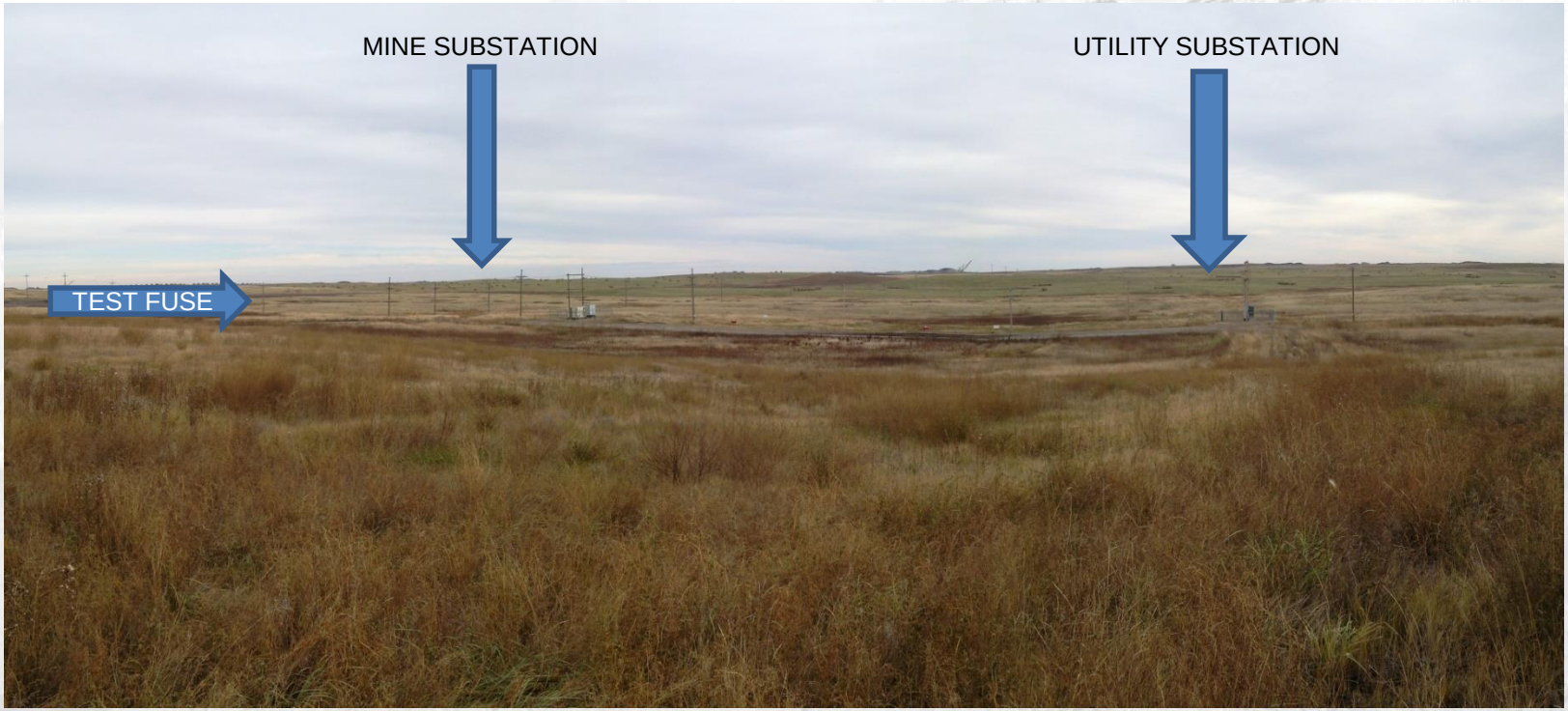
Westmoreland Coal Company

MAIN SUBSTATION CIRCUIT BREAKER FAILURE

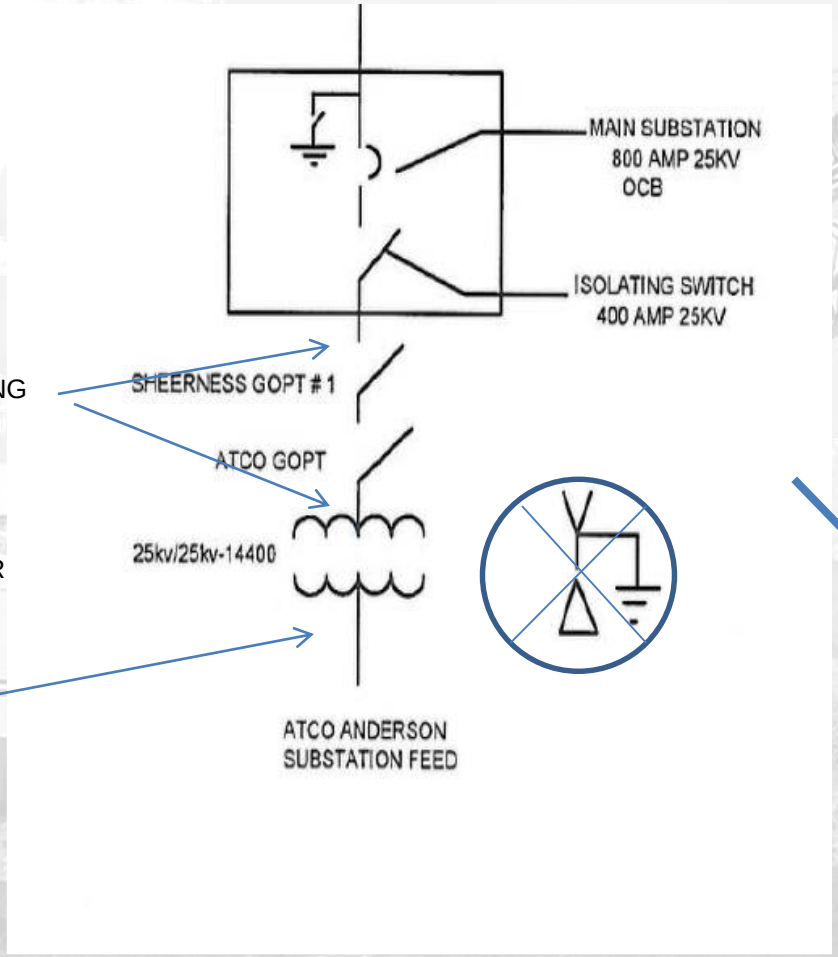
SHEERNESS MINE

WESTMORELAND COAL

OVER ALL AREA OF FAILURES



MAIN SUBSTATION SHEERNESS



LOCATION OF LIGHTENING ARRESTOR FAILURES

UTILITY TRANSFORMER

UTILITY FUSES

25 AMP NGR

- THE MAIN SUBSTATION CIRCUIT BREAKER FAILED WITHOUT INDICATION AND WAS OPERATED FOR AN UNKNOWN PERIOD OF TIME WITH THE B PHASE POLE ‘STUCK’ CLOSED. WAS ONLY DETECTED IN THE FOLLOW-UP TO POTENTIAL GROUND FAULT
- PROTECTION FAILURE
- THE PERSONNEL DANGER OF HAVING 1 PHASE ENERGIZED AFTER THE CB ‘OPENS’ IS HUGE. WITH 2 PHASES OPEN THE LITES GO OUT AND EVERYTHING APPEARS SAFE. POWERLINE STRIKES WOULD BE A MAJOR ISSUE

- TAVRIDA VACUUM CIRCUIT BREAKER USES MAGNETIC ACTUATOR NOT THE MORE COMMON TO OUR SITE LINKAGES / GEARS / AND SPRINGS. DIFFICULT TO VISUALLY OBSERVE BREAKER STATUS. NOT SURE IF A CONVENTIONAL STYLE ACTUATOR WOULD HAVE GIVEN US AN INDICATION OF FAILURE.

