

Rev	Revision Note	Date	Drawn by	Approved
7-2	Dimensional and Text change	23/10/12	AS	MS
7-3	HV Earth Mat Dimension amended	30/10/12	JM	MS
7-4	6-Way HV Mat Earth Bar added, amendments to earthing detail and arrangements	10/05/13	AS	MS
7-5	Design altered to include Conducrete. Notes and comments amended to suit	23/04/14	AS	MS
7-6	Wording of sub station stamp amended.	10/09/14	SW	MS

**NOTES:**

**1. HV EARTH MAT**

THE CABLE PIT WILL NORMALLY BE LEFT UNFILLED AND COVERED WITH GRP GRATINGS. IF IT IS SPECIFIED THAT THE PIT IS TO BE SHINGLE FILLED, AN EARTHING LOOP SHOULD BE INSTALLED AT A DEPTH OF 300mm IN FRONT OF THE EQUIPMENT IMMEDIATELY BELOW WHEN AN OPERATIVE WOULD BE STANDING WHILST OPERATING THE SWITCHGEAR.

REFER TO DRAWING GTC-E-EA-0003 FOR REINFORCING MESH EARTH CONNECTION DETAILS.

INSTALL 3X 1200mm EARTH RODS AT EACH CORNER OF BUILDING. AS INDICATED CONNECT RODS USING 120mm<sup>2</sup> BARE COPPER EARTHING CONDUCTOR. TOPS OF EARTH RODS 600mm DEEP. CONDUCTOR LAID IN PRE EXCAVATED TRENCH 600mm DEEP AND 450mm FROM THE FOOTINGS. ADDITIONAL EARTH LOOP IN FRONT OF SUBSTATION TO BE 1.6m FROM DOOR FACE.

HV EARTH MAT MUST BE BELOW 10 Ω BEFORE CABLES CONNECTED.

IF NECESSARY LAY ADDITIONAL 120mm<sup>2</sup> BARE COPPER ALONG HV CABLE TRENCH TO ACHIEVE ABOVE VALUE OR LESS. THIS CONDUCTOR MUST BE SEPARATED BY AT LEAST 9.0m FROM ANY LV NEUTRAL EARTHING ELECTRODES AND LAID AT LEAST 200mm UNDERNEATH AN HV CABLE (OR IF NOT POSSIBLE ALONGSIDE THE HV CABLE)

**2. LV NEUTRAL EARTH MAT**

CONNECT LV NEUTRAL BAR AT THE TMFC TO FIRST EARTH ROD USING 70mm<sup>2</sup> PVC INSULATED STRANDED COPPER EARTH CONDUCTOR. MINIMUM DISTANCE FROM ANY CONDUCTING METAL ASSOCIATED WITH THE HV EARTH MAT TO BE 9.0m.

EACH EARTH ELECTRODE TO BE 3X 1200mm EARTH RODS. IF NECESSARY INSTALL ADDITIONAL ELECTRODES AT 4.0m SPACING TO ACHIEVE BELOW 10 Ω RESISTANCE BEFORE CONNECTION OF LV CABLES. CONNECT ADDITIONAL RODS USING 70mm<sup>2</sup> BARE COPPER.

**3. CONDUCRETE**

THE BARE EARTH CONDUCTOR AND THE TOPS OF THE EARTH RODS ARE TO BE COVERED IN CONDUCRETE AFTER INSTALLATION TO BOTH IMPROVE THE EARTH VALUE AND PREVENT INTERFERENCE TO OR THEFT OF THE EARTHING CONDUCTORS. CONDUCRETE SHALL BE INSTALLED IN ACCORDANCE WITH AN APPROVED METHOD STATEMENT. IN BRIEF, THE POWDERED CONDUCRETE IS Poured DIRECTLY FROM THE BAGS ONTO THE EARTH WIRE FORMING A MOUND (AS SHOWN IN SECTION A-A) AND COVERING ALL THE EXPOSED COPPER INCLUDING THE TOPS OF THE EARTH RODS. THE GROUND IS THEN BACKFILLED IN THE NORMAL WAY. THE RECOMMENDED PPE, EYE PROTECTION, GLOVES AND RESPIRATOR (WHERE THERE IS INADEQUATE VENTILATION) SHALL BE USED AT ALL TIMES IN ACCORDANCE WITH COSHH DATA REFERENCE SHEET.

