Substation DC Auxiliary Supply – Battery And Charger Applications

Substation DC Auxiliary Supply - Battery And Charger Applications (on photo: Newly completed DC auxiliary power supply of substation in Naramata BC; credit: Paul Chernikhowsky via Flickr)

DC voltage 110 V or 220 V

Power substation can have one or several DC systems. Factors affecting the number of systems are **the need of more than one voltage level** and the need of **duplicating systems**.

> *Today, normal DC auxiliary supply systems in power substation are operating **either on the 110 V or 220 V level**, though lower levels exist. Some systems at the substation may require lower voltages as their auxiliary supply source.*

A typical example of these systems would be the optical telecommunication devices or the power line carrier (PLC) equipment, which normally requires **48 V**. If the power consumption of these devices is low enough, their supply can be arranged with DC/DC converters, supplied by the higher voltage level DC system.

Elements of DC Auxiliary System //

Single-battery and charger application

The main components of the system are battery, charger and distribution switchboard including the DC system monitoring relay. Figure 1 shows the main line diagram of a **single-battery and charger application**.

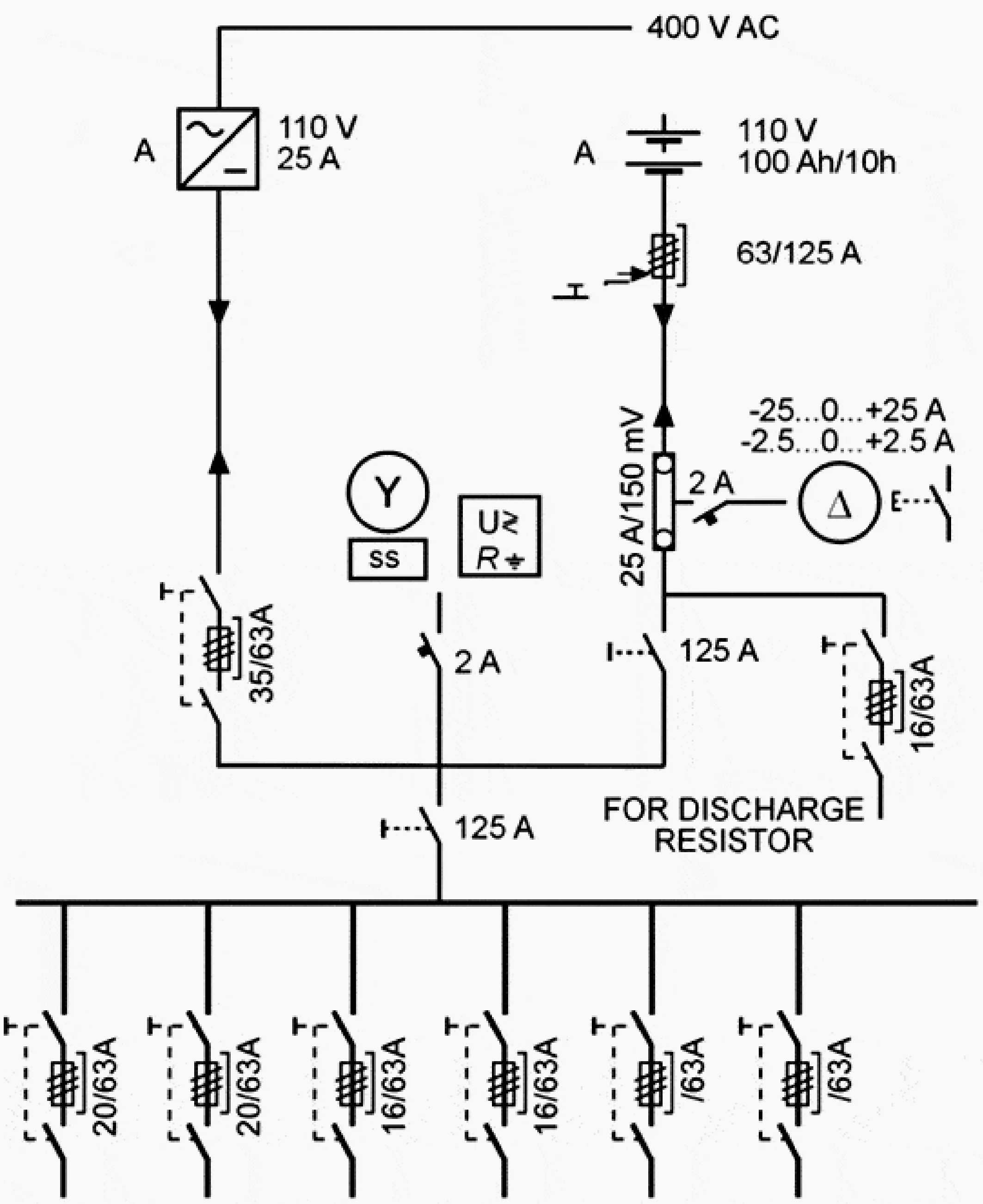


Figure 1 – Typical single-battery and charger application

