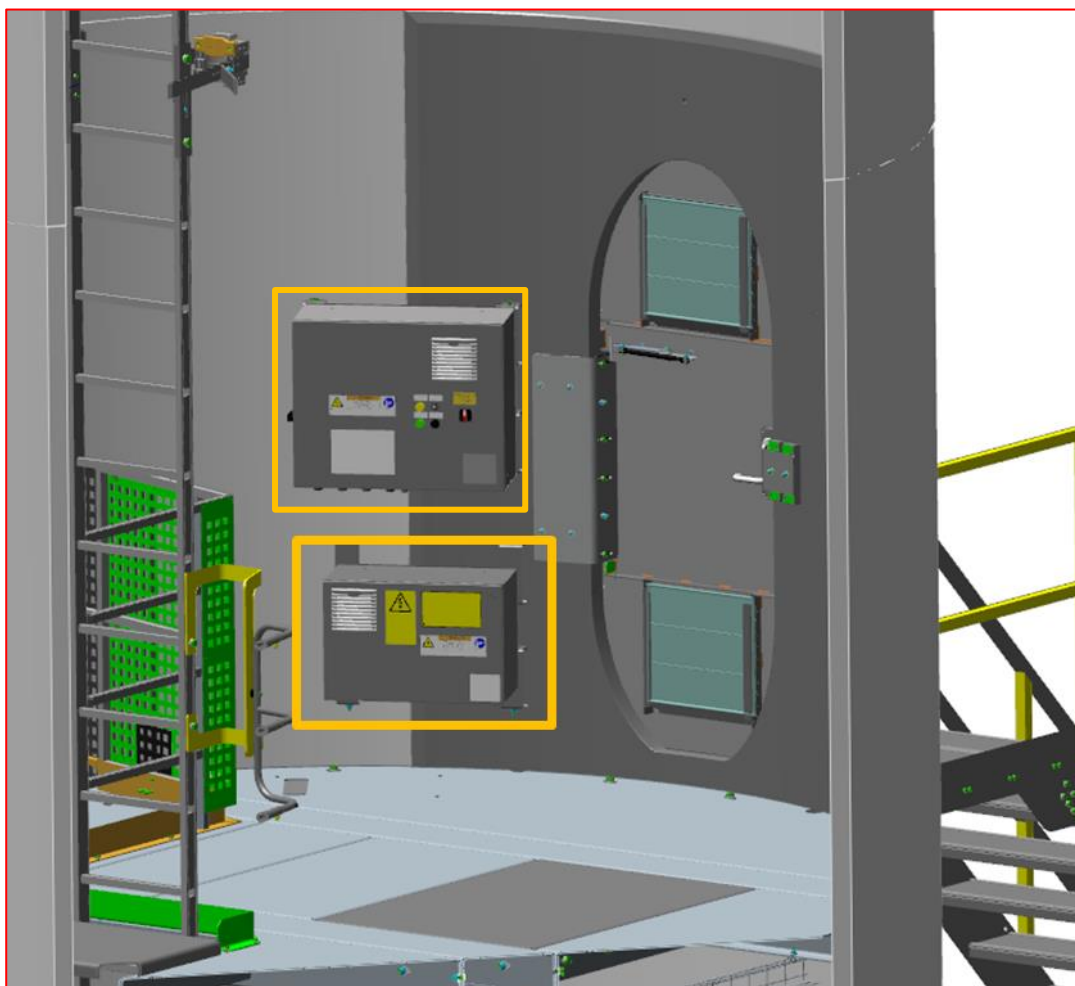


Document no.: 0064-5403 V00

# Light system description

## 2MW platform Mk10-11

## 3MW platform Mk3



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## 1 Disclaimer

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## 2 Introduction

The purpose of this document is to provide a functional description of the light system control box / Battery Box Option for the light system in the Wind turbine. For 2MW platform an additional functionality is added to support the Ready to Protect (RtoP) system in High Voltage Switchgear (HV SWG)

This document will cover two functionalities:

1. Light system operation
2. RtoP operation

For 2MW platform the RtoP system supports up to 48hrs, if all pre-conditions are full filled.

The 2MW and 3MW platform turbines have different functionalities and therefore it is important to pay attention to which turbine type the light system applies.

