PS/LPI/JP/SPEC. 83-29
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EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CERN - PS DIVISION

SPECIFICATION

FOR THE LOW-VOLTAGE DISTRIBUTION SWITCHBOARDS

FOR EQUIPMENT BUILDING No. 3 OF THE LEP PREINJECTOR

This is a translation.
In case of doubt, please refer
to the original French version.

CONTENTS

1. INTRODUCTION

1.1 Subject of the price enquiry

This price enquiry covers the design study, construction, testing, transport and possibly the installation at CERN (see price enquiry document) of two main l.v. distribution switchboards, referred to as BT1 and BT2 and a set of auxiliary distribution switchboards BT/AUX.A1...A3 as described in the specification.

These switchboards are intended for equipment building No. 3 of the LEP preinjector on CERN's site at Meyrin, Switzerland. The distribution system is to power the semiconductor rectifiers for the beam transport magnets.

1.2 Attached documents

The following documents are attached and shall form an integral part of the specification:

- Circuit diagram	EPA 7 PE 0000 0815 4
- Switchboard installation	EPA 7 PE 0000 0816 4
- Distribution BT1 + 2 / variant a	EPA 7 PE 0000 0817 2
- Distribution BT1 + 2 / variant b	EPA 7 PE 0000 0818 2
- L.v. auxiliary distribution / AUX. A1 - A3	EPA 7 PE 0000 0819 3

Note: Bidders are invited to ask the officials handling this price enquiry for any additional information which they may deem necessary to form a more accurate idea of the services required. In this connection it must be pointed out that, once the order has been placed, the contractor shall not be entitled to claim that there has been any error of interpretation on his part either of the content of the price enquiry or of the accompanying documents.

1.3 General information

The specification deals generally with low-voltage distribution switchboards.

Item 4.1 of this specification gives a detailed description of the switchgear equipping the switchboards covered by this price enquiry.

2. GENERAL CHARACTERISTICS

2.1 Standards

The distribution switchboard and its switchgear and controlgear shall at least comply with the requirements of the IEC publications listed below :

- Low-voltage switchgear and controlgear/ circuit breakers	IEC 157-1	(1973)
	IEC 157-1A	(1976)
- Low-voltage controlgear - Contactors	IEC 158-1	(1970)
	IEC 158-1A	(1975)
- Current transformers	IEC 185	(1966)
- Low-voltage fuses :		
Part 1 : General requirements	IEC 269-1	(1968)
Part 2 : Supplememtary requirements for fuses for industrial applications	IEC 269-2	(1973)
Part 2 : Appendix A Examples of standardized fuses for industrial applications	IEC 269-2A	(1975)
- Low-voltage air-break switches, air-break disconnectors, air-break switch disconnectors and fuse combination units	IEC 408	(1972)
- Factory-built assemblies of low-voltage switchgear and controlgear	IEC 439	(1973)
- Classification of degrees of protection provided by enclosures	IEC 529	(1976)

2.2 Operating conditions

- Installation indoors, with normal atmospheric conditions.

- Ambient air temperature: max. + 40°C (average over 24 h ≤ 35°C)
  min. - 5°C.

- Altitude: < 2000 m.

2.3 Electrical characteristics

- Number of phases	3 + neutral
- Rated operating voltage	380 V
- Rated frequency	50 Hz
- Dielectric test voltage	2500 V (rms)

- The neutral point of the l.v. winding of the 18000/400-231 V (Dyn 11) power transformer powering the switchboard is directly connected to the earthing circuit in its immediate vicinity.
- The presumed maximum short-circuit current at the switchboard input which could be provided by a 2000 KVA transformer is about 50 kA.
- If two switchboards are each powered by a transformer, facilities for coupling between the two sets of busbars are provided only as an emergency measure if one or other of the transformers should break down; there are no facilities for connecting the two transformers in parallel.
- The neutral is distributed and shall be regarded as an active conductor with a cross-section of at least half that of the associated phase conductors.

2.4 Permissible loads on the switchgear

Every item of switchgear shall be capable of carrying its rated current without exceeding its specified temperature rise. This requirement shall also be observed if all the switchgear in the same column is operating simultaneously, with a diversity factor of between

0.8 and 1 depending on the composition of the column (type, rating and number of outputs).

2.5 Phase identification and wiring colour code

- The three phases shall be designated R, S and T and the neutral N.
- Phase rotation: R.S.T.
- Colours of phases and neutral:
  - . R = orange
  - . S = green
  - . T = violet
  - . N = light blue.
- The S phase shall always be arranged centrally in all sets of busbars and their connections.
- Colour code for wiring and miscellaneous:
  - . d.c. (+): red
  - . d.c. (-): dark blue
  - . a.c., undefined phase: brown or black
  - . earth: yellow/green stripes.