In a typical installation, especially with batteries of considerable size, the batteries are installed **in a separate battery room**. The ventilation of the battery room shall be adequate, considering the type and size of the battery. Temperature level in the battery room **should not exceed 25°C**, since temperatures above this significantly affect the lifetime of the battery.

> *The charger and distribution switchboard are **normally located in the same room**, separate to the battery.*

The main fuses of the battery are housed in separate plastic boxes, one for plus connection and one for minus connection. These main fuse boxes should be placed close to the battery itself.

The main fuses are supervised and an alarm is given in a **case of a blown fuse** (Figure 2). If a main fuse (**F1 or F2**) is blown, the overcurrent tries to divert its path via **paralleled miniature circuit breaker (F1.1 or F2.1)**. This miniature circuit breaker has a very small rated current and is also tripped immediately, **causing the alarm contact 95-96 to close**.

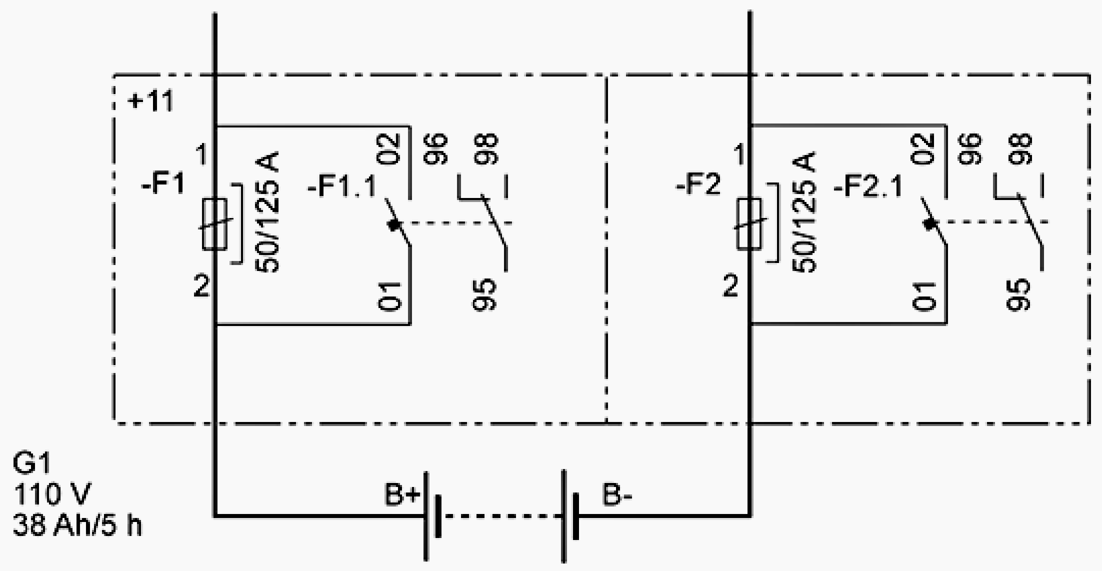


Figure 2 – Battery main fuse supervision

The cables leading from the main fuse boxes to the distribution switchboard are run separately for both polarities **with at least a 10 cm distance between each other**. The cables are installed in non-conductive (plastic) pipes for the total length.

Usually at the distribution switchboard there is provided **a separate fuse switch output for connecting external battery discharger equipment**, as shown in Figure 1. This output can be utilized while making a battery discharge test during substation commissioning or regular maintenance and testing.

