Transcript of Proceedings

of an

Inspection

by the

Board of Inquiry into the Occurrence of Bush and Grass Fires in Victoria

Wednesday 11th May 1977

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SEC Chadstone Training Centre
and
SEC Fishermen's Bend Testing Laboratory

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by the

BOARD OF INQUIRY

into

THE OCCURRENCE OF BUSH AND GRASS FIRES IN VICTORIA

on

WEDNESDAY, 11TH MAY, 1977.

BEFORE:

SIR EDWARD HAMILTON ESLER BARBER, Q.C.

INSPECTION HELD AT THE S.E.C. CHADSTONE TRAINING CENTRE, and the S.E.C. FISHERMEN'S BEND TESTING LABORATORY.

12.GT.AC.

DEMONSTRATION OF LOW VOLTAGE CONDUCTOR CLASHING WITH FAULT CURRENTS AND ELECTRICAL CONDITIONS THAT EXIST ON THE S.W.E.R. SYSTEM SUPPLYING GLEN-THOMPSON POLE 11 SUBSTATION AND ITS ASSOCIATED L.V. CIRCUITS - AT S.E.C. CHADSTONE TRAINING CENTRE.

MR. WILSON: Here we have set up as close as we can get it to the Lloyd's property at Glen-Thompson. We have an incoming 22 kV line. This whole system can be made alive in various ways. We have an incoming 22 kV feeder which we can take a spur off feeding an isolating transformer. The outer two conductors coming in through the EDO fuses to the outer bushings on the transformer and coming out from the centre bushing up to the EDO to the 12.7 s.w.e.r. line. Obviously we have shortened the installation considerably to fit it all in.

You will notice the earth conductor down from behind the transformer and that is the return path for current along the s.w.e.r. line. The EDOsin this case have solid lengths in them as we have adequate protection back in the system.

Coming to the s.w.e.r. transformer installation which is of similar construction to the one at pole 11 on the Glen-Fraser spur, we have a clamp-on fuse from a Dee loop. We have a surge diverter mounted at the top of the pole on the line itself coming down from the clamp-on to the upper bushing, the high voltage bushing of the transformer.

Coming to the other side of the pole - coming out from the transformer are those black leads on the lefthand side of the pole to the two low-voltage fuse holders. The two lower conductors are the actives, the upper conductor is the neutral, the same configuration we have at Glen-Thompson. The EDO fuse has a two amp link in it,and the low voltage fuses are 55 amp.

From there we have taken away a span of approximately the same length as the first span out from the pole 11 substation, with approximately the same sag. We have lowered the whole installation about six feet so that we can get at it more readily.

The s.w.e.r installation, the secondary side of the s.w.e.r. transformer, 400 volt lining so we can take off either 240 volts or phase across the whole winding we can take off single phase 400 volt. Between either of the lower conductors and the upper conductor we have 240 volts, between the upper conductors we have 280 volts.

MR. BARNARD: What is the surge diverter?

MR. WILSON: The surge diverter in this type of installation is to protect the transformer. It is not the same as the one at Glenthompson. It is in this installation normally. The only thing we have done is change the transformers. The s.w.e.r. transformer is changed to a 10 K.R.A. unit to ensure we have the same electrical conditions as at Glenthompson, and we have put in here a large s.w.e.r transformer that is on the Glenfraser spur. This is to ensure that the fault currents we have in this installation are as near as we can arrange it to the situation at Glenfraser. The fault current on the high voltage side

and the fault on the low voltage side will be about 25 amperes. The currents on the low voltage side will be of the order of 500 amperes. This will be explained in more detail in my statement tomorrow.

The operating procedure - the whole installation is alive. Power onto the transformer supplied through the clamp-on fuse to the low voltage side being supplied through the two low voltage fuses. The wires are alive. You will notice a rope hanging across the lower low voltage conductor. One of our operators will pull that rope down and release it, allowing the bottom conductor to spring back up to and clash with either the upper or lower conductors. The clash will occur and at or about the same time either the high voltage fuse or, in some cases, the low voltage fuse will operate. I think in all the tests we have carried out here, we have only had one low voltage fuse operate, compared with a dozen or so high voltage fuses. Following the test, the operators will remove the links for inspection and you can look at the conductors and anything else you wish to see on the installation.