Note: Yellow/green stripes shall be used everywhere to identify the earth and for no other purposes. Except for the yellow/green stripes, the colour of the insulating sheath of the other conductors may differ from the standard colours but only if the standard colours are unobtainable and if sleeves in the standard colours are fitted at the ends of the conductors and at the junctions between them.

2.6 Scope of supplies

The items to be supplied shall include all the switchgear defined in this specification.

If assembly is included in the contract (see price enquiry document), it shall concern the assembly work on the various columns, including connecting the auxiliary circuits (CERN will provide the handling equipment on the spot).

The contract shall not include connecting the cables to the input and output circuits.

3. DESIGN CHARACTERISTICS

3.1 Structure

3.1.1 The switchboards shall be of the prefabricated modular type, consisting of several juxtaposed columns to take the input and output switchgear. They shall be of metal, completely enclosed, and capable of being freely arranged in the premises provided.

3.1.2 There shall be facilities at each end for extending the switchboards by the addition of extra columns.

3.1.3 For the basic version, it is intended to have the switchboard fitted to leave a free space of about 800 mm behind it (see layout sketch). Here, bidders may propose cable-connecting compartments with access from the rear.

If required on account of certain factors (depth, type of construction, etc.), bidders may propose a system in which the switchboard is fitted against a wall, provided that there is clear access from the front for all connection and maintenance work.

3.1.4 The measuring instruments, the labels, the data plates, the switchgear controls and the display panel shall be fitted on the front panel.

3.1.5 The columns shall be of the compartmented type providing excellent vertical and horizontal internal separation and insulation between the various parts, viz:

- main busbar compartment
- auxiliary busbar compartment
- switchgear compartment (input and outputs)
- cable connection compartment.

3.1.6 The switchgear shall be fitted in the columns in vertically partitioned compartments, with one item per compartment as a general rule. For low-rated outputs, several items of switchgear may be fitted in the same compartment. The items shall be either fixed in the compartments or fitted on a removable panel. The compartments shall be closed off by doors. It shall be possible to operate the switchgear either by a withdrawable control integral with the removable front panel or by a direct control integral with the switchgear projecting through a hole or cut-out in the door.

The modular design shall make it possible to extend, add and modify the switchgear in a column.

3.1.7 The outside casing of the switchboard, which shall normally be closed, shall provide a degree of protection of at least IP 31.

3.1.8 Both the transformer input and the output cables shall be led in from the bottom. The cable bushes or the cover plates beneath the switchboard shall be such as to provide a degree of protection of at least IP 2X.

3.1.9 All the access doors to the switchgear and connections shall be fitted with a lock (operated by RONIS No 2132 A or KABA No. 209874 key, to be specified by the bidder).

3.1.10 Ventilation slots shall be provided at the top, at the rear and/or the front, and there shall be air passages or inlets in the compartments to assist natural ventilation.

3.1.11 The casing and all the components constituting the switchboard shall be designed to withstand the thermal and dynamic stresses generated during a short circuit. Every precaution shall be taken to provide a high degree of protection for the personnel in the event of a fault inside the switchboard (arcing).

3.1.12 All the insulating components (screens, partitions, etc.) shall be of fire-resistant material which does not give off corrosive gases during a fire.

3.1.13 As a general rule, the switchboard shall be painted with RAL 7030 light grey (the final colour will be decided upon in consultation with the contractor).

3.2 Busbars

The main busbars, of constant cross-section, shall be designed for the rated current shown on the diagram.

The cross-section of the neutral busbar shall be at least half that of the main busbars.

Screens shall be fitted between the columns to prevent the propagation of any arcs.

At each end of the switchboard all the busbars shall be arranged and drilled to permit the easy connection of additional columns.

Branches from the main busbars to power the various components of the same column shall consist only of bars.

3.3 Cable connection

The cable-connection compartment shall be accessible from the front or rear depending on the type of connection selected and the intended location of the switchboard (see 3.1.3).

There shall be enough space on both the input and output sides for the cables to be easily pulled and arranged and to provide clear access to all the connections.

Allowance shall be made for the use of single-core aluminium cables with bimetal lugs for cross-sections of over 50 mm^2.

Special attention shall be paid to the connection of the cables to the transformer secondary inputs and to the heavy-current outputs (several 240 or 400 mm^2 aluminium cables in parallel, fitted with SIMEL type XCX bimetal lugs).

Terminal profiles shall be fitted to avoid the need to bend heavy cables in the compartments.

Screw-type terminals may be used for outputs of up to about 100 A. Above this figure, copper bars shall be provided, drilled so that the lugs can be secured with nuts and bolts. The copper bars shall exhibit no sharp edges which could injure the installation staff.

Drillings for cables:

- 1 x 50 mm^2 Al) - 1 x 95 mm^2 Al)	hole dia. 11
- 1 x 150 mm^2 Al	hole dia. 13
1 x 240 mm^2 Al) 1 x 400 mm^2 Al)	hole dia. 17

Connections may be made directly to the terminals of the switchgear provided that they satisfy all the conditions set out above.