## 3 Light system operation 2MW/3MW

### 3.1 Work light / Emergency light

The light system design in the wind turbine is to provide work light on all identified workplaces in the turbine with a minimum level of 50lux. The concept of operation described as follows.

The supply lines to the luminaires in tower and the nacelle, are split in three parallel power conductors with common neutral and PE.

The power lines are describe with following identification, see also figure 3.1 for conceptual overview:

- Power conductor 1: Work light
- Power conductor 2: Emergency 1 (EMG 1)
- Power conductor 3: Emergency 2 (EMG 2)

Note.: The light inside the hub is **not** supported by this centralized light cabinet!

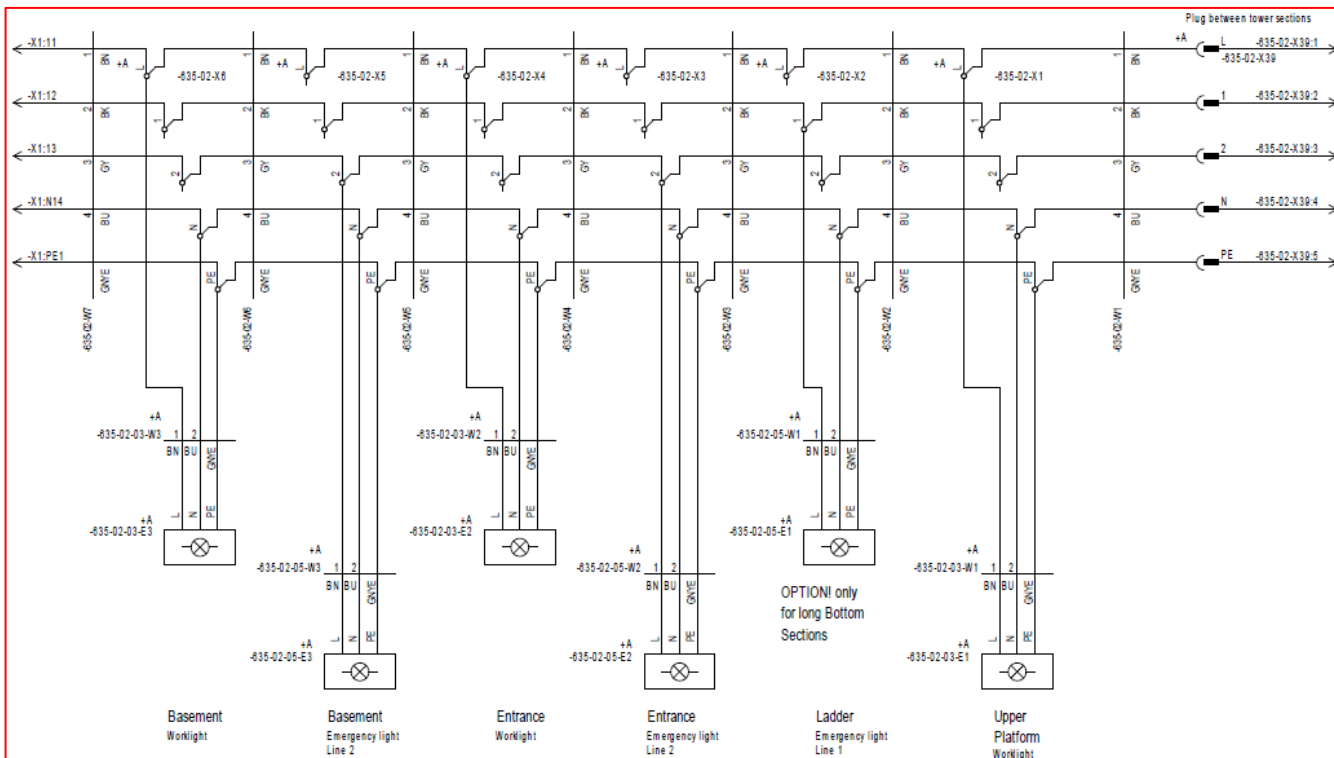


Figure 3.1.1 – Electrical layout of power lines & definitions

In normal conditions, all power lines will operate as normal work light. The condition will first change when normal grid is not present. When grid is lost, the normal work light operation gets disabled, and Un-interruptible Power supply (UPS) will automatically switch over to provide power for EMG 1 and EMG 2. Expect a short flicker in luminaires, until light UPS is in operation. The light level decreases in the turbine. Light level will drop from 50lux to minimum 10lux. This should bring attention the personnel to evacuate the turbine in safe manner.

