SHE Bulletin No. RF-LFI-WS-027

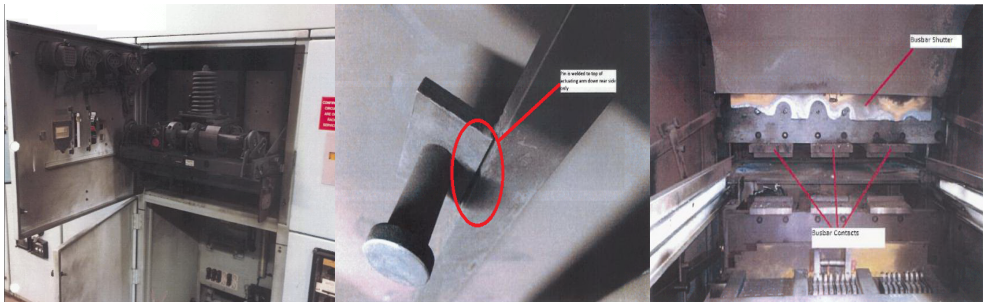
FOR ISSUE TO WHOLESALE, ENTERPRISE, EMBEDDED GENERATION NETWORKS

SHE ALERT

ELECTRICAL FLASHOVER TO SWITCHBOARD INCOMER 415v CIRCUIT BREAKER – NON SSE RELATED

What happened?

An electrical flashover occurred at a non-SSE Power Station which involved a 415 volt switchboard ACB (see external report below for further details). Whilst re-energising the switchboard a flashover occurred causing an ejection of sparks and flames to exit the cubicle. The switchboard Incomer ACB door was fully closed and secured resulting in the cubicle containing the flashover and venting out the vents at the rear of the cubicle as it is designed to do in the event of such a fault, i.e. away from any personnel in front of the switchboard. No injuries occurred.



The investigation found that the flashover was caused by the busbar shutters on the 415v ACB cubicle not being fully opened when the ACB was racked in.

The reason for the busbar shutters not opening fully was that the shutter lifting pins had become bent. The investigation concluded that the pins would only become bent if the shutter linkage was prevented from moving when the ACB was pushed into the service position. For this to occur, either the shutter or shutter operating mechanism was jammed in some way, or it could have been due to an isolation lock being inadvertently left on when attempting to insert the ACB.

Further inspections of the pins identified that they were only welded to the actuation arm on one side rather than on both sides which allowed the pins to bend more easily.

This event demonstrates the importance of remote operation of electrical switchgear, or the operation on a dead circuit whenever possible.

What action is required?

Manager:

- Ensure a switchroom management process is in place to successfully control access, maintenance and switching operations

Supervisor:

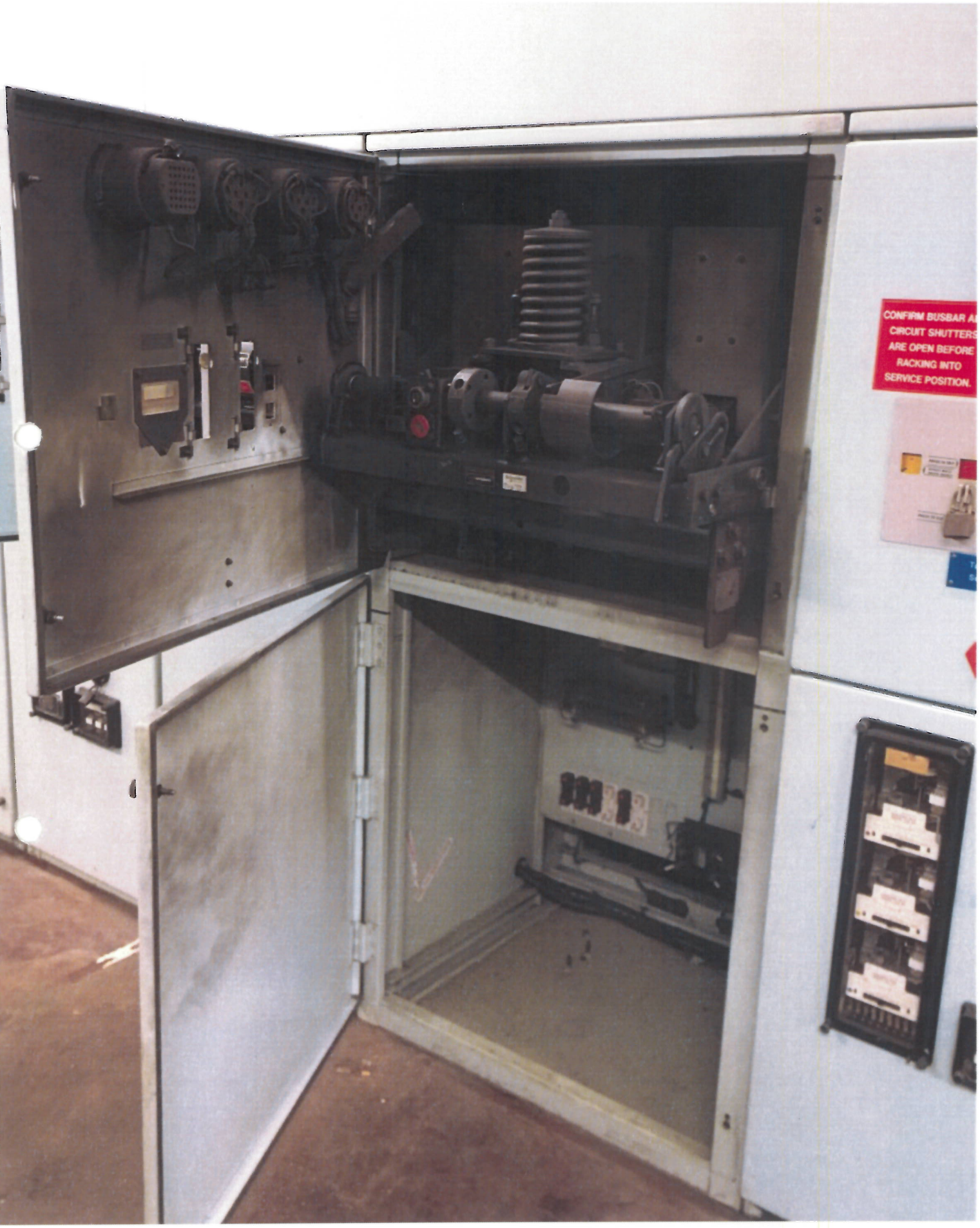
- Provide a suitable maintenance schedule to adequately maintain switchgear
- Check the integrity of busbar pins for fatigue or cracking and implement repairs if necessary