NOTE: THE INSULATED EARTH CONDUCTOR WHICH IS THE 9.0m SEPARATION BETWEEN HV AND LV EARTH MATS MUST NOT BE COVERED IN CONDUCRETE

**4. BONDING**

ALL ITEMS OF PLANT (E.G. LV BOARDS, RTU, RMU ETC.) MUST BE BONDED TO THE 6-WAY EARTH BAR USING 120mm<sup>2</sup> PVC INSULATED STRANDED COPPER EARTH CONDUCTOR. IF FITTED, STEEL DOORS/FRAMES AND STEEL VENTILATORS TO BE BONDED TO HV EARTH BAR USING PVC INSULATED MIN 16mm<sup>2</sup> STRANDED COPPER EARTHING CONDUCTOR. DOOR LEAVES TO BE BONDED TO FRAMES TOP AND BOTTOM USING FLEXIBLE COPPER BRAID. THE MAIN EARTHING CONDUCTORS FROM THE EARTH MAT ARE CONNECTED TO THIS EARTHING POINT USING COPPER COMPRESSION LUGS.

**5. COMBINATION / SEGREGATION OF EARTHING**

**COLD SITES (PREFERRED EARTHING ARRANGEMENT):** WHERE THE NEW SUBSTATION IS PART OF THE MAINLY UNDERGROUND CABLE NETWORK WITH A NUMBER OF INTERCONNECTED CABLES AND SUBSTATIONS AND THESE EXISTING SUBSTATIONS HAVE 'COMBINED' HV AND LV EARTHING SYSTEMS. THE NEW SUBSTATION WILL ALSO BE DESIGNATED A 'COLD SITE'. THE INSTALLED EARTHING SYSTEM IS DESIGNED TO LIMIT THE RISE OF EARTH POTENTIAL TO <math>-430V</math> IN THE EVENT OF AN EARTH FAULT AND IS A LOW ENOUGH VALUE TO ENABLE THE CIRCUIT PROTECTION TO OPERATE. FOR A 'COLD SITE' THE HV AND LV EARTH MATS SHOULD BE CONNECTED BY CLOSING THE LINK IN THE LV CABINET.

**HOT SITES:** IF THE NEW SUBSTATIONS IS NOT DIRECTLY CONNECTED BY UNDERGROUND CABLE BACK TO THE SOURCE PRIMARY SUBSTATION AND IS TYPICALLY SUPPLIED BY SHORT LENGTHS OF CABLE FROM AN OVERHEAD LINE NETWORK, IT IS LIKELY THAT THE SITE WILL BE DECLARED 'HOT' BY THE DNO. WHERE IT IS CONFIRMED BY DESIGN CALCULATIONS THAT THE EARTH POTENTIAL RISE EXCEEDS 430V THE HV AND LV EARTHING SYSTEMS WILL BE OPERATED AS 'SEGREGATED' SYSTEMS AND THE EARTH LINK IN THE TMFC WILL NOT BE FITTED. A 'HOT SITE' WARNING NOTICE SHOULD BE FITTED IN ITS PLACE.

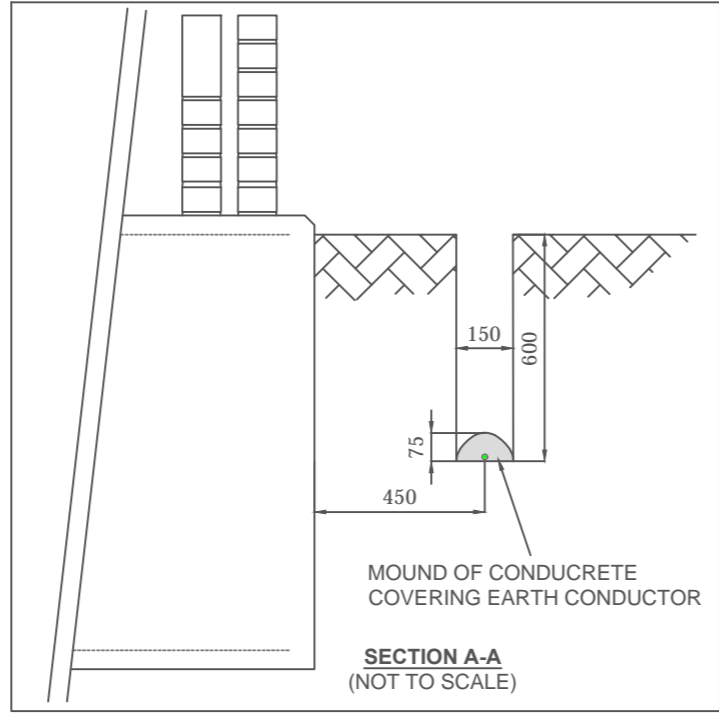
WHERE THE SITE IS DESIGNATED A 'HOT SITE' SPECIAL CARE SHOULD BE TAKEN TO PREVENT ANY METAL STREET FURNITURE, FENCES OR STREET LAMPS BEING INSTALLED WITHIN 9.0m OF THE PERIMETER EARTHING ELECTRODE. THE CONTROL ENGINEER MUST BE NOTIFIED OF ALL HOT SITES AT THE TIME OF ENERGISATION. A RECORD OF ALL HOT SITES WILL BE MAINTAINED.