- **HISTORY**
- ORIGINAL MININIUM OIL CB
- CB CHANGED OUT IN APRIL OF 2015
- SUBSTATION LOG BOOK SHOW GROUND FAULT TRIPS NO CAUSE FOUND AUGUST 20,
- AUGUST 23, AUGUST 29, SEPT 10 (UTILITY FUSE BLOWEN), SEPT 12, SEPT 26 (UTILITY FUSE BLOWN), SEPT 28 (UTILITY FUSE BLOWN)
- FOUND SKY WIRE FALLEN OFF PIN CLOSE TO ‘C’ PHASE IN THE PIT AND REPAIRED

- WORK ORDERS SHOW DIFFERENT STORY
- LIGHTENING ARRESETOR FAILURES BETWEEN THE UTILITY TRANSFORMER AND OUR SUBSTATION,
- WHEN INSPECTED IN THE SHOP OUR ARRESTORS WERE FOUND TO BE RATED AT 21 KV
- THE THOUGHT NOW IS THAT PHASE TO PHASE 25KV WAS ON THESE ARRESTORS. THIS WOULD INDICATE AN UNCLEARED GROUND FAULT

- SUB LOG SHOWED GROUND FAULT TRIPS
- THEN MAYBE SHORTED RESISTOR?
- WE TOOK AN OUTAGE AND USING OUR TEST SETUP (WIRED IN) WE INJECTED A TEST CURRENT INTO THE CT. THE CB TRIPPED AS EXPECTED
- WE THEN DECIDED TO PUT A PHASE TO GROUND FAULT ON THE SYSTEM THROUGH A SMALL FUSE (5 AMP) AND SEE WHAT HAPPPENED

Sept 10 ATCO Xfmr fuse blew

Sept 12 Ground fault Reset ok

Sept 26/16 Pit Power loss. 1 phase fuse on ATCO side blown @ 1:1 transformer. ATCO issue
FPS - V unbalance trip
Phase V Rev trip
Over voltage trip
undervoltage trip
started RK-325 - Remote fault
- Ground fault

Sept 28/16 Pit Power Loss again. Same phase fuse blown again at Atco Transformer.
FPS - Pk Inverse Trip G.1
V Unbalance Trip.
Phase V Rev Trip.
Over voltage Trip
Under-voltage Trip.
Started RK-325 - Ground Fault only.

* Found skywire off of it's mount by 736. It was laying under "C" phase insulator in close

- LOCATION OF THE FUSE SETUP THAT HAD NOT BEEN USED SINCE WE INSTALLED THE INJECTION TEST WAS ON THE POLE 2 POLES OUT FROM THE SUB
- WE SHUT DOWN THE SUB AND INSTALLED THE FUSE, THE PLAN WAS TO OPEN THE GROUNDING SWITCH, CLOSE THE ISOLATOR AND WALK TO THE FENCE
- THERE IS AN OPEN CLOSE BUTTON FOR THE CB ON THE FENCE SO WE CAN SWITCH WITH NO ARC FLASH HAZARD

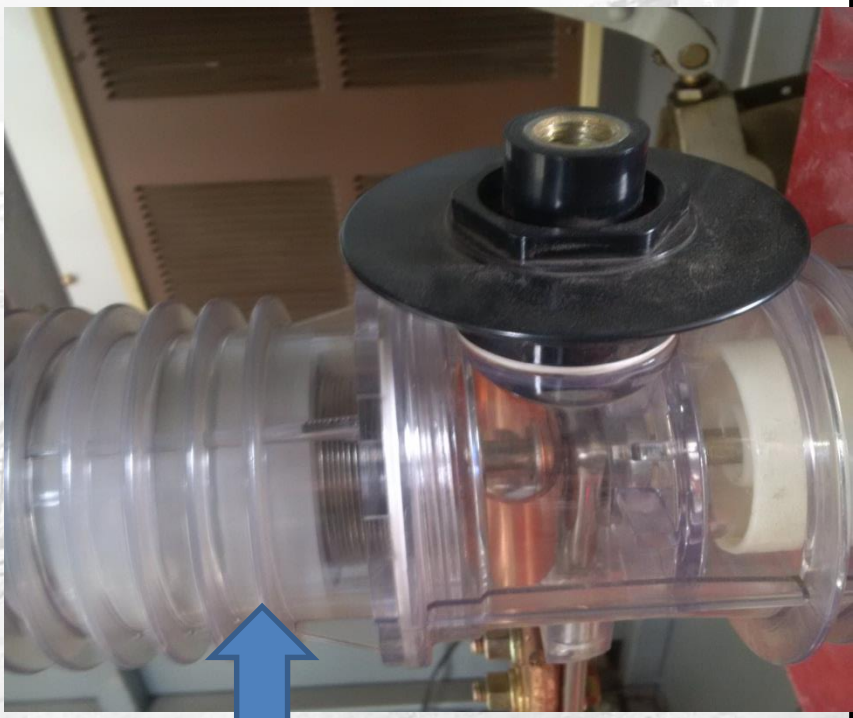
- THE CREW LOOKED BACK AT THE FUSE AND IT HAD DROPPED DOWN
- WE REPLACED THE FUSE, THEN AS THE SWITCHING PROCEDURE WAS DONE WE SAW THE FUSE DROP OUT WHEN THE ISOLATOR WAS CLOSED
- THE IMEDIATE THOUGHT WAS THE CB HAS FAILED
- WE GOT OUR HV TESTER AND CONFIRMED ON THE ROOF TOP BUSHINGS THAT B PHASE WAS ENERGIZED