Auxiliary power supply switchboard (photo credit: bpa.ru)

Duplication of the system

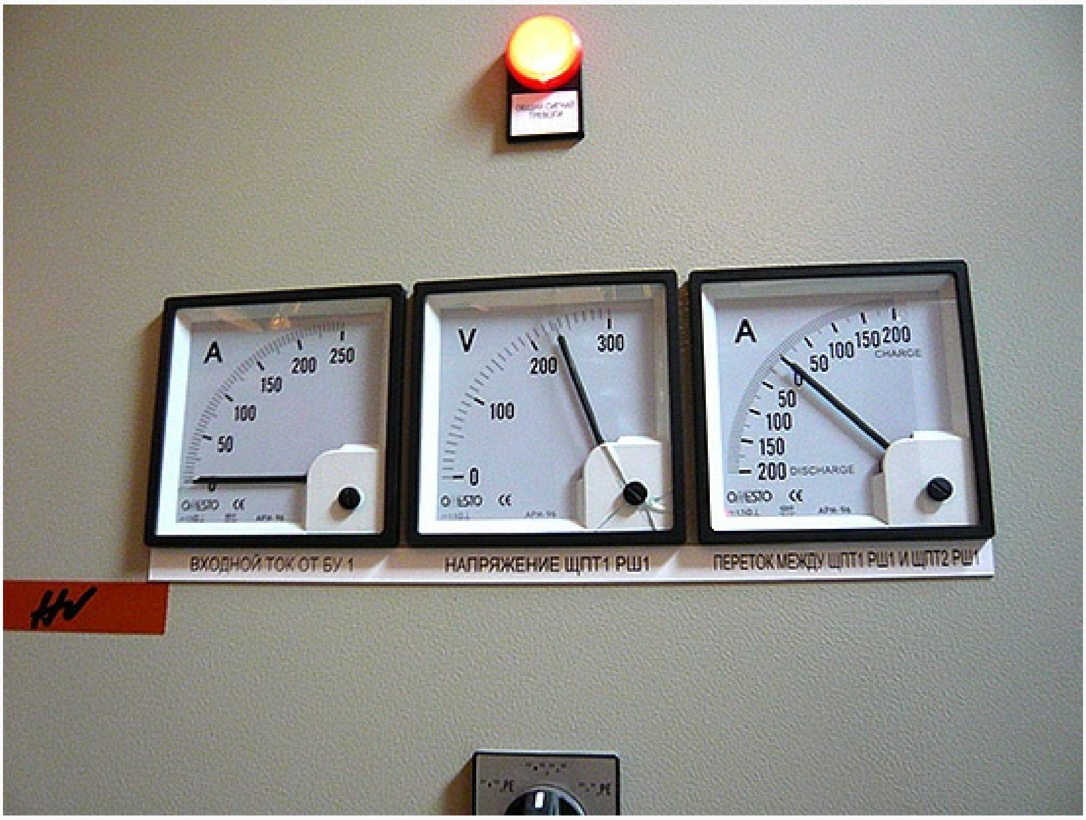
Relay protection, control and interlocking circuits //

Since the DC system supplying specially relay protection, control and interlocking circuits is of paramount importance to the **substation's reliable and safe operation**, the energy supply has to be always available. The need of this reliable supply becomes even more important during disturbances and faults in the high- or medium-voltage primary circuits.

As a result of these faults, the AC auxiliary voltage may not be available, because the incoming feeders may have tripped. After such situation, the re-energizing of the substation **is solely depending on the DC auxiliary power available**.

The importance of this reliable DC-auxiliary power is crucial for the substation as such. The higher (more important) role the substation plays from the complete distribution or transmission network point of view, the higher are the demands for the substation's DC auxiliary power systems.

> *To meet the increased demands for reliability and availability, **the DC system can be doubled** (Figure 3). This means that there are two separate systems, at the same voltage level, running in parallel. Both of the systems have their own batteries and chargers.*



Auxiliary power supply metering (photo credit: bpa.ru)

The distribution switchboard is divided into two separate sections , where both battery and charger sets are supplying their own sections.

There is a bus tie switch connecting the busbars of the different sections together. Under normal conditions, this bus tie switch is kept open. In case of faults or maintenance on one of the battery and charger sets, the bus tie can be closed, thus enabling the other battery and charger set to supply the whole load.