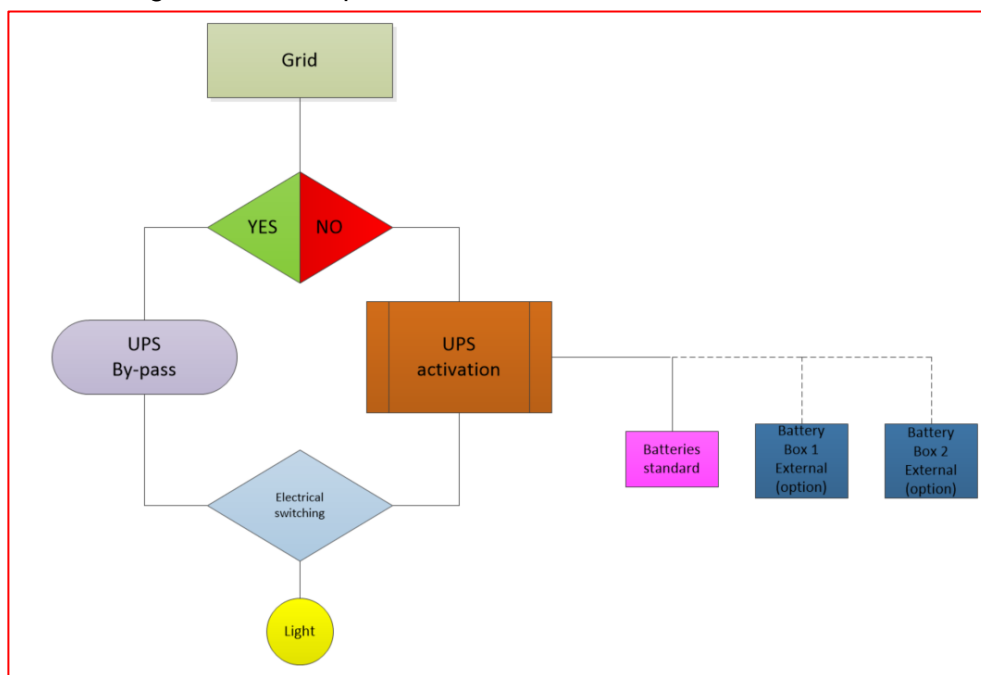


Figure 3.1.2 – Conceptual light system operation

This function is intended to advise the service technician that the grid conditions has changed, and light system is in Emergency light operating mode. It's prohibited, to work in turbine during emergency light mode. Technicians are obliged to evacuate the turbine until grid returns, or establish external supply to turbine.

### 3.2 Backup time

The standard light box cabinet ++51 is as standard, able to support 30 minutes back-up time for emergency / escape light. If more time is required, a battery box, can get connected to the Light system control cabinet. This will extend the back-up time to 60 minutes in total.

Two cables from battery box, is required to connect to the Light system control cabinet.

Up to two battery boxes can connect to the light system cabinet. Each battery box will provide additional 30minutes of backup time and will provide a total of 90 minutes back-up time for emergency escape/guidance light.

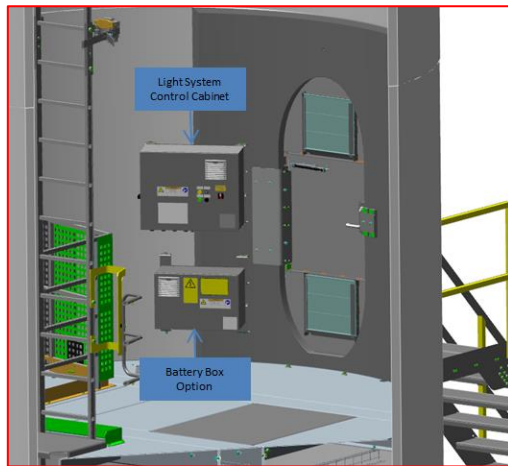


Figure 3.2.1: Principle location of Battery Box Option (Vestas light box version)