Where there is one shared compartment per column, the connections shall be properly compartmented per output or the ends of the cables shall be protected by metal or insulating caps so that cables can be connected or connections can be inspected in complete safety while some outputs are in use and live.

3.4 Access to the switchgear

No live part shall be accessible (degree of protection at least IP 2X) if it is necessary to open compartment doors for the purposes of operation or inspection (e.g. adjusting the releases, replacing fuses etc.).

Access to the active components shall be possible only once the protective screens have been removed.

3.5 Variants

Bidders may propose any variants to the design, arrangement, etc., suggested by their design studies which may be more suitable for their designs or standard finish, provided that the technical and safety requirements of this specification are observed.

4. DESCRIPTION OF THE EQUIPMENT

4.1 Switchgear

4.1.1 SWITCHBOARD BT1

Variant a: outputs fitted with fused switches and circuit-breakers (diagram EPA 7 PE 0000 0817-2).

4.1.1.1a One "transformer input" fitted with a circuit-breaker:

Rated current	3200 A
Rated operating voltage	380V/50 Hz
Three- pole and neutral bar (1600 A)	3P + N
Withdrawable (four-pole)	
Circuit-breaking capacity	≥ 50 kA rms to IEC-P2

With independent manual operation

With 3 magneto-thermal releases, comprising:

- instantaneous magnetic releases
- timed (selective) magnetic releases
- thermal releases

With 1 48 V d.c. minimum-voltage release

With 1 48 V d.c. current emission release

With 3 auxiliary reversing contacts "O+C" indicating the position of the circuit-breaker.

With 1 auxiliary contact for signalling release following a fault.

With a device to inhibit switch on, secured by a padlock.

With a mechanical locking device (lock or padlock) preventing the circuit-breaker from being reinserted.

4.1.1.2a One 630 A output fitted with a set of fused switches, including:

- 1 low voltage air-break switch (making capacity on short circuit with fuses : > 50 kA rms).

  Rated current 630 A

Three-pole

Manually operated, tripping and releasing independent of the action of the operator.

With device to inhibit switch on, secured by a padlock.

- 3 low-voltage fuses (high-breaking capacity)

  Rated current 630 A

4.1.1.3a One 400 A output fitted out in the same way as for 4.1.1.2a, but with:

- 1 switch, rated current 400 A
- 3 fuses, rated current 400 A.

4.1.1.4a 3 x 400 A outputs, each fitted with a circuit-breaker:

Rated current 400 A

2 x 3-pole outputs

1 x 4-pole output

With 3 adjustable magneto-thermal releases (Irth: 400 A).

Circuit-breaking capacity suitable for the short-circuit current likely to arise at their point of use.

Fixed type.

With manual control and device to inhibit switch on, secured by a padlock.

Note: These three circuit-breakers fitted to the power supply outputs for the l.v./AUX A1 - A3 distribution system shall be selected so that their limiting capacity permits the use down-stream of circuit-breakers with a lower circuit-breaking capacity than the presumed short-circuit current at their point of use.

4.1.1.5a One 250 A output fitted out in the same way as for 4.1.1.2a, but with:

- 1 switch, rated current 250 A
- 3 fuses, rated current 250 A

4.1.1.6a 3 sets of outputs, each fitted with:

- 1 fused switch assembly comprising :
  1 switch, rated current 400 A
  2 three-pole outputs
  1 four-pole output,

otherwise as 4.1.1.2a

  3 fuses, rated current 400 A

(see note below)

- an intermediate distribution system and circuit-breakers:
  rated currents: see diagram
  three or four-pole
  3 magneto-thermal releases

with a manual control and device to inhibit switch on, secured by a padlock.

Note: The fuse/circuit-breaker combination shall take account of the fuse ratings and the type of circuit-breakers selected (circuit-breaking capacity and releases).

4.1.1.7a One "busbar coupling system" fitted with a switch:

Rated current 3200 A

Four-pole (3P + N)

With manual control

With device to inhibit switch on, secured by a padlock.

SWITCHBOARD BT1

Variant b: all the outputs fitted with circuit-breakers (diagram EPA 7 PE 0000 0818-2).

4.1.1.1b One "transformer input" identical to that of variant a (see 4.1.1.1a).

4.1.1.2b One 630 A output fitted with a circuit-breaker:

Rated current 630 A

Three-pole

With 3 adjustable magneto-thermal releases (Irth: 630 A)

Circuit-breaking capacity suitable for the short-circuit current likely to arise at its point of use.

Fixed type

With manual control and device to inhibit switch on, secured by a padlock.

4.1.1.3b One 400 A output fitted out in the same way as for 4.1.1.2b, but:

Rated current 400 A

Releases/Irth: 400 A

4.1.1.4b 3 x 400 A outputs identical to those of variant a (see 4.1.1.4a).

