Health and Safety Executive OC 483/18

Field Operations Division

To

Agricultural, Factory and Quarries Inspectors

FCG Specialist Inspectors (Electrical)

CROMPTON PARKINSON TF 15 AM 11 KV OIL CIRCUIT-BREAKER FAILURE

Introduction

1 This OC, which is based on TD Minute TD 1B/T/24/1990, highlights a failure of the above equipment.

Background

2 In July 1990, a Crompton Parkinson TF 15 AM 11 kV oil filled circuit-breaker, installed in a ULC1 housing, exploded spontaneously. The circuit-breaker tank ruptured and the expelled oil caught fire. The fire was extinguished by the operation of a fixed CO_2 installation. There were no injuries to persons but there was considerable damage to the substation.

3 The circuit-breaker, serial number 114922/66, was rated at 400 amps load current. The short circuit rating was 250 MVA at 11 kV, with an ASTA certificate number 5191 to BS 116: 1952 *Oil circuit-breakers for alternating current systems above one kV.*

4 The fault level at the point of installation was 204 MVA with an earth fault current of approximately 3 kA. The fault was cleared by the operation of the incoming supply authority circuit-breakers at the infeed substation. The fault duration was calculated to be 450 m Secs.

5 The failed circuit-breaker was found in the open position with the earth fault flag down on its protection relay.

6 The failed circuit-breaker controlled a furnace installation consisting of:

(1) 80 metres of 11 kV cable;

(2) a vacuum circuit-breaker;

(3) a step down auto-transformer with its star point earthed via a surge divertor; and

(4) the furnace transformer.

7 The circuit-breaker had been successfully manually operated several times in the previous weeks. It had been operated successfully some 4.75 hours prior to the failure.

8 Detailed investigation of the system and failed circuit-breaker revealed amongst other things:

(1) no fault on the installation beyond the failed circuit-breaker;

(2) no signs of an earth fault within the circuit-breaker;

(3) major arc damage to busbar side male and female contacts;

(4) little arc erosion, consistent with load operation, on circuit side male and female contacts;

(5) verdigris deposits on the isolating contacts of other units on the switchboard;

(6) total destruction of the busbar side isolating contacts. (These consist of 12 fingers held together with 2 circular springs); and

(7) evidence of fibre contamination and metal particle contamination of the oil. These included fibres of cotton and asbestos, together with iron and copper particles.

9 The main conclusion of the investigation is that there was an internal phase to phase fault in the circuit-breaker caused by contaminated oil. The lack of phase barriers in this design of unit makes oil quality a significant factor.

10 There was evidence of poor maintenance in the verdigris found elsewhere. The iron and copper particles may have come from cutting activities associated with removal of the unit.

11 The use of a vacuum circuit-breaker in series may have had a contributory influence in that large over-voltage transients are caused during operation.

12 This is the first known catastrophic failure of a circuit-breaker of this type. It is known that some months before a Type TD 15 BM unit failed in a different manner due to inter-phase insulation failure. These circuit- breakers, of the same "family", do not have inter-phase barriers fitted.

13 This incident reveals yet again the need for particular care in oil handling and the cleaning of high voltage switchgear oil tanks. Best advice is the use of foam wipes or chamois leather wipes. Cloth or man-made wipes are not acceptable.

15 May 1991

(1339/FOD/1991)

Disc No: FOD1C\Editors\J97\13.3.91\DH\DS

(NEW DISC REF: J:\EDITORS\CA1\J97MR91.SAM)

ASI headings

Circuit-breakers: Crompton Parkinson: electrical equipment.