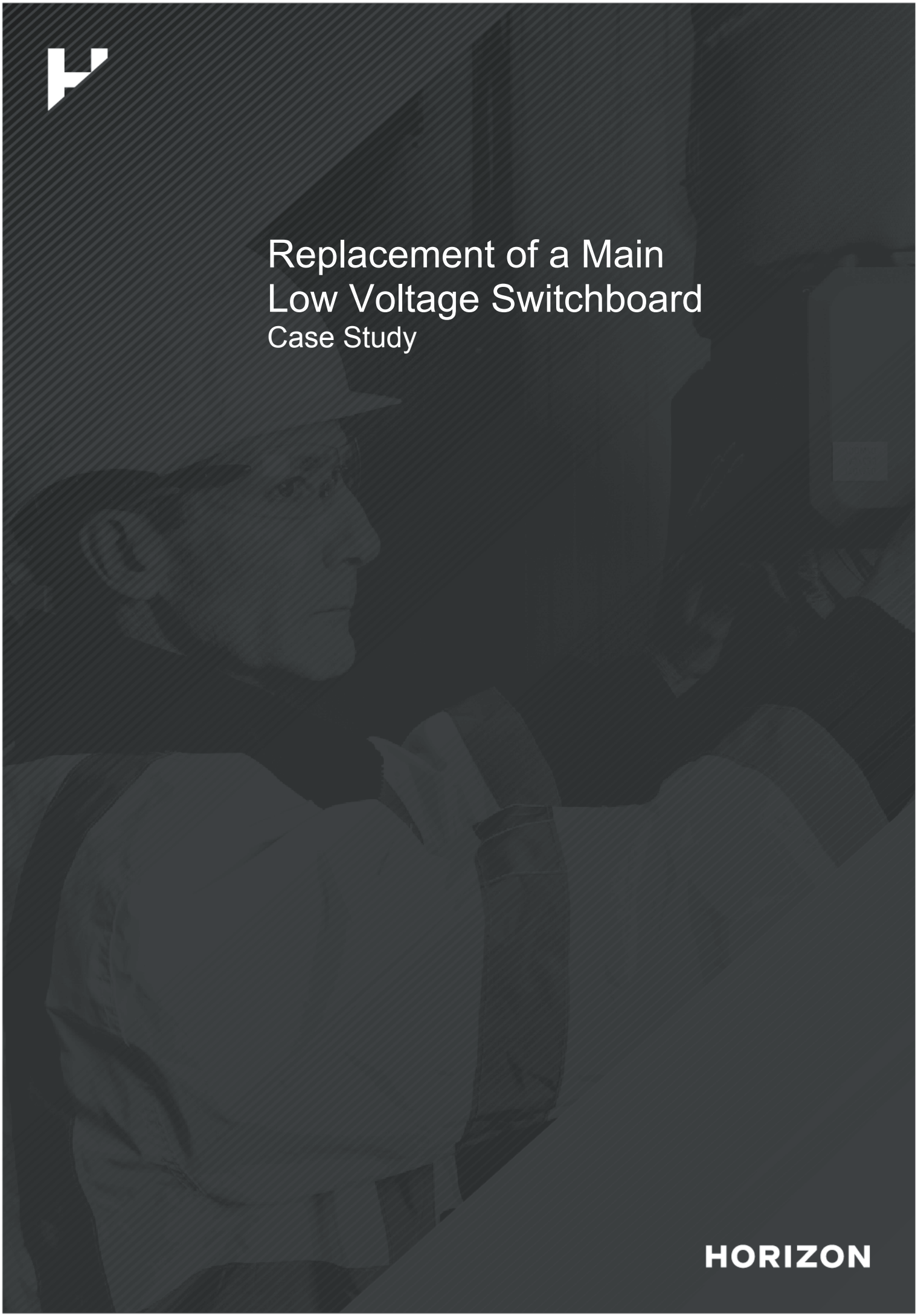
Replacement of a Main Low Voltage Switchboard

Case Study



HORIZON

Any enquiry about the purpose or content of this document should be referred to:

Managing Director
Horizon Engineering Solutions Ltd
Unit 11
Ravenhill Business Park
Ravenhill Road
Belfast, BT6 8AW

t. +44 (0)7850 507 116
e. mburrows@horizonengineering.co.uk

This is a Controlled Document and is maintained by Horizon Engineering Solutions Ltd, without whose permission it may not be modified, reproduced or released to any third party. Any changes to the Policy shall be made only by the Managing Director.

