

## Safety Alert 191209-1B (Update)

22 June 2020

### Serious burns sustained while operating high voltage oil-filled switchgear

Two workers sustained serious burn injuries while working on electrical network assets.<sup>1</sup> Information provided by the network operator indicates that a **failure occurred within an oil-filled metal clad switch (the Switch<sup>2</sup>) while operating work was being performed.**

In response to the incident, the network operator put temporary operating restrictions in place while the accident was investigated.

The network operator reported that the Switch failed when an open operation was carried out on the Switch as an upstream circuit breaker (CB) reclosed onto an unknown fault. This caused an electrical arc as a result of the Switch attempting to break fault current.



Image taken at site by a SafeWork NSW inspector after the accident

<sup>1</sup> The incident occurred on 9 December 2019.

<sup>2</sup> An ABB SD3+SDAF switch. IPART understands that Andelect and ABB branded SD-series metal clad switches are similar equipment.

## **Additional switching safety controls implemented by the network operator**

Following completion of the investigation, the network operator has lifted the temporary operating restrictions and put ongoing additional switching safety controls in place. The two workers have returned to work on pre-injury duties.

IPART understands the network operator has now implemented the following ongoing additional switching safety controls:

- ▼ The auto reclose function must be disabled on the closest immediately upstream auto reclose device prior to carrying out field switching of any high voltage overhead or underground switch, except for:
  - The switching of expulsion drop out fuses supplying a single overhead transformer where fuses are located either above or immediately adjacent to the transformer, or
  - The switching of sub-transmission equipment inside a zone substation switchyard, where the equipment is protected by busbar or similar protection.
- ▼ Compliance with this policy of disabling auto reclose for switching must be physically audited by senior system operators on a regular weekly sampling basis.
- ▼ Anyone not directly involved with the switching operation or assisting/supervising the switching operator, must remain at a sufficient distance from the operating area to prevent risk exposure due to equipment failure or an arc flash. Any persons required to assist/supervise the switching operator must use the same PPE requirements as the switching operator.

## **Reinforcement of existing switching safety controls**

IPART understands the network operator required managers and supervisors to brief all authorised switching operator employees and reinforce the following critical controls:

- ▼ Completion of a comprehensive worksite Hazard Identification, Risk Assessment and Control (HIRAC) and ensure this is reviewed and updated as required at each change of location during switching.
- ▼ All switching operations on the transmission and distribution system, including the low voltage system, must be coordinated by System Operations.
- ▼ There will be no unrecorded or unauthorised switching operations.

- ▼ Personal Protective Equipment (PPE) is an important final control that can minimise risk when correctly worn. Ensure authorised employees have the necessary PPE for switching the network, that it is in good condition and is worn correctly (e.g. outer gloves worn in conjunction with insulating gloves (1000 volt rated) and arc rated face shield with chin guard fitted).

### Results of investigation by the network operator

The two workers were performing switching to re-energise portions of an 11kV distribution feeder following isolation of a reported fault on an overhead section of the feeder (the Feeder). They closed the Switch to energise an underground section of the Feeder from an adjoining distribution feeder. This section of the Feeder contained an unknown cable fault.

Upstream feeder protection operated as designed and the fault was cleared by an upstream CB. The CB auto reclosed after 10 seconds, re-energising both the Switch and the section of the Feeder with the cable fault. The upstream feeder protection again operated as designed and the fault was again cleared by the CB.

At the time the Switch was operated it was believed that it would only be picking up normal back feed load.

The auto reclose function on the CB protecting the feeder was not disabled prior to the Switch being closed. The Switch, when closed, energised the unknown cable fault. The current generated from the cable fault was within the rated capacity of the Switch for the close operation.

The CB operated (opened) as designed and expected, interrupting the fault current.

As the auto reclose function was not disabled, the protection system reclosed the CB after a 10 second delay, re-energising the faulted section of cable.

The Switch was found in the open position with evidence of arcing on the tips of both its moving and stationary contacts. The Switch was assessed and tested and found to be performing as designed. The physical evidence suggests that the field operator was in the process of an uninstructed open operation of the Switch as the CB closed.

This caused an electrical arc as a result of the Switch attempting to break fault current<sup>3</sup>. The pressure generated by the arc caused deformation of the switchgear lid and the ejection of hot oil over both employees.

Neither employee was wearing a face shield or insulating gloves at the time of the incident.

### **Where can HV oil-filled switchgear be found?**

HV oil-filled switchgear may be found in electricity distribution networks, high voltage customer installations, mines and other facilities (including electricity generation and transmission facilities).

### **Is action required by network operators?**

Network operators may consider it necessary to assess the types of high voltage switchgear in their networks (particularly HV oil-filled switchgear), review the risk controls they have in place, and implement the appropriate level of risk controls to eliminate or reduce risks so far as is reasonably practicable.

Potential risk control options include, but may not be limited to:

- ▼ Disabling auto reclosing during fault finding and network restoration switching activities
- ▼ Remote energised switching of older manually operated switchgear using permanent or temporary actuators
- ▼ Local de-energised switching of oil-filled metal clad distribution switchgear
- ▼ Use of suitable arc rated clothing, face shield and other PPE when performing local energised switching, and
- ▼ Risk-based replacement of older switchgear with modern oil-free switchgear compliant with internal arc containment standards.

### **SafeWork NSW investigation**

SafeWork NSW inspectors responded to the incident. SafeWork NSW commenced an investigation to determine the cause and the circumstances of the incident. IPART understands SafeWork NSW has now completed its investigation.

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<sup>3</sup> The Switch is designed and rated to close and open normal load current, and to close onto a fault.