



Before



After

Oil Circuit Breaker Explosion

The incident occurred in a South African Coal Mine

September 2009

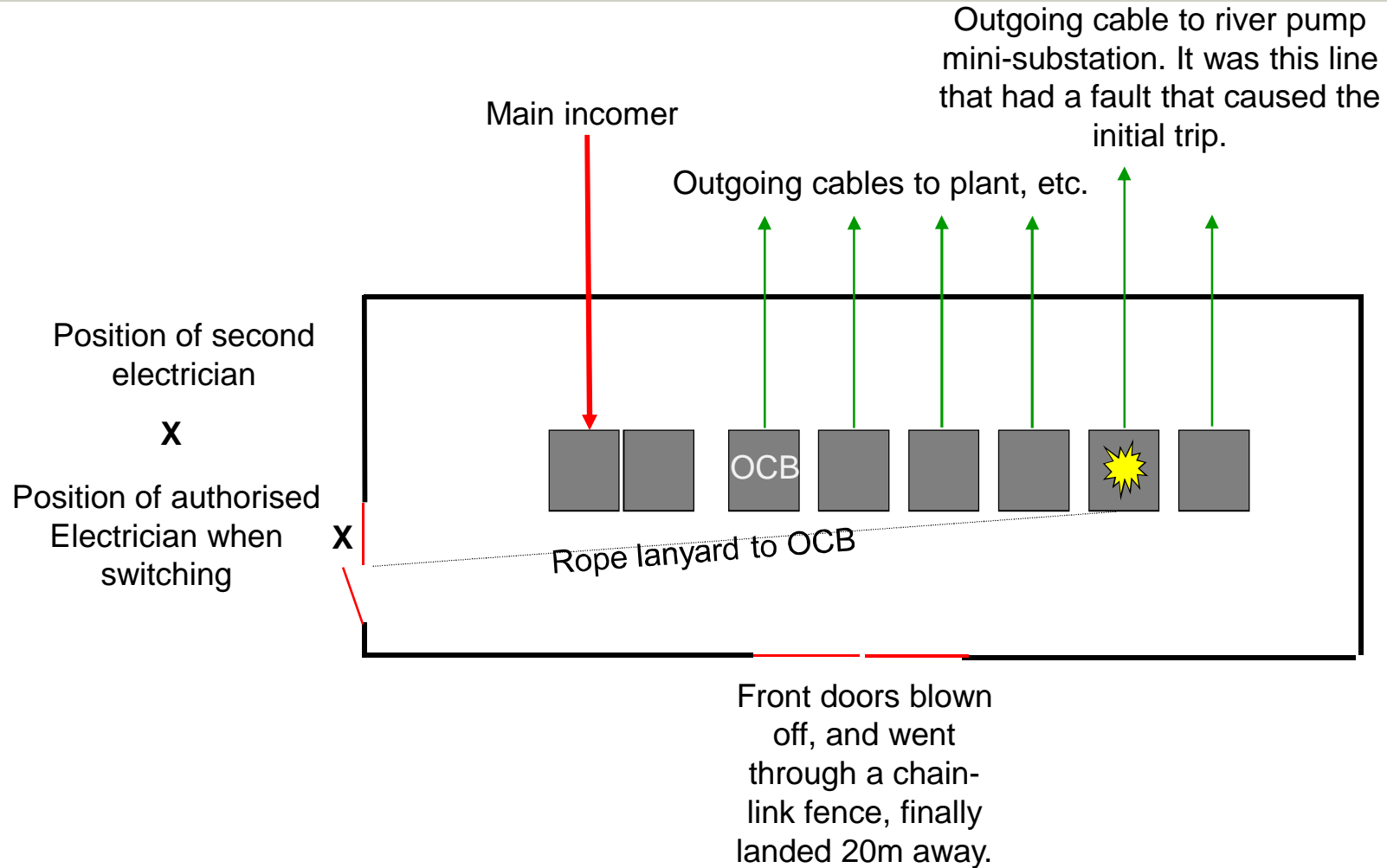
Incident Description



Description of Incident

The authorised electrician undertook remote switching of an 11kV Oil Circuit Breaker (OCB) at the main substation. The OCB exploded, probably due to mechanical failure, and the resultant blast wave blew off the doors of the substation, and seriously damaged the building. The electrician broke his upper right arm when the door behind which he was standing was forced violently open. An intense fire followed, destroying all equipment within the substation.

Diagram of substation layout



Incident Overview (photos)



This door was latched, top and bottom, and exploded outwards

Position of electrician when switching. Note the flash-suit worn during operation.

Incident Overview (photos)



Relays housed in this unit

Breakers in this unit, submerged in oil. Note blast damage to steel casing.

Bank of OCB's. The unit second from right exploded. The rest were damaged by the blast and ensuing fire.

Incident Overview (photos)



Above: Position of front doors. They were blown towards the camera position, and though a chain-link fence, the remains of which can be seen in the foreground.

Left: Doors behind which electrician sheltered during switching. Note the cracks in the brickwork. Supports were installed after the event.

Underlying Root Cause & Key Contributing Factors

Underlying Root Cause:

The contacts in the switchgear did not engage or disengage correctly in time to prevent prolonged arcing and subsequent oil vaporisation, which led to a violent explosion within the substation.

Key Contributing Factors:

1. Age of the switching equipment (OCB switchgear)
2. Cable fault and the electromechanical relay not flagging the cause of the trip prior to the incident occurring
3. Risk assessment not considering the explosion potential

Key Learnings:

1. Following procedures to the letter can save lives - operational discipline
2. OCB switchgear has explosion potential and must be managed accordingly
3. The fundamental success of safety depends on thorough risk assessments

Permanent Corrective Actions to be Taken

Action	By when
Replace all OCB's with modern technology (SF6 or vacuum)	31 August 2011
Ensure electrical remote switching is fitted to all medium voltage switchgear to allow for switching from outside the building (at a safe distance) in which the switchgear is housed	16 October 2009
Where OCB's are currently used, all baseline risk assessments must be reviewed to include mitigation strategies for explosions. The hierarchy of controls must be applied. Revise procedures accordingly	30 September 2009
Comprehensive testing must be done on all medium voltage switchgear. This includes oil testing, speed tests and testing of all mechanisms.	31 December 2009
Full flash suits must be worn when local racking and spring charging takes place on medium voltage switchgear	30 September 2009