There is one thing I should have pointed out. We are not operating today under access permit conditions. You will notice that the clamp-on installation we have has a lifeline clamp on both ends of the lead, thus enabling the operator to totally disconnect the fuse from the installation and put it on that spike you see sitting out from underneath the bushing, thus ensuring he is completely free of any possible electrical feeds while he is operating manually on the fuse.

MR. BARNARD: How was the current worked out? Was it calculated in circuit?

MR. WILSON: It has been calculated, but they have measured it in the past.

I think for the first cable tests we could look at the clashing, and then do a couple more and look at the clamp-on fuse.

(Demonstration of clashing conductors).

You will notice that the clamp on fuse has operated and dropped out, the tail has dropped out. We will wait until the operator ensures that circuit is removed completely. The gentleman operating the installation is one of our operating instructors, and he is carrying out the sort of procedures the linesman would normally be doing. The lifeline gloves are low voltage gloves, and he is removing the low voltage fuses.

If you like to now inspect the conductor, we have been clashing here for a day or so. There are small burn marks in this area, particularly just here. They are quite fresh. These others are older; they are the ones we were doing last week.

This is a buzzer, the function is merely to show there is a continuous circuit between the two. If these fuses are blown you will get no buzz. There is a current through the fuses. The low voltage fuses have not blown. It is a 55 amp Nilcrom.

Firstly, the operator will remove the lower lifeline clamp and re-attach it to the spike, thus ensuring

MR. WILSON.

he is isolated from any possible electrical feeding. He will now remove the clamp on fuse body itself from the line and also attach it to the spike. Before attaching it to the spike he will give it to the operator standing on the ground who will remove the upper part of the fuse link and replace it with a new one.

This is the other part of the link including what we have called the button. The lower part will be removed in a few seconds. If anyone wants to see the tube, or the bicycle pump, this is it.

THE BOARD: Between those two was a single wire?

MR. WILSON: Yes.

MR. DUNNE: Is that the sort of fitting at the Cressy fire and at Wallinduc?

MR. WILSON: It is similar. It is a five amp link. This is a two amp link so the fuse will be bigger at Wallinduc. It may or may not have that spring.

MR. DUNNE: I think it did.

DR. PENMAN: What happens when you go to the strand with stainless steel?

MR. WILSON: Not in the Commission's installations.

DR. PENMAN: All yours would be one strand?

MR. WILSON: Yes. The operator is now re-establishing the link inside the fuse. He will first remove the bottom clamp and attach it to the transformer bushing. He will then put the top of the clamp onto the lifeline. As he attaches it you will notice a small "zip" sound; that is the current passing from the line through the fuse to energise the transformer, the so-called in-rush current.

MR. BYRNE: Would this be like the transient you mentioned yesterday?

MR. WILSON: It is of a different nature. It is a connecting transient. Yesterday I was referring to a disconnecting transient.

DR. PENMAN: What happens inside the transformer?

MR. WILSON: The first thing that happens in the transformer is the establishment of the magnetic field. To do that requires some arcing from the network. That arcing you heard was the current being drawn to the clamp-on fuse.

The procedures being carried out are of an established routine nature. They are always done exactly the same way.

The operator is now replacing the low voltage fuses. The situation, of course, being alive at that time. He always connects the electricity from the source to the load.

Here we have a choice. You can either watch further clashing or watch the clamp. We are repeating the test again, the conductors will be clashed by means of the rope and this time you can observe the operation of the clamp-on fuse.

(Further clashing takes place).

MR. WILSON: The purpose of the demonstration today has been to show you firstly the operation of the fuse, the clashing of the low voltage conductors, and the difference in the amount of light emitted by both those phenomena. We can repeat the tests until you are satisfied that you have seen enough.

MR. BARNARD: Are you going to do one with the neutral wire and the active wire to show which fuse goes then?

MR. WILSON: That is a matter of probability. We can attempt that. I cannot guarantee the result.

MR. MARKS: I think it would be wise to watch it again to see if the operation is identical each time.

MR. WILSON: We will have one more test, probably active to active.

THE BOARD: The natural is on the top. Is that always so?

MR. WILSON: No, it is not. Our installations are not always standard. The one at Glenthompson was.

MR. STANLEY: Is there any reason for the position of the neutral?

MR. WILSON: Largely a matter of the way in which the registered electrical contractor strings the wires. We have no laid down standard. We leave it to their discretion. One can say it would be advisable for the neutral to be on the bottom. If someone is carrying some pipe and happens to touch the bottom one, he is slightly more safe.

