and clean cable of VDU were in the same trough. The earth wire of STM equipment and CAT-6 Cable were running in the same trough. 	<ul style="list-style-type: none"> Surge Arrestor to be provided with all 25W VHF sets. Height of Air Terminal/Lightning Arrestor to be made taller than VHF antenna. Dirty cables to be carried in separate trough and minimum 50mm distance to be maintained between dirty and clean wires.
11.	<p>At Katkamsandi, VF transformer and Maple equipment got defective which resulted in UFSBI failure.</p> <ul style="list-style-type: none"> It was observed that dirty cables coming into Telecom equipment room are directly connected to telecom equipment instead of taking them via Line Protection Module/ Data Line SPD. 	<ul style="list-style-type: none"> All conductors entering OFC room from outside shall be provided with Data line SPD/Line Protection Module. Unshielded Data cables (CAT-6 cable) shall be separated by a distance of 50mm from power carrying conductors and earth conductors.