Contents

Section 1
Introduction

This Case Study Outlines Horizon Engineering Solutions Ltd involvement in the design, project management, isolation, testing, commissioning and bringing into service a new Main Low Voltage Switchboard at a Client Site.

It also highlights the issues and difficulties which can often arise when dealing with old switchgear legacy issues on Client sites.

We also hope that it illustrates the range of services and solutions we provide to our Clients.

Section 2
Project Background

The existing switchboard was installed in the early 1970's and supplied electrical power to a significant area of a production facility at one of our Client sites.

During a detailed internal inspection carried out by a Client appointed switchgear maintenance specialist it was found that:

- There were no available maintenance records or drawings.
- The switchboard had not been maintained for several years as evidenced by the build up of dirt and grime both internally and externally.
- The internal separation design of the switchboard was such that it could only be safely isolated utilizing the supply transformer HV circuit breaker.
- Labelling on the switchboard was confusing and indistinct.
- Several voltmeters, ammeters, indicator lights and control switches were found not to be functioning and several CT's were found to be burnt out.
- The switchroom floor and walls were covered in dirt and grime.
- Parts of redundant switchgear were found to be lying all over the switchroom floor.
- There was a redundant unsecured power factor control panel containing suspected PCB filled capacitors.
- Numerous cable connections onto switchgear were found to be in a poor state of repair due to the cumulative effects of repeated overheating and cooling.
- Most of the switchgear arc chutes were suspected to contain Asbestos materials.
- Several protection relays were found not to be functioning and beyond repair.

At this point it was evident to the site team that emergency remedial repairs would have to be carried out to return this switchboard to service. It was fortunate that these defects were discovered at the start of a weeklong shutdown period.

The site team enlisted the support of Horizon personnel to prepare an Emergency Response Plan and engage the services of several specialist contractors as follows:

- An Asbestos specialist to inspect and confirm the nature of the arc chute material. The specialist duly confirmed that the arc chutes did indeed contain asbestos materials. However, he advised that in his opinion the arc shuts were intact, did not pose a risk and provided they were not disturbed that they could remain in service. He also advised that the switchboard should be labelled as containing Asbestos materials and added to the Client Asbestos register.
- A competent switchboard installation contractor then proceeded to:
  - Remove all defective protection relays.
  - Install, test and commission spare protection relays which were on site at the time.
  - Replace all defective CT's and associated wiring.
  - Clean the switchboard internally and externally.
  - Clean the switchroom and remove all redundant materials.
  - Ductor test the switchboard busbar assemblies.
  - Flash test the switchboard.
  - Replace all labels, indicator lights, and control switches, and were possible try and repair all defective voltmeters and ammeters.
  - Exercise all switchgear and carry out maintenance in accordance with the manufacturer's instructions.
  - Inspect the PFC capacitors which were found to contain PCB.

- On completion of the remedial works to the switchboard an electrical contractor:
  - Renewed all the defective cable connections onto switchgear and were this was not possible moved the connections onto spare switchgear within the switchboard.
  - Verified and tested all outgoing circuits.

  The above works were completed within five days and the switchboard was returned to service in time for the start-up of production.

  Following a review by the Client it was concluded that due to the deteriorating condition and importance of this switchboard to production operations it would have to be replaced.

  Initially Horizon were appointed to prepare a costed business case proposal in accordance with the Client's capital application process.

  Following approval of this proposal Horizon were appointed to design and project manage the entire project.

Section 3
Project Execution Plan

To execute this project in a timely and cost-effective manner in accordance with the Client's business needs a detailed Project Plan was prepared identifying the key elements and specific tasks which would need to be carried as follows:

Design

a. Preparation of Switchboard and Installation Specifications and Drawings.
b. Approval of Switchboard manufacturing drawings.
c. Approval of Contractor prepared installation drawings and technical submissions.
d. Carrying out of Protection and Co-ordination studies.
e. Attendance at Switchboard Factory Acceptance Testing.

Procurement

a. Preparation and issuing of installation enquiry documentation to Client approved competent electrical contractors and switchboard manufacturers.
b. Making recommendations to the Client regarding the appointment of contractors based on analysis of returned enquiry documentation.
c. Monitoring and agreeing Contractor procurement plans for the purchase of the switchboard and any long lead materials and equipment.
d. Delivery, offloading and temporary storage of the switchboard on site.