4.1.1.5b One 250 A output fitted out in the same way as 4.1.1.2b, but:

Rated current 250 A

Releases/Irth: 250 A.

4.1.1.6b 3 sets of outputs identical to those of variant a (see 4.1.1.6a).

4.1.1.7b One "busbar coupling system" identical to that of variant a (see 4.1.1.7a).

4.1.2 SWITCHBOARD BT2

Variant a: outputs fitted with fused switches (diagram EPA 7 PE 0000 0817-2).

4.1.2.1a One "Transformer input" identical to that of switchboard BT1 (see 4.1.1.1a).

4.1.2.2a 9 x 400 A outputs each fitted with a set of fused switches as for 4.1.1.2a, but with :

1 switch, rated current 400 A

Four-pole

3 fuses, rated current 315 A

SWITCHBOARD BT2

Variant b: outputs fitted with circuit-breakers (diagram EP 7 PE 000 0818-2).

4.1.2.1b One "Transformer input" identical to that of variant a

4.1.2.2b 9 x 400 A outputs each fitted with a circuit-breaker as for 4.1.1.2b, but :

Rated current	400 A
Four-pole	
3 releases/Irth	320 A

4.1.3 AUXILIARY SWITCHBOARDS BT/AUX A1 - A3

Each of these switchboards shall comprise one input from main switchboard BT1 and 2 or 3 sets of circuit-breakers (to be defined by the bidder).

The circuit-breaking capacity of the circuit-breakers shall be suitable for the short-circuit current likely to arise, taking into account the characteristics of the upstream protective circuit-breakers. (see note of 4.1.1.4a).

4.1.3.1 1st set (BT/AUX A1)

One 400 A input fitted with a switch:

Rated current	400 A
Three-pole	

With device to inhibit switch on, secured by padlock.

Outputs:

2 or 3 intermediate distribution systems according to the layout in the columns, and

18 circuit-breakers:

Rated current	See diagram

Three-pole

3 magneto-thermal releases

Fixed type

With manual control and device to inhibit switch on.

secured by padlock.

4.1.3.2 2nd set (BT/AUX A2)

As for 1st set.

4.1.3.3 3rd set (BT/AUX A3)

Fitted out in the same way as 4.1.3.1, but:

Input: four-pole

Outputs: 18 circuit-breakers, rated currents: see diagram

four-pole

3 magneto-thermal releases.

4.2 Measuring equipment

The flush-fitting, square (96 x 96) measuring instruments shall be fitted to the front panels of the switchboards in such a manner that there can be no error concerning the circuit to which they apply.

The inputs shall be fitted:

- upstream of the circuit-breaker, with a voltage "ON" indicator using neon lamps powered via HCBC fuses;
- downstream (on the side of the main busbars), with a 0 - 500 V voltmeter powered via HCBC fuses and a 7-position voltmeter selector.

The input shall also be fitted with:

- an instantaneous read-out ammeter on the R and T phases;
- an ammeter giving instantaneous read-out and maximum indication (integration time about 10 min.) on the S phase.

As shown on the diagrams a bimetal-type ammeter with maximum indication shall be fitted on the S phase of all the outputs.

4.3 Low-voltage fuses

All the low-voltage fuses shall be of the HCBC type complying with standards NF-C60.200, C63.210, C63.211, DIN 43.620 and IEC publication No. 269.

The fused-switch assemblies shall be designed so that the fuses can be changed easily and safely.

4.4 Earthing bar

A main copper earthing bar with a cross-section of at least 120 mm^2 shall be fitted and interconnected in each compartment and arranged in such a way that the various outputs and earths of the switchgear can easily be connected to it.

4.5 Display panel

The display panel, which is intended to provide a clear and immediate idea of the relations between the circuit-breaking equipment, the busbars, the inputs and the outputs, shall consist of a black painted line (the use of adhesive strips is forbidden).

4.6 Labelling

Engraved labels, with white lettering on a black background, shall be screwed to the fronts and rears of the switchboards to show the identification and CERN code numbers and the purposes of the circuits (CERN will provide the contractor with a list).

In addition, all the switchgear and miscellaneous devices (switches, instruments, etc.) shall be marked.

4.7 Auxiliary circuit wiring

Flexible wires running in channels shall be used for the auxiliary circuits (auxiliary contacts for the switchgear, coil power supplies, relays, etc.).

The wiring shall be connected to distribution frames consisting of insulating terminals (screw or spade type) clearly separated from the power connections and marked.

5. TESTING

5.1 Type tests

If the manufacturer can provide CERN with type test certificates complying with the IEC recommendations or with the publications listed under 2.1, type tests will not be required.

If CERN regards the test certificates as inadequate in some important respects, the manufacturer shall perform the tests deemed necessary at the start of the contract.

The manufacturer will also be asked to provide documents certifying that the short-circuit withstand tests have been made on switchboards identical to those proposed.