**6. SUBSTATION ELECTRICAL INSTALLATION**

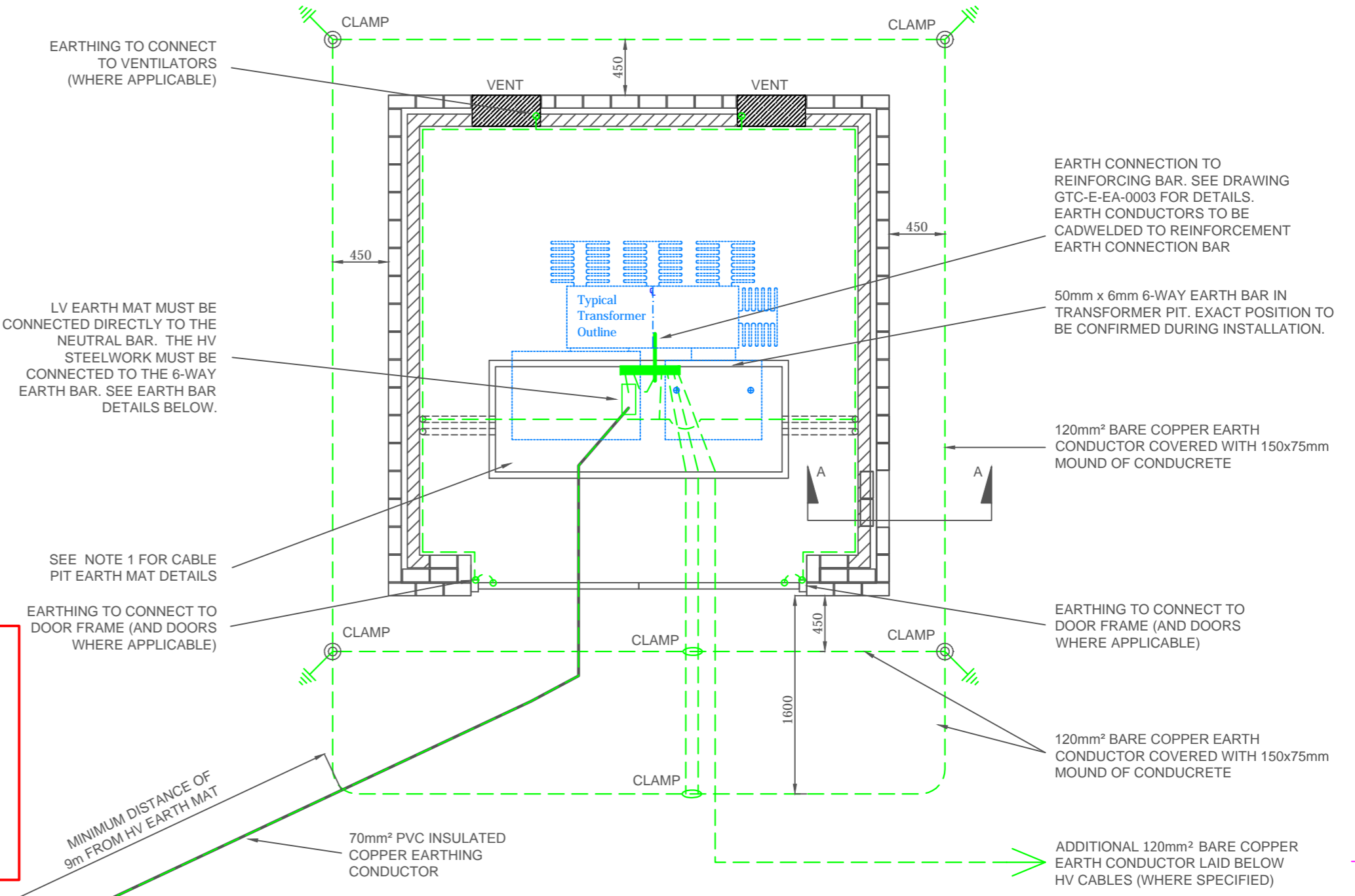
FOR HOT SITE IT IS VERY IMPORTANT TO ENSURE THAT THE SUBSTATION ELECTRICAL INSTALLATION IS COMPLETELY ISOLATED FROM THE LOCAL LV SYSTEM PME EARTHING TO AVOID DANGER.