THE BOARD (looking at fuse): The last one took the whole of the wire.

MR. WILSON: Yes. One gets everything between these two extremes. If you like to watch the placement of the elements in the fuseholder, we will demonstrate that.

MR. BARNARD: I was thinking if he fitted one loosely, you would get different burning?

MR. WILSON: Yes.

MR. BARNARD: More burning and more black.

MR. WILSON: Whether it is more or less, it is difficult to say.

MR. DUNNE: Is this always done from the ground?

MR. WILSON: Always is difficult to know. It can be done by the gentleman up the poll.

THE BOARD: There are times when there is only one man?

MR. WILSON: Yes. In that case he does it on the poll. You will see this better at the laboratory where we have a number of these and you will be able to try it yourself on a spare tail and twist it around to tighten it up. The circuit at this stage is only complete to the low voltage terminals and the fuse link, those are alive. Not until we put the low voltage fuse in is it alive to the conductor.

THE BOARD: Has he got some sort of torch?

MR. WILSON.

MR. WILSON: He has a spotlight on his vehicle. He uses that to see what has happened first, and then puts it on the spot. For this test we will again operate on the bottom conductor so we will probably get an active to active clash. For the next test we will attempt to do an active to neutral.

MR. MARKS: You can do active to neutral by putting a rope on the top wire?

MR. WILSON: We are more likely to get a solid contact. Again, this is what I was explaining yesterday. It depends on the length of time of the arcing.

DR. PENMAN: And on the length of time the wire is contacting?

MR. WILSON: And the temperature of the air. There are many things involved.

MR. STANLEY: So it certainly need not be immediate at all?

MR. WILSON: It can never be immediate.

(Page 5 follows)

MR. WILSON: There is one part of the installation I did not fully cover in my initial run through. You will notice on the top of the tank on the right hand side there is a connection to the earth lead which runs down the pole - it is connected to a set of spikes which are driven into the ground at the base of the pole to provide an effective earth and return current for the low voltage is into the earth, through to the earth and back to the isolating substation.

For this test, at the suggestion of Mr. Barnard, we are leaving out the fuse of the circuit for the bottom conductor so that the bottom conductor will not be alive - only the centre will be alive at 240 volts. Therefore, the only connection we can get is one active and one neutral.

I shall explain briefly now and more fully tomorrow what we call co-ordination between high and low voltage fuses - that is, which fuse blows first and why. For an active to active fault it is more probable that the high voltage fuse will blow than that the low voltage fuse will blow. For an active to neutral fault the events are probably equal probability.

To demonstrate the test device does work, there is a low voltage blown fuse and there is no external indication that the fuse has blown, no sign of conductance and no sign of any path through the fuse - but, it has blown.

.....

ACTIVE AND NEUTRAL TEST:

For this test, we have not replaced the bottom fuse or the fuse supplying the bottom conductor. This should be an active to neutral fault. (After completion of test): That demonstrates that sometimes engineering calculations do work. That is the way the fuse blew or fractured; the particles are boric acid and it has a porcelain housing. That part is not pure silver but a silver composite. Porcelain is not a good conductor so that if the fuse blows at one point it gets hot and cracks.

2nd Test Carried Out:

With this one the melting temperature is different but the distance of arcing and burn length is about the same. If I were to give you a black and white photograph of both tests, you could not tell the difference.

MR. PENMAN: Have you ever managed to getall the particles?

MR. WILSON: Yes, we have a box full.

The reclosers behind us are of relevance, the ones on both these poles. (indicating). The other day we were setting up this installation and we

carried out 12 tests of this nature. During the tests we placed tarpaulins underneath the conductors but afterwards we were unable to find any particles. Other tests have been carried out with conductors placed in a vale or bed so that they clashed under laboratory conditions and we were able to collect particles then. Later on this afternoon you will see some particles.

These two reclosers are called, one, the Kyle single phase recloser and, two, the OYT 3 phase recloser. After looking at these reclosers, a regulator and some pieces of equipment we will then move on to look at the underground installations. This afternoon, following tests in the laboratory we will see fuses operate under darkened conditions. The Board will visit part of the maintenance workshop in order to see several pieces of equipment dissembled. Two pieces of equipment which will be viewed later are here on the pole (indicating). On the right is an installation of single phase Kyle recloser - the same type that is in the Hamilton feeder, HIN No. 3. These reclosers have an immediate operating current of about 70 amps and go through a supply of up to 4 reclosers before locking out. I shall explain that in detail tomorrow.