CERN may require a temperature-rise test to IEC publication 439, article 8.2.1. The exact test procedure will then be discussed with the contractor.

5.2 Routine tests

On acceptance at the works, the routine tests shall be made as set out in IEC publication 439, article 8.3.

*)

If the manufacturer assembles the equipment on the CERN site, the following tests shall be performed after installation:

- insulation resistance measurement;
- tests on the mechanical operation of the equipment;
- tests on the auxiliary circuits.

6. DOCUMENTS TO BE PROVIDED

6.1 Documents provided with the tender

- Type and supplier of the proposed switchgear, its main technical characteristics, and descriptions.
- A general description of the structure and design of the switchboard, the construction of the compartments, the partitions etc.
- Technical characteristics of the main busbars.
- Drawings, diagrams or sketches showing the main dimensions of the

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*) In addition, the manufacturer shall demonstrate the installation of the cables in the compartments and their connection to the terminal strips. CERN can provide samples of cables with lugs.

switchboard and the proposed general layout of the switchgear.

- A list of any sub-contractors.
- A list of references.

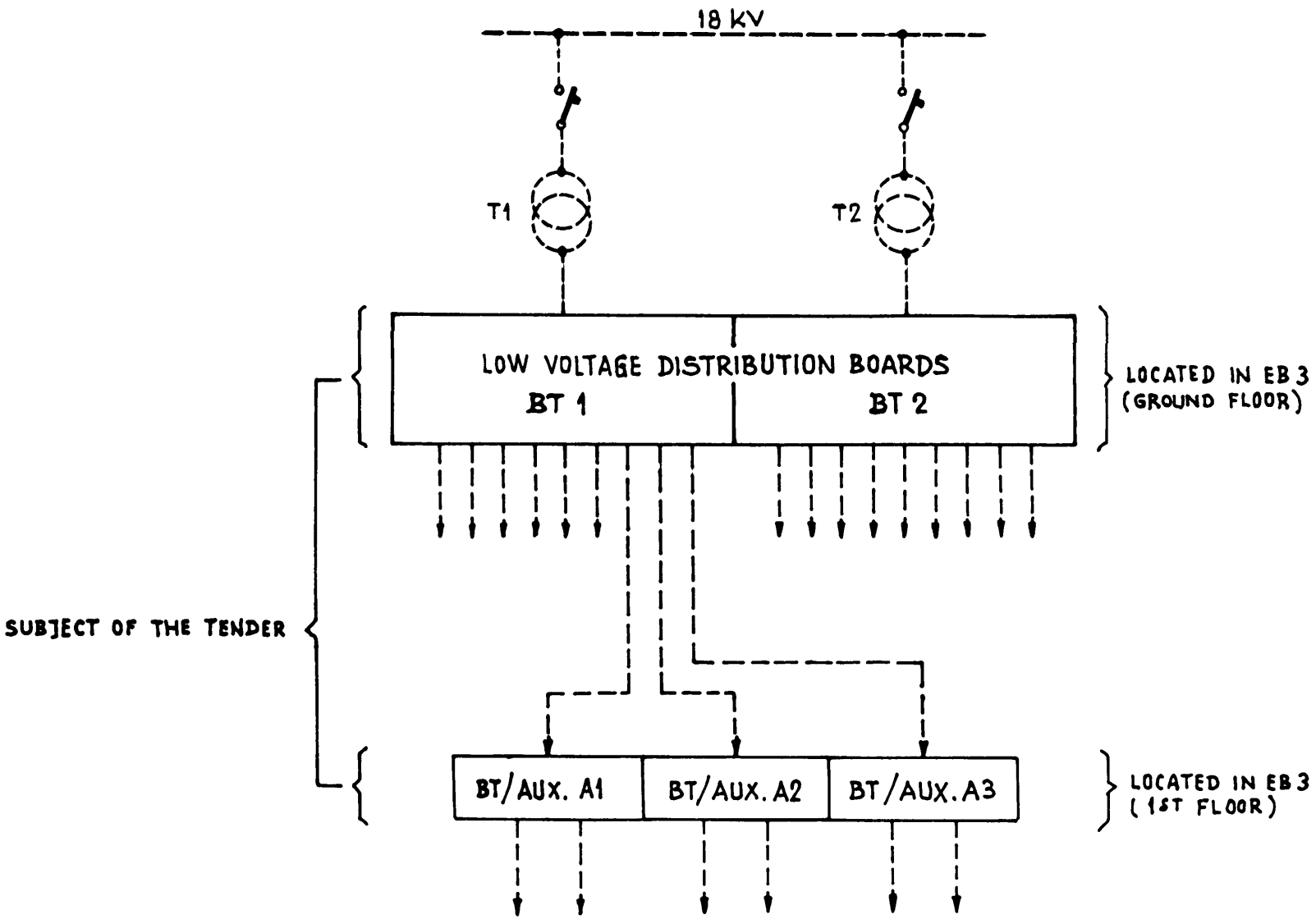
6.2 Documents to be supplied by the contractor

The contractor shall make the following detailed drawings and submit them to CERN for approval before starting work:

- The basic structure of the switchboard, showing the position of the necessary securing means, cross-pieces and supports, and the aperture for the cable lead-through.
- The physical layout and the position of the switchgear for all the types of compartment (inputs, outputs, coupling).
- The arrangement of the main and auxiliary busbars.
- The layout of the cables and their connection in the connecting compartments.
- The circuit diagram of the heavy current system and the auxiliary wiring with all the auxiliary contacts, terminals and markings.