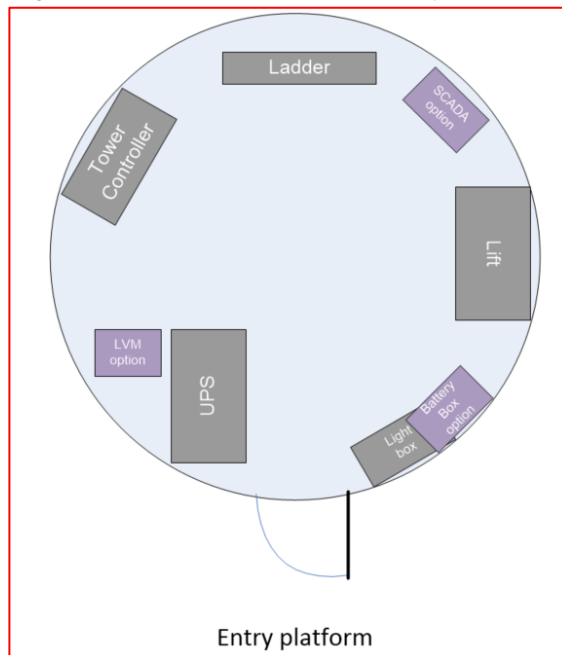


Figure 3.2.2: Location of cabinets at tower entry platform

## 4 Ready to Protect (RtoP)

### 4.1 RtoP operation only for 2MW

The light system for 2MW has an additional functionality, when emergency light is not in function. The function is to provide 24Vdc to the RtoP system. The 24Vdc is only to provide power to the Voltage Detection System (VDS) unit located in the HV SWG and a few relays located in ground controller. The VDS in HV SWG is demanding power for monitoring the high voltage grid up to 48 hours. Refer to electrical interface to VDS In figure 4.1.1.