On my left is a 3 phase OYT recloser installation. As can be seen, the size, complexity and cost of these installations is in proportion to the amount of equipment which can be seen on the pole. I shall also be dealing with costs in my submission tomorrow and detailing those costs.

Over here there is what appears to be a transformer but, in fact, it is a voltage regulator. One of these is also in the Hamilton feeder. I will be describing this in detail in my statement tomorrow but, briefly, the purpose of the voltage regulator is to try and keep constant voltage at this stage, allowing for fluctuations during the day and during the seasons of the year. Hence, it gets its name "voltage regulator".

Immediately behind, on this other pole, is an installation of powder filled fuses. These are high current rupturing capacity devices used in the metropolitan area. I will also mention these further tomorrow. They are not suitable for rural areas where there are low volt currents because they do not successfully clear those types of faults - they tend to explode.

<u>The inspection party prodeeded to the underground reticulation area.</u>

MR. WILSON: The underground reticulation area is where the linesmen are trained in the use of pieces of equipment. (An inspection of the underground reticulation area was carried out).

UPON RESUMING:

INSPECTION, STATE ELECTRICITY COMMISSION, FISHERMEN'S BEND TESTING LABORATORY.

MR. WILSON: I want to explain a few things about what you will see during the inspection as well as the precautions we would like you to observe during the tests. A series of five tests on fuses will be run. The first test will be on an expulsion drop-out hinged fuse without a fire choke and with the fuse cap on. This will be to demonstrate the sort of phenomenon with which we were faced prior to the development of the fire choke.

Whilst the fire choke is being fitted to the device, I will invite you to search for particles in the stainless steel tray which has been placed in an appropriate position to catch the particles when the fuse blows. You will also be taken to the control room where you will see the set up and examine the oscillographs and measurements of the tests we conduct throughout the day and throughout the tests we have been conducting.

The fire choke will be fitted to the expulsion fuse and another series of tests will be carried out with the EDO fuses in normal condition in the field.

We shall then take off the cap and run through the third series, the particle emission on the drop of the fuse link to the ground. At the conclusion of the series you will also be invited to inspect the trays for particles and to look at the top part of the link. It may take a minute or two but you can get there as soon as the tests have been completed and feel the temperature of the various pieces.

Following that we will look at the clamp on fuse fitted with the standard 2K fuse link and the final series will be the single wire earth return clamp on expulsion fuse fitted with a sparkless 2K fuse link, manufactured by Essantee.

We shall then break for discussion and afternoon tea, following which Mr. Rankin will provide us with a demonstration of the high voltage impulse generator, which simulates a lightning strike. That will take place within the closed in enclosure.

Following that demonstration we shall move into the maintenance workshop which is situated in the building behind us and we will look at some of the items of distribution equipment. They will be assembled and dissembled in various stages, in order to see how they operate, how large they are and what it is all about.

It is intended to carry out two shots at each test; you have an option of a third test should you require it. To be fair, in testing these sorts of things one does need large numbers of tests to obtain a statistical spread of what happens.

These black cables across the floor come from another building across the road where we have a short circuit testing installation in which there is a source we

can control. There will be an opportunity to ask questions about that during the break.

This current comes in here (indicating) at 240 volts and that is applied to the low voltage side of the s.w.c.r. transformer inside this roped-off area. We then take a lead from the high voltage side of the transformer, about 12.7 kV. That is taken through a measuring device which measures the actual current passing through the conductors for the test; it passes up to the top of the structure where it is stretched either to the EDO or to the D ring. From the bottom end of the clamp on, there is an earth on the transformer, thereby completing a short circuit. Unlike normal installations where it is energised and the fault comes on, in this case we have reversed it and have applied a fault directly across it; we have energised it at the initiation of the test.

MR. BARNARD: Are you putting a designed current into it?.

MR. WILSON: Yes, a 2 K fuse link. The tests are conducted under trial test conditions. We have a rope which will be placed there in position at the beginning of the tests for safety precautions and the only people who will pass the barrier are people involved in the test procedures. Once the equipment is set up for the tests an earth is applied to the installation to make sure that if it is accidentally energised, no-one can be harmed. Once all personnel are clear of the area, the engineer will remove the earth and he will announce that the earth has been removed and the area is clear. He will indicate by a box on the wall to the gentlemen conducting the test that the area is clear and ready for the tests. A countdown series will follow.