REFER TO THE SUBSTATION SPECIFICATION FOR DETAILS OF LIGHTING AND POWER INSTALLATIONS REQUIREMENTS (DOCUMENT NO. EIN0012)

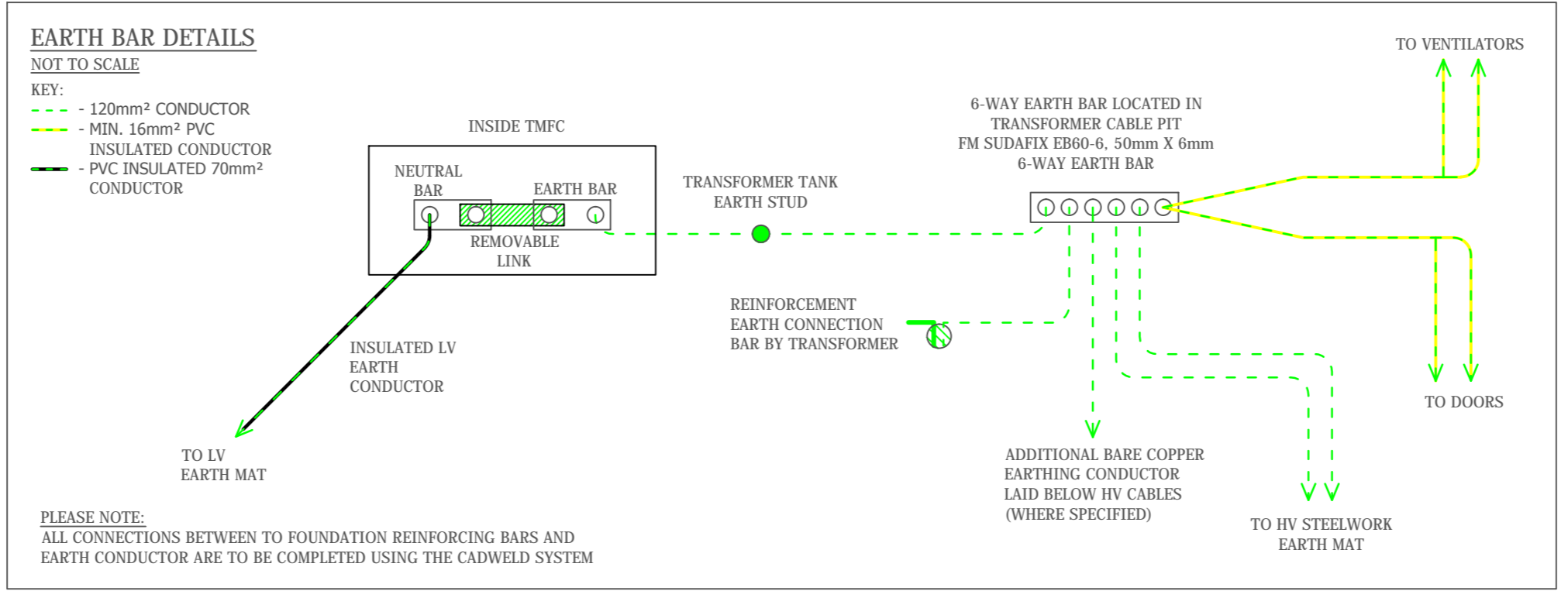
ALL PORTABLE TOOLS AND APPARATUS USED IN THE SUBSTATION MUST BE 110V. IN ALL CASES A SUITABLY RATED 230/110V TRANSFORMER MUST BE USED TO SUPPLY THIS EQUIPMENT.



**FOR FULL BASE DETAIL PLEASE REFER TO GTC SUBSTATION DRAWINGS GTC-E-SS-0010/11/12 AND GTC-E-EA-0003, AND SUBSTATION DOCUMENT GE-TGI-IG-0032**



**APPROVED FOR CONSTRUCTION**



**PLEASE NOTE:** ALL CONNECTIONS BETWEEN TO FOUNDATION REINFORCING BARS AND EARTH CONDUCTOR ARE TO BE COMPLETED USING THE CADWELD SYSTEM

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All cables and equipment used on this design are to be in accordance with G81 standards.

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Drawing Scale : NOT TO SCALE  
O.S.REF : N/A  
Drawing Number : GTC-E-EA-0001\_R7-6  
Description : SUBSTATION EARTHING LAYOUT