- IT IS UNCLEAR WHAT THE RESULT WOULD HAVE BEEN IF THE FAILED CB POLE HAD NOT BEEN THE ONE WE WERE GROUNDING FOR THE TEST
- WE COULD NOT SEE EVIDENCE OF ISSUES FROM THE SERVICE AISLE OF THE SWITCH HOUSE
- WE ISOLATED AND CHECKED INSIDE. WE FOUND VISIBLE EVIDENCE OF FAILURE IN B PHASE

B PHASE LH-FAILED
GOOD PHASE RH

METAL SPRAY

DISCOLORED, DARK



AREA CLEAR

CLEAR CAN SEE COMPONENTS

- IT APPEARS THAT A LIKELY SCENARIO IS THAT WE HAD A GROUND FAULT IN OUR PIT, THE CB OPERATED BUT 1 PHASE FAILED TO OPEN
- THIS EITHER DIRECTLY OR BACKFEED THROUGH A TRANSFORMER LEFT ONE PHASE GROUNDED AND STRESSED THE OTHER 2 AT 25KV TO GROUND
- OF COURSE THE ONLY PLACE THAT WAS STILL ENERGIZED FOR THIS TO HAPPEN WAS BETWEEN THE UTILITY SUB AND OUR SUB

- SCENARIO
- WITH THE GROUND FAULT LIMITED TO 25 AMPS BY THE RESISTOR THE PRIMARY TRANSFORMER PROTECTION DIDN'T TRIP (FUSES) UNTIL ARRESTORS FAILED GIVING A PHASE TO PHASE FAULT

- REALLY HAVE NO IDEA WHEN OR WHY THE CB FAILED
- VERY CONCERNING THAT WE WERE ABLE TO CONTINUE SWITCHING WITHOUT ANY INDICATION OF TROUBLE

CURRENT RESOLUTION

- CB SHIPPED TO DELTA FOR INITIAL EVALUATION, REPLACEMENT SHIPPED
- CB NOW GO TO TAVRIDA FACILITY IN SWITZERLAND FOR MORE DETAILED ANALYSIS INCLUDING COMPONENT TRACKING
- SHEERNESS & PAINTEARTH MINES HAVE IMPLEMENTED HV INDICATORS ON LOAD AND LINE SIDE OF CB

COMMENTS / FEEDBACK

- WHAT COULD WE HAVE DONE DIFFERENT TO IDENTIFY PROBLEM EARLIER?
- HAS ANYONE SEEN A VCB SINGLE POLE FAIL CLOSED?
- RE-INFORCES THE NEED TO ALWAYS ISOLATE AND GROUND HV BEFORE WORK
- RE-INFORCES THE CODE REQUIREMENT FOR A VISIBLE BREAK DISCONNECT

- COMMISSIONING DID NOT INCLUDE CONTACT RESISTANCE TEST OR HV TEST ACROSS CONTACTS. THIS MAY NOT HAVE INDICATED ANYTHING OTHER THAN THEY WERE GOOD WHEN INSTALLED
- THIS CB DOESN'T HAVE AN OPERATIONS COUNTER. THESE ARE ALWAYS GOOD TO CONFIRM LOG BOOK RECORDS ALL EVENTS