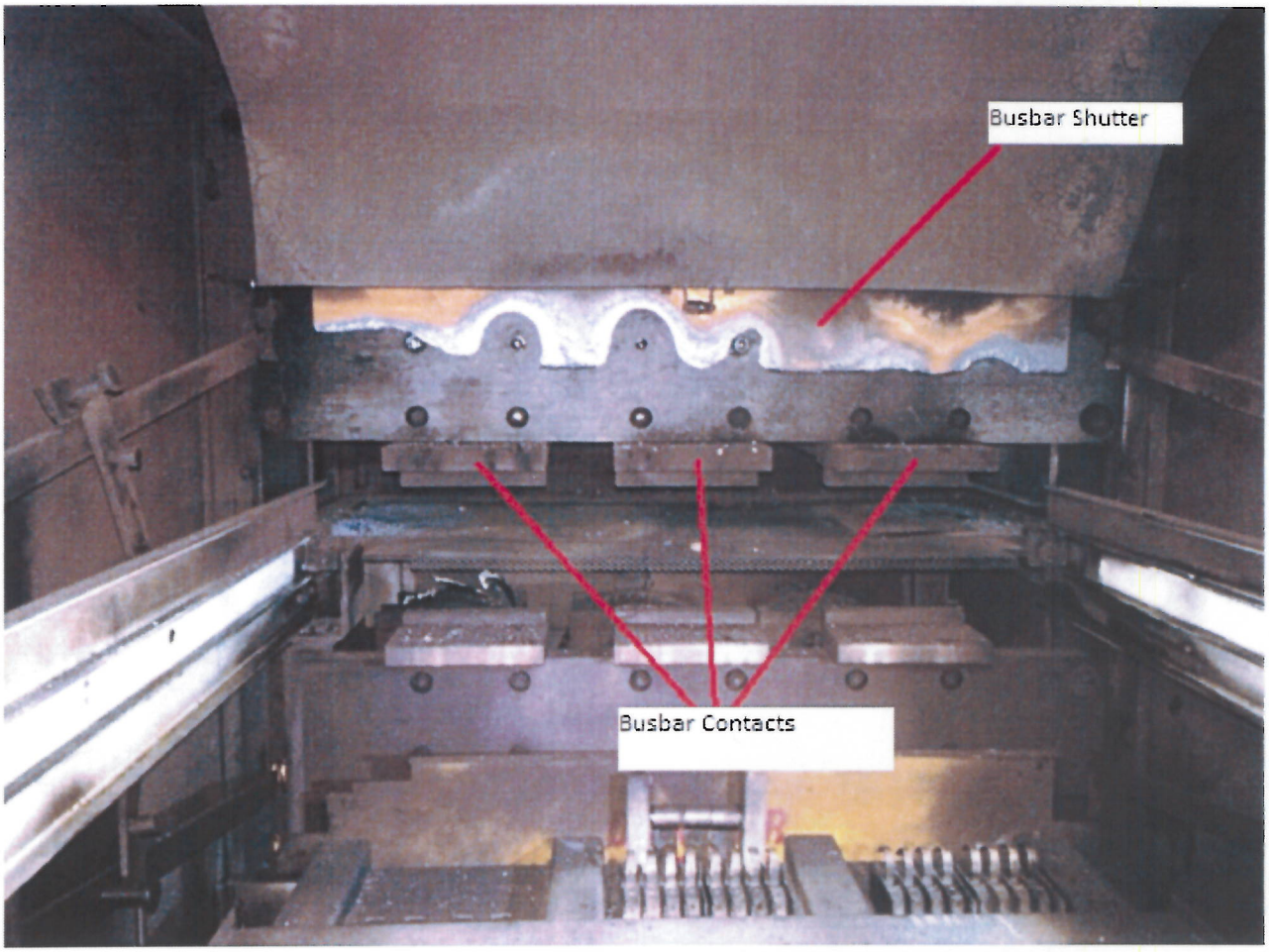
Everyone:

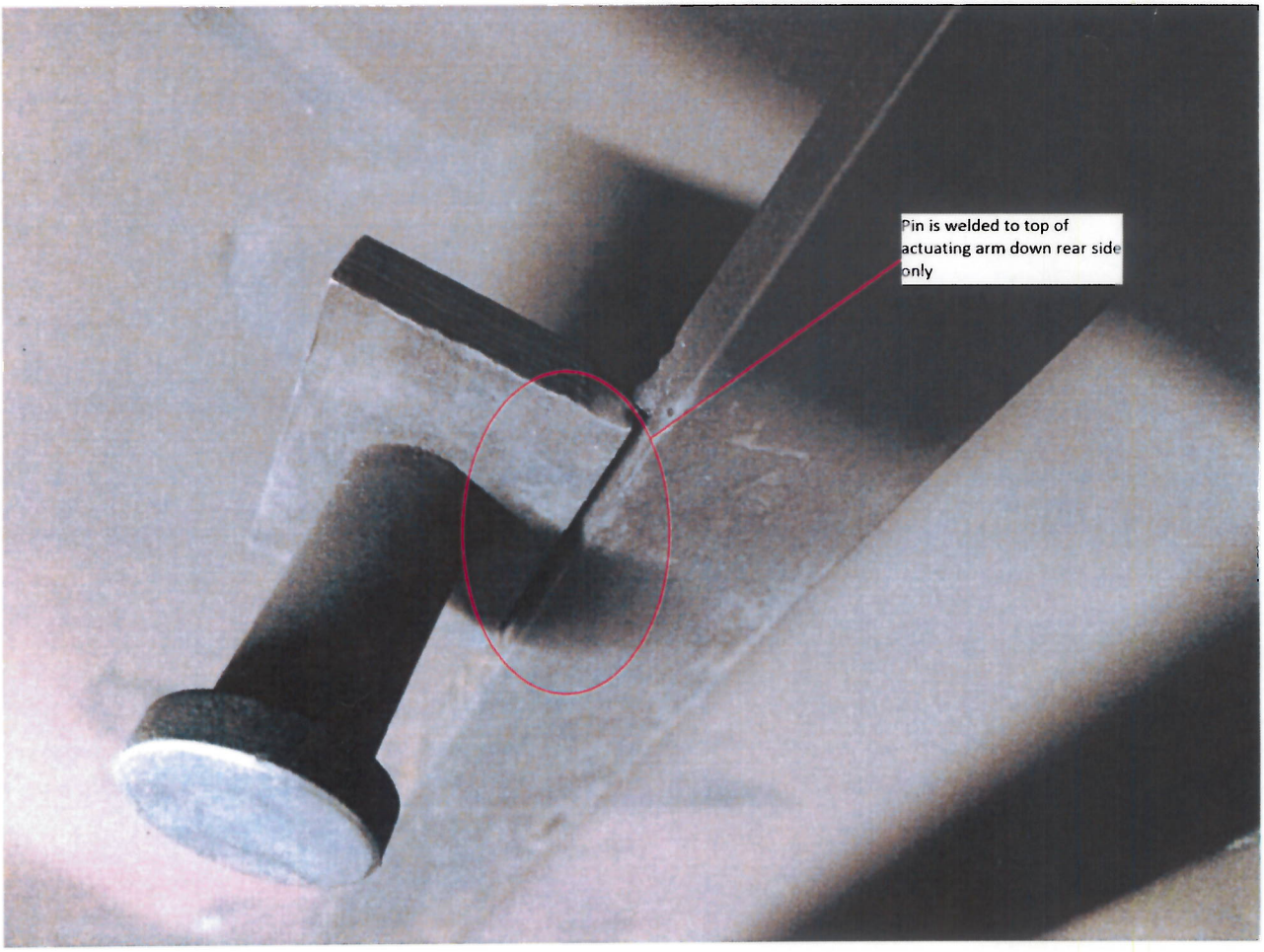
- Ensure all points of isolation have been removed if you are responsible for their removal
- Ensure switchboard doors are fully secured to contain any release of electrical energy
- Follow all procedures correctly and wear suitable PPE for the task
- Think about your work position – am I in the line of fire?

Communication by (ü)	LSG		Notice board	ü	Tool-box talk	ü	Team brief	
Communication complete by (ü)	1 week		2 weeks		1-month	ü	2-months	

Issued by: Robert Thompson, Thermal Generation Business Support — Date of issue: 29:08:2016


CONFIRM BUSBAR A
CIRCUIT SHUTTERS
ARE OPEN BEFORE
RACKING INTO
SERVICE POSITION.