6.3 Documents to be provided after provisional acceptance

The contractor shall supply CERN with two complete sets of documents comprising the construction drawings, circuit diagrams, lists of all the equipment and technical instructions for all the switchgear (commissioning/operation/maintenance).

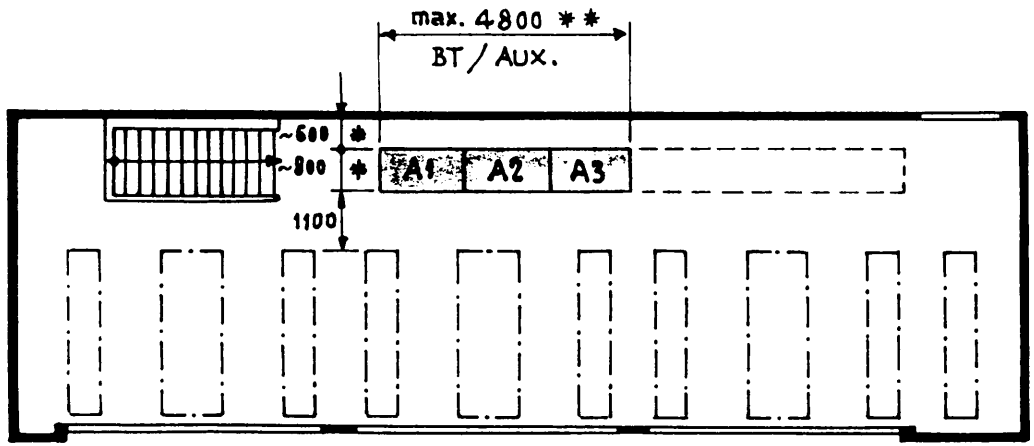


PRINCIPLE OF LOW VOLTAGE DISTRIBUTION

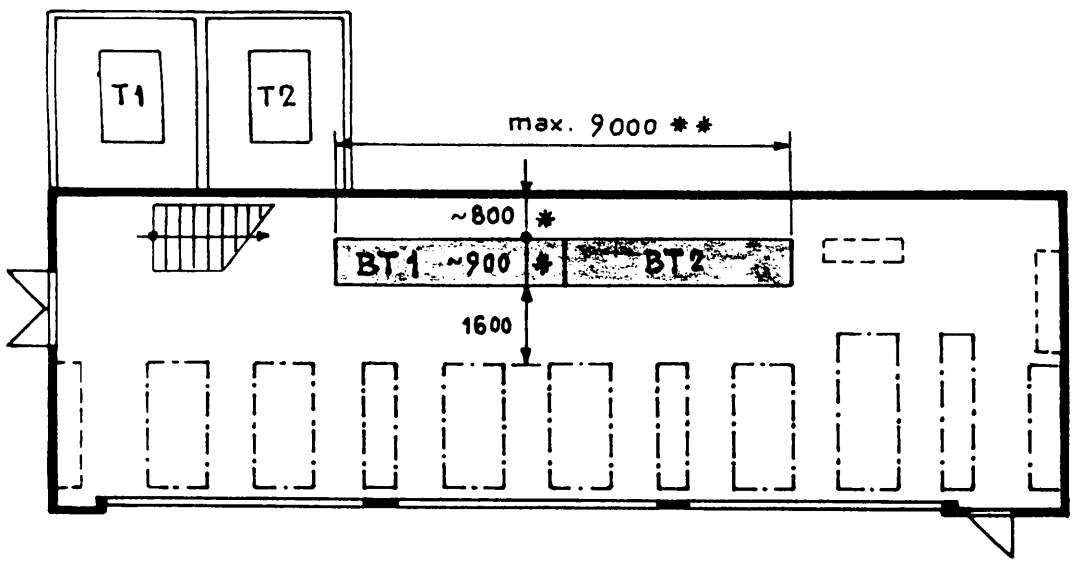
LOCATED IN EQUIPMENT BUILDING EB 3
ANNEX TO SPECIFICATION PS/LPI/JP/SPEC. 83-29

3.8.83.