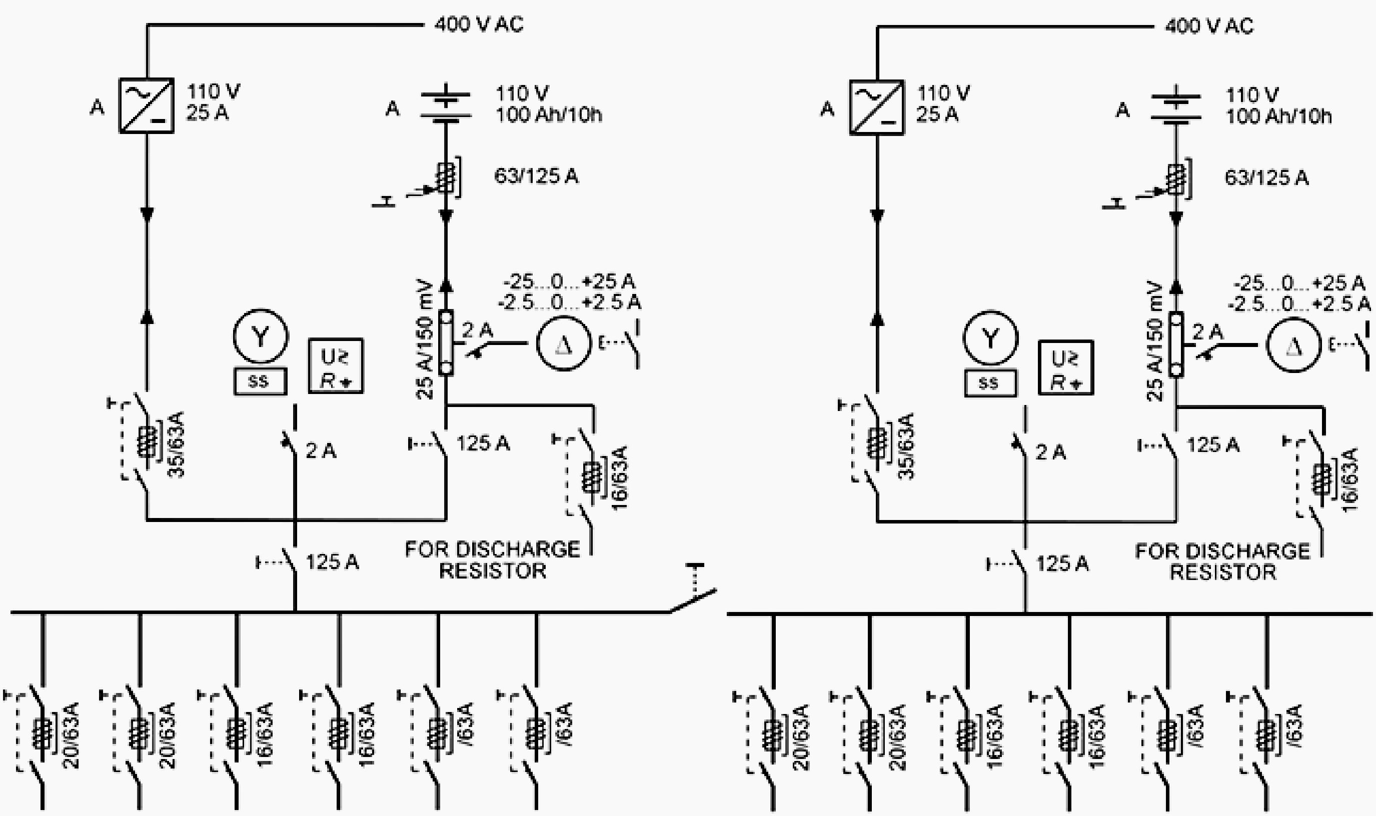


Figure 3 – Typical doubled battery and charger application

The actual circuits that the doubled DC system is supplying are distributed equally among the two sections in the switchboard. Circuits with doubled functions, like **trip circuit 1** and **trip circuit 2**, are connected to separate sections. This way, the fault in one of the sections does not affect the tripping circuits connected to the second section.

The doubling of circuits, **especially regarding protection circuits**, should continue all the way to the actual primary devices.

This means that for example with the circuit breaker there should be two separate tripping coils, one for trip circuit 1 and second one for trip circuit 2. The cabling for these two circuits (tripping coils) should be done **with separate cables utilizing**, as far as possible, also different cabling routes.

Furthermore, a common practice is that the main protection relays receive their auxiliary supply from as well as give their trip commands to the trip circuit 1, whereas the backup protection relays utilize the trip circuit 2 for the same functions. The local and remote circuit breaker control functions (opening command) typically utilize the trip circuit 1.

***Reference** // ABB's Distribution Automation Handbook – Elements of power distribution systems*