Busbar Shutter
Busbar Contacts


Pin is welded to top of actuating arm down rear side only

Eggborough
Power Ltd

Fire: F9782/9628

Stage: Archive

General Details of the Fire

Fire Title	**Electrical Flashover on U2 Boiler / Turbine Services Switchboard 2A**
Occurred	Fri 17 Jul 2015 17:09
Business Unit	./Eggborough
Fire Location	Eggborough
Site Area	Internal Plant Area - U1 / U2 28ft Boiler House Switchroom
Plant Item	Unit 2
Details	Electrical flashover occurred on switchboard incomer 415v ACB whilst re-energizing switchboard. Small amount of sparks / flames / smoke witnessed expelling from switchgear. Sparks / Flames rapidly extinguished themselves without intervention. No casualties or injuries incurred.
Immediate Actions	Incident alarm raised and IRT deployed. Fire Brigade called to site. Station IRT and Fire Brigade checked for evidence of heat / fire and non present, hence, no fire extinguishers or water was necessary. Switchroom purged of residual smoke. Switchboard isolated and made safe.

Assessment

Type of Safety Incident	Process Safety
Risk Assessed	No
External Agencies	
Further Investigation	yes
Due By Date	16 Aug 2015
Urgent	no
Nominated Person	Steve Clark
Investigation Requirement	Steve, please investigate this incident to understand the root cause of the flashover. Review past preventative maintenance regimes , the frequency of these activities, recent maintenance work and the operational steps that were taken prior to the flash over occurring. Record all actions on the Madison system, along with any improvement actions that may have come out of the investigation.

Investigation

Contributing Cause	Job Factors - Depreciation of equipment
Other Cause	
Investigation Findings	Investigation has shown that the flashover was caused by the busbar shutters on the 415v Boiler / Turbine Services Switchboard 2A Incomer ACB not being fully opened when the ACB was racked on. This resulted in a 3 phase flashover when the circuit was subsequently energized by remotely closing the 11kV ACB on the 11kv to 415v Boiler Turbine Services Transformer 2A. It is important to note that 415v Boiler / Turbine Services Switchboard 2A Incomer ACB door was fully closed and the securing screws were fully tightened down. This resulted in the switchgear cubicle containing the flashover and venting out of the vents at the rear of the cubicle as it is designed to do in the event of such a fault i.e. away from any personnel in front of the switchboard.