Pre-Shutdown Works

a. Liaison and notification of key stake holders within the Client organisation regarding the power outage which would be required to changeover the switchboard.
b. Approval of Contractor Risk Assessments and Method Statements.
c. Site clearance to facilitate Contractor site set up.
d. Excavations to facilitate cable jointing and Earthing System installation.
e. Installation of Earthing System.
f. Installation of replacement electrical services within the switchroom.
g. Connection of temporary mobile generators to support essential Client utility, production and fire safety systems.
h. Preparation of Safety documents in accordance with site Electrical Safety Rules to include:
   I. i.Switching Programmes.
   II. ii.Earthing and isolation drawings.
   III. iii.Permits.
   IV. iv.Risk Assessments and Method Statements.

Shutdown Works

a. Issuing of all appropriate Permits.
b. Transportation of switchboard from temporary storage to Main LV Switchroom.
c. Isolation and disconnection of essential Client utility, production and fire safety systems to facilitate connection of temporary mobile generators.
d. Starting, tending and fuelling of generators for the duration of the shutdown.
e. HV and LV switching operations to isolate and make safe the existing switchboard from all sources of supply and from the existing low voltage distribution system.
f. Removal and disposal of asbestos arc chutes by a specialist asbestos removal contractor.
g. Removal of redundant PFC control panel and associated PCB filled capacitors by a specialist contractor licenced to remove and dispose PCB’s.

h. Disconnection and identification of all incoming and outgoing cables.
i. Dismantling, removal and disposal of existing switchboard.
j. Modification of existing switchboard support steelwork to facilitate installation of the new switchboard.
k. Offloading and erection of the new switchboard and associated power factor correction panels within the switchroom.
l. Diversion, jointing and connection of existing cabling into the new switchboard and new power factor correction panel.
m. Erection of BMS Panel and connection of interconnecting cabling.
n. Completion of lighting and emergency lighting installation within the switchroom.
o. Completion of small scale power installation within the switchroom.

Testing and Commissioning

a. Site acceptance testing of the new switchboard including verification of protection relay settings.
b. Testing of BMS interconnecting cabling to enable BMS engineers to recommission the BMS outstation.
c. Testing of all LV power cabling.

Re-instatement

a. Disconnection of mobile generators and re-connection of Client utility, production and fire safety systems to normal mains supplies.
b. Cancellation of all Permits.
c. HV and LV Switching operations to facilitate the progressive re-instatement of all power supplies.
d. Site checks to verify that all systems had returned to normal service.

Section 4
Project Timeline

The project started in February with the manufacture of the Switchboard and Power factor Control Panels which were completed in June.

The installation of the switchboard and PFC panels were originally scheduled to take place during the Client's July shutdown period. However due to the Client's business needs at that time it was not possible to get a shutdown of sufficient duration to permit the replacement of the switchboard and PFC panels. The Client was also not able to advise when the next suitable window would be.

Therefore, in conjunction with the Client, the electrical installation contractor and the switchboard manufacturer it was agreed that the Switchboard and PFC panels which were ready for delivery would be packaged and put into temporary storage on the Client's site until a suitable convenient date could be agreed with the Client.

In October Horizon was advised that the new switchboard could be installed during the December Christmas shutdown period and all contractors were duly notified.

Pre-Shutdown works commenced in late November and culminated in the existing switchboard being isolated from the Client's LV Electrical Distribution System four days prior to Christmas.

Work began with the removal and disposal of the asbestos arc chutes and PCB filled capacitors by specialist contractors.

Thereafter the electrical installation contractor began to disconnect all cabling and dismantle and remove the existing switchboard, followed by modification of the existing switchboard support steelwork in readiness for the erection of the new switchboard. Lighting, emergency lighting and small-scale power installation works were also carried out in the switchroom. These works were completed on Christmas Eve. The site was then shut down for Christmas Day and Boxing Day.

Work resumed early on 27th December with the erection and site acceptance testing of the new switchboard, including the commissioning of protection relays. All works were completed late that evening in preparation for the reconnection of cabling.

From the 28th to 30th December the electrical installation contractor progressively re-connected and tested all cabling so that by early evening on 30th the new switchboard was ready for switch-on.

After cancellation of all permits power was progressively restored to the site with the final circuit being being energised at midnight in readiness for the resumption of production activities the next morning.

This switchboard has now been operating trouble free for several years. The internal separation design of the switchboard and the inclusion of spare circuit breakers has enabled the Client to add new circuits without shutdowns to meet the everchanging needs of a dynamic production facility.

Horizon Engineering Solutions Ltd
Unit 11 Ravenhill Business Park
Ravenhill Road
Belfast BT6 8AW
t. +44 (0)28 9099 6040
e. info@horizonengineering.co.uk

horizonengineering.co.uk

HORIZON