At Zero, the test will apply, and you will see it. As an additional precaution we have a television camera which will show that no-one is near when the test is applied. Upon conclusion of the test the engineer still will ascertain from the man controlling the current that the two main circuit breakers are open, and, on receiving that confirmation he will re-apply the earth. At this stage we can obtain access to the equipment.

I intend running two tests on the EDC fuse without a fire choke. We can run a third test, if you like, and at the end of that, after all safety precautions have been observed, you are welcome to go and look for the particles.

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MR. MARKS: Are you going to tell us the control current?

MR. WILSON: Yes, I shall have to check on the exact value for today because it does vary. It is 23 amperes at 12.7 kV.

MR. BARNARD: Is that the fault current?

MR. WILSON: That is the fault current, 12.7 kV. That is a level at which we anticipate a fairly high degree of particle emission. If we go to higher currents than that the particle emission drops off. The particles are more vapourised. We have chosen a value which will gives a fairly high degree of emission.

MR. MARKS: How does that represent normality in the system?

MR. WILSON: It happens to be almost the exact situation at Glenthompson. I think it was 24 amps or 25 amps. It is between 20 and 25 amperes anyway.

MR. DUNN: You said the higher the current, the particles vaporise. Does the converse apply?

MR. WILSON: No, you get less of the fuse element destroyed during the test. This is the stage where you get less destroyed, some burning of the crimps. This is what we consider the worst position.

TEST SERIES 1 - EXPULSION DROP OUT (EDO) HINGED FUSE WITHOUT FIRE CHOKE AND WITH THE FUSE TUBE CAP ON. STANDARD 2K FUSE LINK.

MR. WILSON: The operator is now removing the earth. We will turn off the main lights in the hall and illuminate the device being tested by the spotlights. The particles you will see will seem a lot larger than they are in fact because of the illumination.

(Test series 1(a) conducted.)

I can assure you what you see is a very subjective view of what happened. The operator is now removing the fuse link.

MR. DUNNE: Would there be more particles than we actually saw?

MR. WILSON: Yes. Some of them would only travel one or two feet.

THE BOARD:(Looking at fuse): The whole wire went.

MR. WILSON: There is some burning on the crimps.

MR. MARKS: Can you reduce the current?

MR.WILSON: Not easily because it involves putting resistance in the circuit which we have not got.

MR. MARKS: What happens when you do reduce it?

MR. WILSON: You get less burning. It takes longer to apply. The 10 amp takes at least 10 seconds to go, and you only get a part of the element destroyed.

MR. MARKS: You get less heat?

MR. WILSON: Less heat and friction.

MR. MARKS: It is at its optimum?

MR. WILSON: Somewhere between 20 and 30 amps.

(Test series 1(b) conducted.)

MR. BYRNE: What is the explanation for the difference? Is it a differing quality of the fuse?

MR. WILSON: Yes, different quality for the fuse, different tension when it is actually tightened up.

MR. BYRNE: In a test series such as this, the current is constant?

MR. WILSON: Yes, it is the link itself and the means by which it is screwed up. We have had quite a lot more particles than that emitted under other tests we have carried out. Three is nowhere near a representative sample.

MR. BYRNE: If we take our observation that the first one produced more sparks, are you able to draw any conclusion that the fuse is tighter or looser?

MR. WILSON: There is no definitive way of measuring it.

MR. BYRNE: So you could not give us a slack fuse to see what difference there is?

MR. WILSON: One fuse test is not enough. One slack test might give you more, but it is not conclusive.

(Test series 1(c) conducted.)

That concludes the three tests of the EDO without a catcher. Once the earth is applied you are welcome to go and see if you can find some of those particles that came down

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INSPECTION OF THE CONTROL ROOM AND EXAMINATION OF THE OSCILLOGRAPHS OF TEST SERIES 1.

MR. WILSON: This is the equipment that controls and monitors the current and voltages we were applying to the test equipment. I do not think it is worthwhile going through a full technical explanation. On the righthand side are the control buttons and indicator lights for the various circuit breakers and pieces of equipment used in the test.