CERN EPA 7PE 0000 0815 4



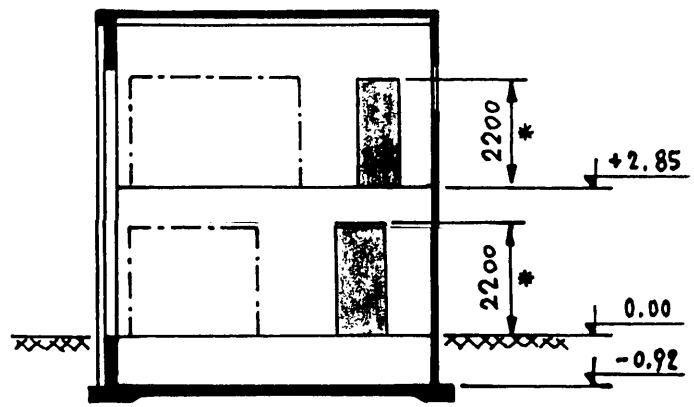
TOP VIEW, 1ST FLOOR



TOP VIEW, GROUND FLOOR

LEGEND :

- SUBJECT OF THE TENDER
- RECTIFIER EQUIPMENT
- OTHER EQUIPMENT



SECTION

* TO BE CONFIRMED BY TENDERER

** THIS DIMENSION DEPENDS ON PROPOSED SOLUTION

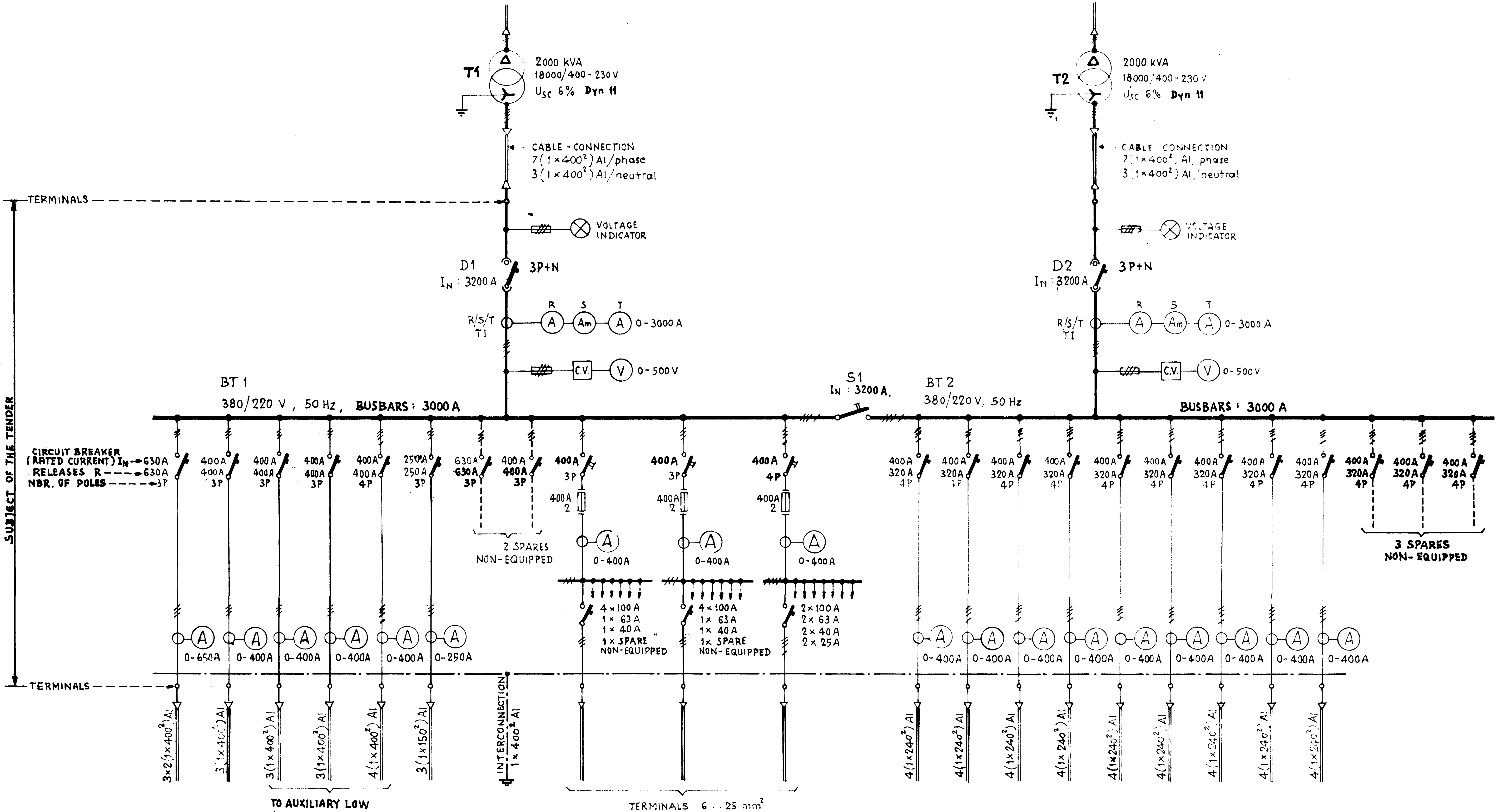
SCALE 1:150

LAYOUT OF LOCATION OF LOW VOLTAGE DISTRIBUTION IN EQUIPMENT BUILDING EB 3

ANNEX TO SPECIFICATION PS/LPI/TP/SPEC. 83-29

3.8.83.