	NOTE - This ACB does not have a remote operation facility and therefore the correct procedure is to close the circuit breaker locally with the incoming supply isolated so that it is closed onto a dead circuit. This was done by opening the 11kV Boiler / Turbine Services Transformer 2A ACB remotely before closing the 415v Incomer ACB local to the switchboard. The reason the busbar shutters have not opened fully is because the pins on the operating linkages have been bent. As the breaker is inserted into the service position in the cubicle, ramps on the breaker operate against these pins raising the shutters. The pin is only welded to the actuating arm along the outside edge and the weld penetration is shallow which makes the attachment weaker than it otherwise could be if fully welded. . The normal clearance between the fully open busbar shutters and the busbar contacts is approximately 45-50mm. The distorted pins were measured to be up to 13mm higher than they would have been if they were not bent. Due to the ratio between the pin to pivot distance and the shutter to pivot distance being approximately 3.7 this translates into a loss of movement in the shutter of up to 48mm. This explains how the busbar to busbar shutter contact occurred. The Boiler / Turbine Services Switchboard 2A, including the incoming ACB and cubicle, was maintained during the major outage in September 2014 by Schneider Electric as part of the Outage Electrical Switchboard maintenance contract. This includes checking the busbar and circuit shutters and their operating linkages. The permit isolation for this work shows that the isolation was external to the switchboard on the 11kv ACB supply to the Boiler / Turbine Services Transformer and NOT on the busbar and circuit shutters, and therefore Schneider were free to check for free movement / operation of the shutters and operating mechanism. There is no suggestion in their final report that the there were any issues with the shutter operation or pins / linkages. The Boiler / Turbine Services Switchboard 2A Incoming ACB and cubicle were again maintained (PM) on 30th May 2015 by EMD, at Operations request, as part of the checks required in preparation for the release and maintenance of 11kV Station Board 2. These checks found no issues with either the ACB or the cubicle equipment, although operation of the busbar and circuit shutters could not be checked as they were locked shut as part of the isolation for the safety document. The operating pins, however, were checked and lubricated as part of the preventative maintenance activity. The two electricians who undertook this work believe the pins were not bent / distorted when this work was undertaken and are confident they would have noticed if they had been. Therefore it is likely that the pins have become bent when de-isolating the ACB and pushing it into the service position. Note that returning the ACB to the cubicle and pushing it into the service position is what operates the opening of the busbar and circuit shutters and this requires considerable effort and relies on generating sufficient momentum to get the ACB fully inserted, by sliding it into the service position. The ACB itself weighs 250Kg. It is not a delicate operation and it would, therefore, be possible to cause inadvertent damage to the shutter linkage operating pins without knowing it. The location of these pins means that they are difficult to see with the ACB inserted. Similarly visually checking that the busbar and circuit shutters have opened fully, once the ACB is in position, is very difficult. The pins would only become bent if the shutter linkage was prevented from moving when the ACB was pushed into the service position. For this to occur, either the shutter or shutter operating mechanism was jammed in some way or it could have been due to an isolating lock being inadvertently left on when attempting to insert the ACB. Conclusions:- 1 The flashover was caused by the busbar shutter operating linkage pins being bent preventing the shutters from opening fully, resulting in contact between the busbar contacts and the shutter. 2 The pins were almost certainly bent by trying to insert the ACB into the service position when the shutters / operating mechanism was not free to move. 3 The fact that the ACB door was fully secured, safely contained the pressure excursion caused by the flashover. 4 Checking that the shutters have fully opened when a breaker is put into the service position is difficult and requires those carrying out the de-isolation process to understand how to check and what to look for. 5 The design of the attachment of the operating pins could be strengthened to reduce the risk of a repeat event - this needs careful review. 6 This event demonstrates the importance of remote operation of electrical switchgear, or the operation on a dead circuit whenever possible.

Actions

8260	**Assigned To**	Steve Clark

	Action	Generate PDA for Operations Safety Controllers staff to be briefed on:-1 Summary of the investigation of the incident2 Requirement to check shutter operating pins for damage prior to putting 415v ACBs into the service position. Also check that all points of isolation locks have been removed. 3 When putting the ACB into the service position, check that the busbar and shutter operating mechanism operates.4 Checking, as far as is practicable, that once the ACB is in the service position that the busbar and circuit shutters have opened fully and that the operating pins have not become bent / damaged.5 Emphasise the importance of ensuring all panel doors are FULLY secured when de isolating and returning switchgear to service in order for any fault which may occur to be contained within the switchgear.6 Reiterate the importance of carrying out switching activities remotely or on to de energised circuits whenever possible.Generate PDA on E,C&I Maintenance Electrical Engineer to brief E,C&I Maintenance teams on:-1 Summary of the investigation of the incident2 Requirement to check shutter operating pins for damage when carrying out ACB and cubicle maintenance and specifically prior to returning a ACB to the cubicle following maintenance.3 Emphasise the importance of ensuring all panel doors are FULLY secured after carrying out maintenance on switchgear in order for any fault which may occur to be contained within the switchgear.Generate a PDA on the Electrical Engineering Technical Engineer to:-Carefully review the design of the attachment of the busbar shutter operating linkage pins and make recommendations on any modifications, if appropriate, which would reduce the likelihood of a repeat incident. Also to recommend timescale and process for carrying out such modifications.
	Due Date	14 Aug 2015
	Status	completed
	Comments	PDAs 1298000, 1298001 & 1298002 generate for the above actions. Completion Date: 13 Aug 2015

Review

Severity	Minor
RIDDOR Dangerous Occurrence	no
Exceptions and Additions	
Completed Satisfactorily	yes
Additional Information	