This device controls the timing of the test so that we switch to right point on wave and voltage. The currents and voltages are measured by this oscillogram here. We can inspect the graphs in a second. I do not think there is any point in going into a detailed explanation unless anyone wishes to ask any specific questions.

THE BOARD: The operator alters this to wherever he wants?

MR. WILSON: Yes, he can alter those to suit different types of tests to get control over the pattern.

THE BOARD: Where is his switch?

MR. WILSON: It is this red button. He ensures both these circuit breakers are open. One can lock it off and take the key away.

This is the output of the oscillogram. This is the 23 volt current, that is the current in the leads coming across the floor. This is where the current builds up through the fuse, 22.4 amps. This is the point where we applied the current. There is no voltage here at this point because we had a dead short circuit. At this point it starts to clear, arcing is taking place, and the voltage builds up and it ceases completely. The total time involved was 23½ cycles for the first oscillograph. The arcing was worse there, better there, and worse there. There was more arcing. One can see there is quite a spread of results. We have not used point on wave.

TEST SERIES NO. 2 - EXPULSION DROP OUT HINGED FUSE FITTED WITH FIRE CHOKE AND WITH A FUSE TUBE CAP ON. STANDARD 2K FUSE LINK.

MR. WILSON: We are about to commence the second series of tests. The same conditions and the voltage and current conditions will be the same throughout the series. This time we have placed the choke on, that is the metal device at the base of the tube.

DR. PENMAN: Is that slightly at a steeper angle?

MR. WILSON: That is fitted into a standard fitting. There is always some minor variation in the field.

(Test series 2(a) conducted.)

THE BOARD: Why does that have to fall?

MR. WILSON: Have to open up?

THE BOARD: Yes.

MR. WILSON: There are two reasons. One is to give a visual indication when patrolling the line that the fuse has gone. The other reason is that this same device is used to operate the circuits. That is, rather than have the fuse operate, we can in fact break that link ourselves manually and open or close the circuit.

MR. MARKS: It is the explosion that causes the thing to drop down?

MR. WILSON: What happens is that when the fuse link breaks the bottom hinge is only being held together by the wire, the bottom hinge in fact breaks, moves aside allowing the thing to fall out.

MR. MARKS: It falls by gravity?

MR. WILSON: It falls simply by gravity. It has in fact been demonstrated by Mr. Weatherhead on some previous occasion.

For the purpose of identifying the oscilloscopes which will be available, I have labelled the tests 1 to 5 as in the programme, and within each test they will be labelled (a), (b), (c), etc.

(Test series 2(b) conducted.)

MR. BYRNE: What is the height above ground?

MR. WILSON: It is 22 feet. In fact, that is a little lower than standard. They are normally about 27 feet.

(Test series 2(c) conducted.)

MR. WILSON: At the conclusion of the tests I shall have the catcher removed and you can tip it up and get the particles out of it.

MR. BARNARD: Can we see the fuse from the last one. That ought to be the most burnt.

MR. WILSON: Would you like to look at the particles at this stage. We will move the trays forward because the emission with the cap off in the next series of tests - there is an emission of particles from the top both as it fuses and as it drops away. On the third of these tests we will get it cleared as quickly as we can so you can move in.

(Page 13 follows)

MR. WILSON: I shall hand you this cap from the series 3(a) test.

THE BOARD: It is not at all hot.

MR. WILSON: On some occasions if you can get in there faster than I did and pick it up, it is so hot that you cannot hold it in your hand.

TEST SERIES 3(b): The test with the fuse tube cap off. On completion of the test, the fuse was handed to the Board.

TEST SERIES 3(c): (Fuse was handed to the Board).

MR. WILSON: That has been arcing as it has fallen out, it has touched the piece of the fuse a couple of times and has arced on each occasion.

While they are changing over the apparatus, you will notice with the cap off that time some particles came out from the bottom and missed the gutter. It is quite different with the cap off because there are two places from which it can vent and the particles are not coming out at anything like the same pressure. They dribble out of the bottom of the tube. In each case, with the cap on, all the particles and pressure are vented from the bottom.

TEST SERIES 4(a):

MR. WILSON: In this case, you will notice that the bottom of the tube is not fully open as it is with the EDO. It is enclosed by a ring and washer which almost completely closes the hole. There is a spring, to give it some tension and at the bottom, a connecting device which is a simple thumb-screw. The lead to the transformer is connected to this bolt at the back; it is connected as a fixture to the installation and this part drops away, the bottom half of the fuse link and the attachment at the base. (After completion of test): The noise that you heard was the bottom end of the tail hitting the aluminium structure, which has nothing to do with the test.