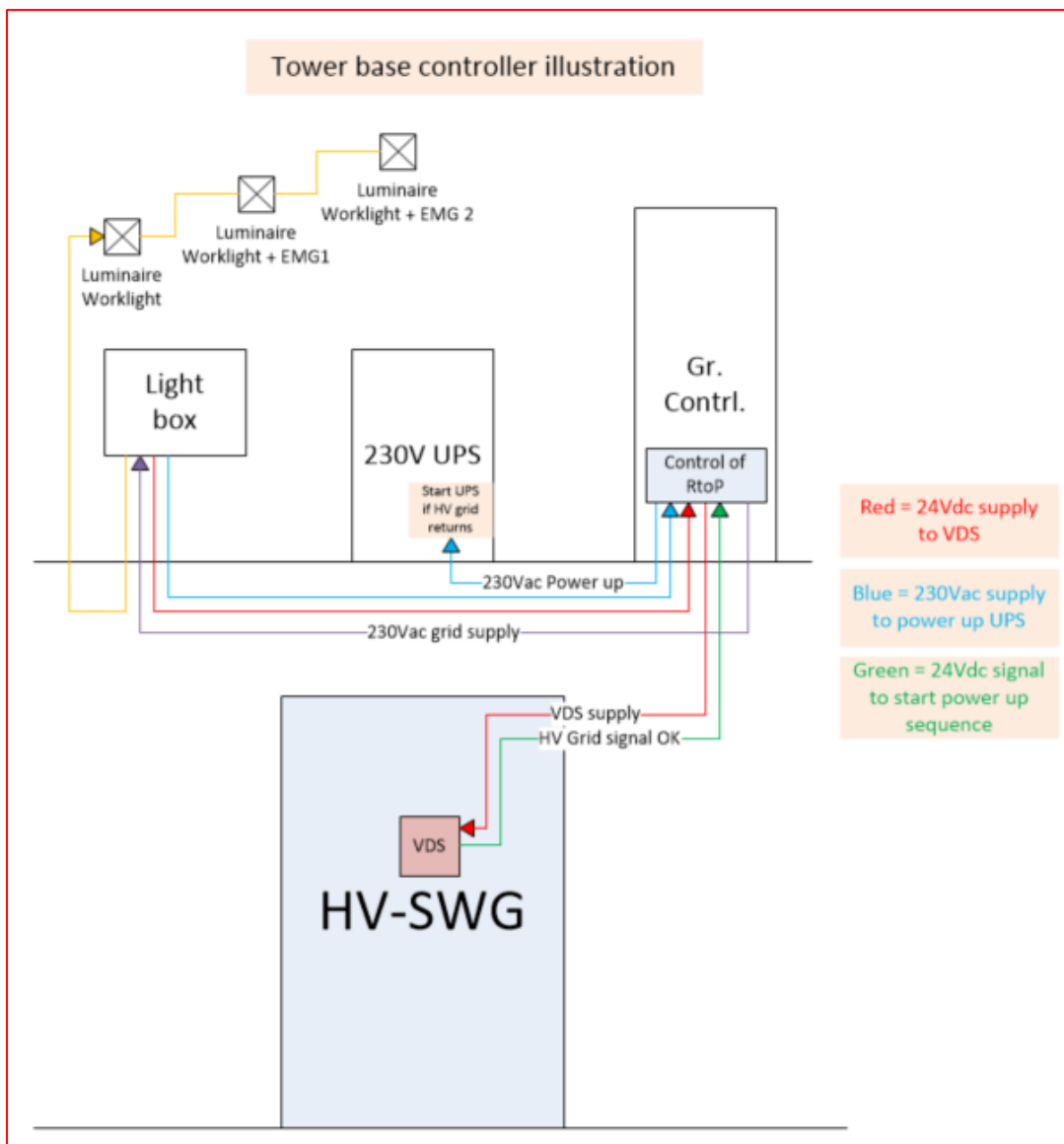


Figure 4.1.1 – Electrical connection overview to RtoP

When VDS detect return of high voltage grid, it will activate the reconnect power up sequence.

The requirement of 48 hours of VDS operation, will not be fulfilled, if personnel have been in turbine during grid drop and emergency light have been in use, due to drainage of batteries and no additional charging of light box batteries can be performed. Personnel safety is always higher rated than functionality.

**4.2 Automatic start-up sequence for 230V UPS**

The light box UPS system in ++51 is designed to start the 230V UPS system, when VDS relay detect the return of high voltage grid within the 48hrs window.

- The VDS relay will automatically activate a relay in UPS cabinet ++06. This relay will apply 230V to the mains of UPS input terminals. The UPS will automatically power up.
- Once the 230V UPS powered up, it will supply 24Vdc to the safety control functions, these functions will make a system check before HV SWG Circuit breaker can reconnect.

The system check consist of following components; Arc and Smoke detection relay + the Safety relay.

**Note. (Applies only for MK10C turbines with Vestas light box):**

**The output power from light UPS ++51, is in the low range of what is required to power up the 230V UPS in ++06. Some clicking from UPS cabinet ++06 can be expected during this pre-charge sequence. Pre-charge time can take up to 30seconds.**

**4.3 Automatic shutdown sequence for 230V UPS**

The RtoP system will not be able start automatically if the 230V UPS has not closed down in correct sequence.

When turbine loose the grid:

- Shutdown sequence of UPS will start in tower controller ++01. Timer -420-02-B6 will time out after 15min, the power to turbine controller will cut off.
- Timer -420-02-B4 starts to time out and after additional 15 minutes the HV SWG circuit breaker will trip, Arc, Smoke detection and safety system will cut off.
- After additional 5 minutes timer -420-02-B8 activates the UPS shutdown sequence.

Pre-conditions for correct VDS operation:

230V UPS shut down sequence. UPS shall shut down into a special sleep mode. When the shutdown signal 5 LED's on UPS panel front will sequent turn on/off up 10-15minutes, before UPS will be in sleep mode.

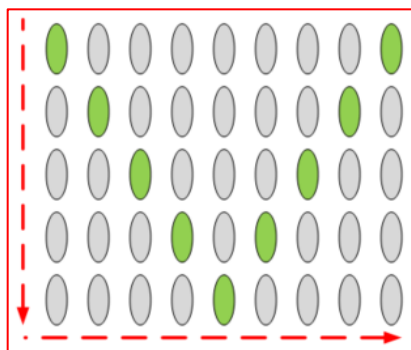


Figure 4.3.1: LED sequence illustration      Figure 4.3.2: LED on UPS panel front  
 Figure 4.2 – Sequential LED light illustration

- Sufficient capacity on batteries in light box is required. If several grid events have occurred within a short time, it can affect the charging of batteries, not fulfilling the automatic start-up sequence. Batteries may not be fully charged and the 48 hours of VDS operation may be jeopardised.