CERN EPA 7PE 0000 0816 4



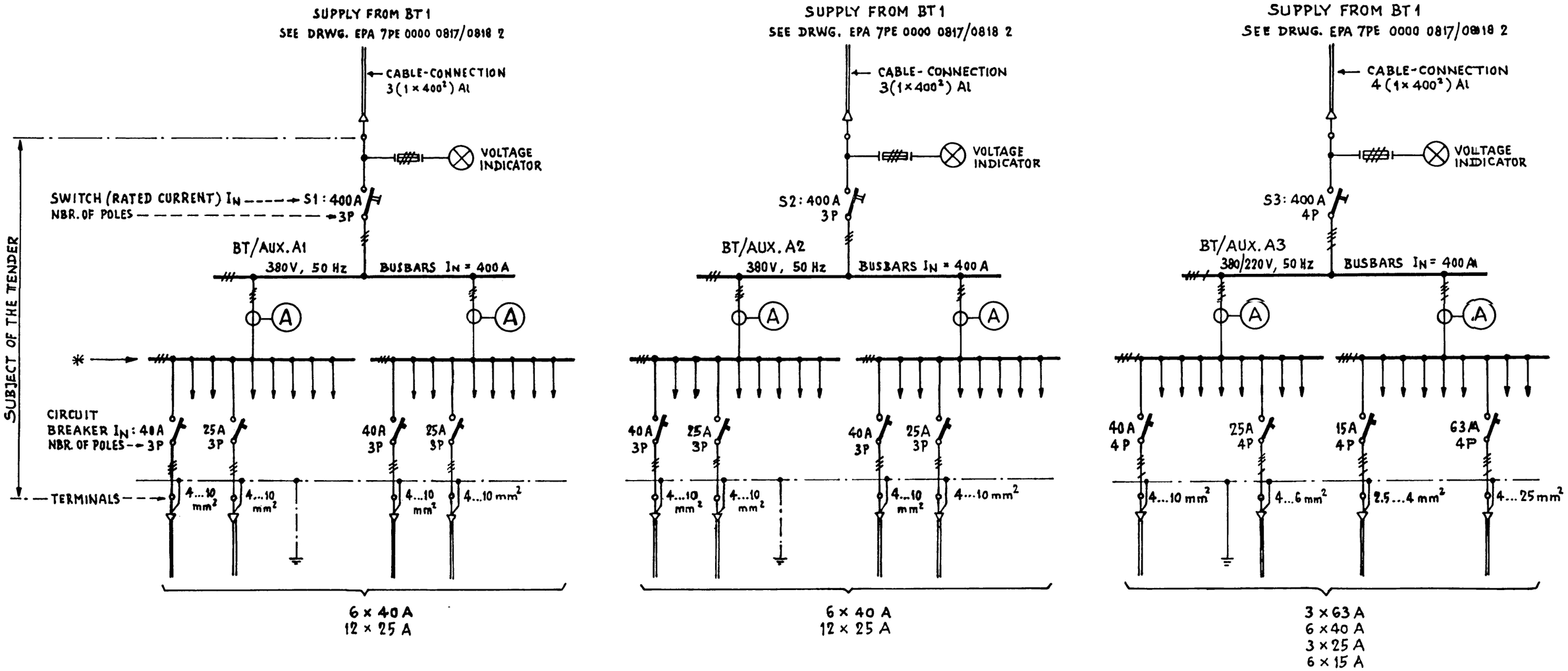
TO AUXILIARY LOW VOLTAGE DISTRIBUTION BOARDS A1, A2, A3
SEE DRWG. EPA 7PE 0000 0819 3

LOW VOLTAGE DISTRIBUTION BOARDS BT1 AND BT2 - VARIANT b

LOCATED IN EQUIPMENT BUILDING EB 3
ANNEX TO SPECIFICATION PS/LPI/JP/SPEC. 83-29

3.8.83. Si.

CERN EPA 7PE 0000 0818 2



* SUBDIVIDED IN 2 OR 3 GROUPS
(to define by the tenderer)

AUXILIARY LOW VOLTAGE DISTRIBUTION BOARDS A1, A2, A3

LOCATED IN EQUIPMENT BUILDING EB 3
ANNEX TO SPECIFICATION PS/LPI/JP/SPEC. 83-29

3.8.83.

CERN EPA 7PE 0000 0819 3