TEST SERIES 4(b): Upon completion of this test, the clamp on fuse was shown to the Board.

TEST SERIES 4(c): (Mr. Wilson showed clamp on fuse to the Board.)

MR. WILSON: The next series of tests will, again, be similar to the last test with the clamp on fuse, this time, using the Stanger, Essantee, Sparkless link by Dickson Primer. These have a number of problems and they have been under development for 15 years. The latest development applied only three months ago is the chamfering of the nylon tube. The object of that is to stop this (demonstrating). As the thing tightens up the braid tends to uncurl and, as it uncurls, it twists here. They are still not very strong mechanically.

MR. MARKS: What is the significance of that?

MR. WILSON: The significance is to put it in and tighten it up - it will protect the clamp on fuse.

MR. MARKS: The linesman, if he is too heavy handed, might not know he has broken it.

MR. WILSON: Yes. Inside the tube it is separated by that nylon element but it does not give that much support, as you can see.

These have a different characteristic in that they will clear in about six or seven cycles.

MR. MARKS: Is that good or bad?

MR. WILSON: Basically it causes problems of co-ordinating any sort of fault. Seven cycles is very fast. Mr. Stanger has not been able to tell us what is the mechanism but it will appear from the enclosure inside the tube that what happens is the element blows and this comes out. On occasions, it gets stuck up in the tube. At the current levels it does not cause problems but with very high levels, when the EDC vapourises, it causes explosion of the tube itself. As I said, these are still in the development stage and there may be room for adaptations. Tomorrow I shall have one that has been cut open so that we can see all the elements inside it. This one goes off with a slight noise, something like the noise that a cap pistol makes. It has been known to go off soundlessly, as one of our test engineers will testify.

TEST SERIES 5(a): (Test was conducted).
There have been examples of dropping sparks. They spark less, being sparkless. One of the problems is that this small plastic sleeve is emitted at high velocity and it hits the ground. They have been emitted to perhaps half their depth in sand.

TEST SERIES 5(b):

MR. WILSON: A particle was emitted from that test. Do you require a third test?

THE BOARD: No.

MR. WILSON: At this stage, are there any questions?

MR. NIXON: No. Perhaps you could leave yourself open to questions tomorrow.

(Page 15 follows)

INSPECTION OF THE MAINTENANCE WORKSHOP AND VARIOUS ITEMS OF EQUIPMENT.

MR. WILSON: The idea of having you here this afternoon was to show you some of the equipment I shall be talking about tomorrow.

We have reproduced our bicycle pump, clamp-on fuse and the EDO catcher. I shall begin with the bigger pieces. These are 22,000 volt circuit breakers normally found in the zone substations controlling the switching of the feeders. At the rear you can see the mechanism inside the tanks. The mechanism here is normally contained within the tank, fully immersed in transformer oil, a special mineral oil for insulation properties. The mechanism is - one set of contacts are fixed with an arc chamber, the other set of contacts are moving, and this device comes up inside through the arcing chamber to make contact. These devices operate very rapidly and are controlled by the sort of cubicle you can see behind. That device monitors system conditions and gives commands to this device to open or close.

Behind you is a different type. There are as many types of these as there are manufacturers. You will remember seeing on the pole this morning the OYT recloser, the three-phase recloser. This is it with its internal mechanism reclosed. This is a small circuit breaker. It has not the capacity the large one has, and therefore is limited in its application. Again, the mechanism in a fixed contact and moving contact. We cannot operate this unless it is under oil and under voltage, otherwise we destroy the mechanism.

This one has four shocks at the volt, it opens, recloses, opens, as many as four times before locking up in the open position.

The smaller version in the corner is the single phase Kyle recloser of the type installed on the Hamilton line. (Operation of Kyle recloser demonstrated). That is the cycle of open, close, as the contacts are opened and closed throughout its operation.

MR. BARNARD: Which is the OYT OCR on the spur at Tatyoon?

MR. WILSON: That is it there. That is the standard type. I shall ask Dennis to explain this for you.