If VDS operation is exceeding the 48hrs window, Vestas Wind Systems A/S can not guarantee power to perform the RtoP. Expect batteries in light box ++51 to be charged from external power source if the 48hrs have exceeded.

## 5 Pre-conditions before leaving turbine

### 5.1 2MW MK10C and 3MW MK3A

Some preconditions are vital in order get RtoP system to operate correct. The importance of putting the listed dis-connectors and switches in correct position before personnel is leaving the turbine is required.

- Main dis-connector -635-01-02-Q1 is ON (pos. 1)
- Service dis-connector -635-01-02-Q2 is OFF (pos. 2)
- Light system activating switch -635-01-02-S1 is turned into OFF (pos. 3)



Figure 7.1 – Light system control cabinet 2MW MK10C & 3MW MK3A



If pos. 2 dis-connector is not turn into the off position, there will be a unnecessary of drainage of the batteries inside the light box ++51, in case of a high Voltage grid drop out. During the high voltage grid drop, the UPS system will start-up and power all the Emergency luminaires, to prevent drainage of batteries, the load must be dis-connected.

## 5.2 2MW Mk10D, Mk11 and 3MW MK3A/B/C/D/E

New supplier of light box cabinet is introduced. Cabinet layout changed from Vestas light box to new light box. Functionality remain the same, dis-connectors are having different locations.

For 3MW turbines it can be expected to have a mix of Vestas light box and new variant.

Main dis-connector -635-01-02-Q1 is ON (pos. 1)

Light system activating switch -635-01-02-S1 is turned into OFF (pos. 3)

Service dis-connector -635-01-02-Q2 is OFF (pos. 2)

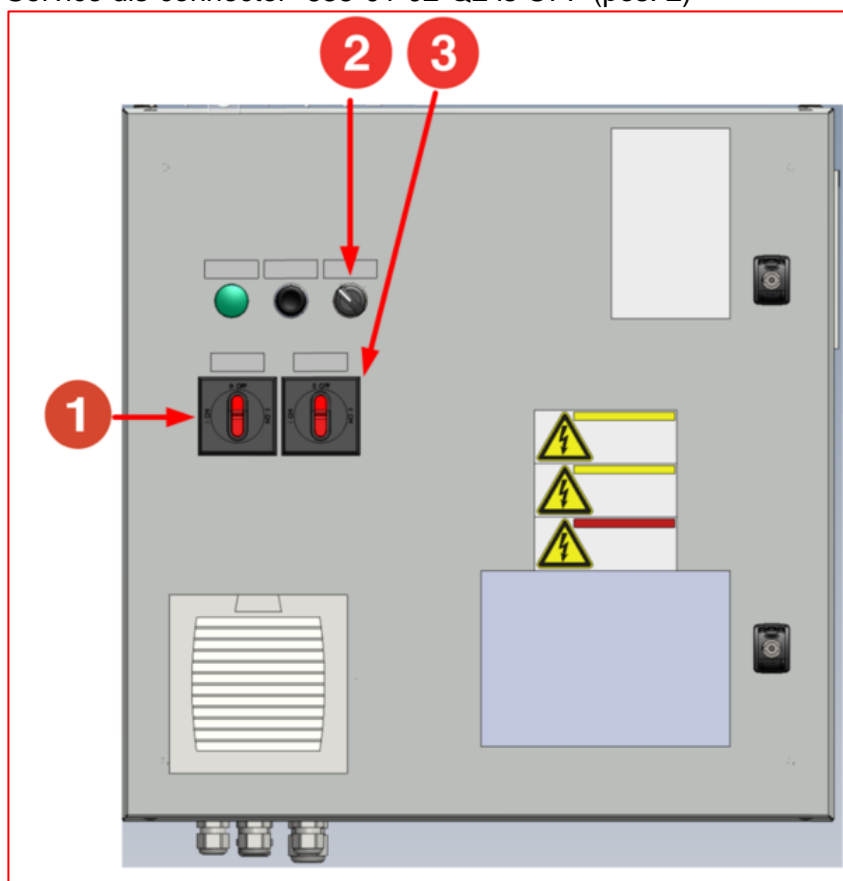


Figure 7.2 – Light system control cabinet 2MW MK10D and 3MW MK3B