DENNIS: Basically, the situation is that we have incoming and outgoing circuit, the recloser is controlled by this coil. We have a set of moving contacts here and the fixed contacts are up here, and this recloser has the same sort of cycle as Mr. Wilson explained before, two fast and two slow reclosers.

MR. WEATHERHEAD: That is where the contacts go up. That moves up into a chamber and makes contact at that point. Those contacts are made in there. The purpose of the grids is to blow the arc out that is formed when the contacts start to open. In fact, there is a control mechanism that allows that to be done up to four times without that arm operation.

MR. WILSON: This is a 22,000 volt 300 kVA transformer which we have taken out of its tank to show you what is inside a transformer. This is the iron coil, the outside to the high voltage winding and inside the low voltage winding, in some cases they are comprised of layers of aluminium foil. There are 1,200, 700 volts, the winding turns are in the same

proportion. We take in the high voltage leads and cut the low voltage leads. This one is damaged in this area.

THE BOARD: Does that not get hot when it is operating?

MR. WILSON: It gets warm, typically up to about 70 degrees Celsius. For that reason, we have cooling mechanisms on the tank itself. This one is suffering more severe damage.

We have a s.w.e.r. transformer down here. This is a typical s.w.e.r. transformer with severe damage. It is very simple.

THE BOARD: Was that struck directly, or was the line struck?

MR. WILSON: It probably did not have a surge diverter on it.

MR. McDONALD: You still use the round ones?

MR. WILSON: Yes, we still have the round and square. That is the extent of thd sort of thing we wanted to show you.

THE BOARD: Thank you, gentlemen.

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Errata, plus *technical comment and opinion* by Michael Gunter 4th October 2009

PAGE 1
"400-volt lining" SHOULD READ "400-volt winding" (Wilson's 6th paragraph);

"either 240 volts or phase across the whole winding" SHOULD READ "either 240 volts or span [or 'connect'] across the whole winding";

"10 K.R.A. unit" SHOULD READ "10 kVA unit" *[kVA = thousand x volts x amps, a rating of the real and reactive power able to be safely transferred by the transformer or line];*

PAGE 2
"You will notice that the clamp-on installation we have has a lifeline clamp on both ends of the lead" SHOULD READ "You will notice the clamp-on installation: we have a live line clamp on both ends of the lead"

All subsequent occurrences of "lifeline", please replace with "live line" *[industry term for working on conductors or installations that are electrically "live" i.e. fully energised ath their normal operating voltages]*

[Wilson] "It has been calculated...." *makes more sense in thw whole sentence if changed to "It hasn't been calculated...."*

"Nilcrom" is a brand of fuse

PAGE 3
"he is isolated from any possible electrical feeding." SHOULD READ "he is isolated from any possible electrical feed-in."

"the clamp on fuse body itself" *for clarity is better expressed "the body of the clamp-on fuse"*

"up the poll" SHOULD READ "up the pole"

"and return current for low voltage is into the earth" *is more clearly stated "and return current for low voltage goes into the earth"*

PAGE 8
[the "backwards" energizing of a 12.7 kV SWER distribution transformer from the LV 240 volt side is very odd indeed. Such a configuration denies the test object (the fuse) a huge amount of transient energy that would normally be delivered from the collapsing magnetic field of the much bigger transformer at the zone substation. Indeed Mr Marks' next question, on page 9, is "are you going to tell us the control current?"]

PAGE 11
"we have not used point on wave." *seems to be a phonetic corruption of an unknown technical phrase. Enquiries will be made of retired power engineers. It's possibly a statistical term relating to Poisson Distribution of probabilities.*

PAGE 14 [test series 5(a)]
"they spark less, being sparkless" - *[who does he think he's fooling? literal engineer's mindset]*

PAGE 15
"this one has four shocks at the volt" SHOULD BE "this one has four shots at the fault"

[Barnard QC] "Which is the OYT OCR on the spur at Tatyoon?" SHOULD BE "Which is the OYT ACR on the spur line at Tatyoon?" *[ACR = automatic circuit recloser, OYT is assumed to be the SEC identifier, such as SP Ausnet's MY001 ACR near Myrtleford]*

[Weatherhead] "...without that arm operation" may be yet another phonetic approximation of technical dialect. Old timers would recognise the expression, most likely.

[Wilson] "This is the iron coil" SHOULD BE "This is the iron core"
"There are 1,200, 700 volts" SHOULD BE "There are 12,700 volts" [i.e. 12.7 kilovolts]