Excerpt of Transcript

1977
Board of Inquiry

into

the Occurrence of Bush and Grass Fires in Victoria

Witness
Anthony Thomas Wilson - Recalled

transcript pages 1770 to 1791

THE BOARD: Would you mind explaining "impedence"? It might help me to follow a little bit. I understand, I think, resistance. Impedence, you said the other day - or somebody said, - was something different from resistance? ---Mr. McCutchan.

Would you mind trying to tell me - in the words of the old hymn - in simple language as to a little child, what impedence means?---I will attempt to. In a direct current circuit, that is, where current is flowing in a continuous path in one direction only, the resistance to the flow of current is purely, as we term it, resistive; it is the resistance of wires and bits and pieces. When we get into alternating current, that is, current that changes direction frequently, there is also an impedence to the flow of current due to the establishment of magnetic and electrical fields. This is not resistive in the same way as direct current, but it does impede the flow of current in the same way.

Thank you. That is an admirable explanation.

(see page 1783)

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fought than any fires previously fought, and gives a variety of reasons for it. But I desire to say this - that if in a particular case a witness of ours has a view that in some area, for some reason specified or unspecified, the fire fight was conducted in a way that was less than ideal, we have the practice of examining such matters without our own organization. We do not come here to complain to strangers, with all respect, about them; we talk them over within the club, and we have indeed institutionalized that performance.

THE BOARD: Yes. Mr. Marks, you wanted to say something before Mr. Barnard takes his departure.

MR. MARKS: I did. I did not want Mr. Barnard to be leaving under any misapprehension as to some evidence we shall be calling in which he may legitimately claim an interest. I did not want it to be thought that after he departs, we slip in a lot of evidence about which he does not know. Just so that that criticism cannot be made, I want you to know, Sir, that we do intend to call some evidence about the history of our problems with tree clearing, particularly with reference to the post 1969 situation, including some correspondence with the Graziers Association of Victoria in which certain undertakings were mutually given and promised. But I only mention that in passing, that there is some correspondence which suggests that the Graziers Association was going to do its part in making sure we were notified about trees, and we would clear them, and so forth and so on. We shall also call some evidence about our knowledge of the danger that might be caused by clashing conductors and some experiments that were done as far back, I think, as 1965, in one year, and of directions given and information gathered from our regions; and there will be evidence, or course, from someone at a high level in the S.E.C. - I am not sure who - about certain steps that are being undertaken.

THE BOARD: Mr. Barnard, I understand you will be still getting the treanscript, will you nd?

MR. BARNARD: I am not too sure of that, but I hear what is said, and no doubt Mr. Nixon will call on me should he think I ought to be here.

THE BOARD: If anything comes up whichis very important, at any rate, in relation to any of your interests, I think you can rely on finding out, on the grapevine, if in no other way, and then you are always welcome to come back again.

MR. BARNARD: Thank you.

ANTHONY THOMAS WILSON, recalled and further examined:

MR. NIXON: In the light of a question you were asked by Mr. Lloyd about the effect of fires at the foot of poles and surge diverters, have you made some inquiries and taken out any figures on that type of event?---Yes.

Do you have those figures with you?---I have two sets of figures which are related to what you are saying. One set indicates the number of occasions over the last ten or so years on which surge diverters have allegedly caused fires. That number is eight, in accordance with Mr. Kirk's figure.

Those are the files I have here?---That is correct. I think the second part which was related to Mr. Lloyd was the evidence

of flashover between conductors due to smoke or fire, which was related to - - -

Let us deal with the second matter first. What figures do you have on that?

THE BOARD: I am sorry. Would you say that again? Flashovers - - -?---Flashovers between conductors and high voltage lines, as a result of smoke or fire.

This theory of ionisation? Yes?---I have here a paper, which you may have, which describes the number of flashovers that occurred in and around Sydney on the 25th January 1975. There are a total of some eighteen. These are very high voltage lines, the large, big spans. You may have that document. It is from Mr. Webb of the S.E.C., New South Wales.

What is the effect of it, Mr. Wilson?---The effect was that on some fifteen to eighteen occasions over a period of about an hour and a quarter, lines flashed over between phases and, indeed, in one case, from the conductor to earth, as a result of the smoke and flame products in the area at the time. I just point that out as evidence of the type of occurrence that I am talking about. I have also some information from our own files of the same sort of occurrence. On the 11th February 1977, the Keilor/Thomastown number three 220,000 volt line was interrupted due to a grass fire in the vicinity of towers 33 and 34. You may have this also.

Did that involve any flashover?---Yes, the interruption was due to a flashover between phases. On the 28th November 1976, the Eildon/Thomastown number one 220,000 volt line was interrupted when smoke from burning off operations in the main line easement caused a flashover. They are some of the major ones. As to the sort of transmission lines involved in rural areas, detailed records have not been kept, because the flashover would cause initial operation of protection devices, which would then re-close. Unless that caused a permanent fault, it is unlikely to be investigated to the sort of extent at which records would be kept of those occurrences. I have some. The Red Cliffs/Hattah line was mentioned in evidence. As to that occurrence that Mr. Marks questioned me on, I have checked the records. That fire came through across the line easement, and the line flashed over and re-closed after the fire had passed through. Subsequently the fire was reported to be burning back towards the line in another place, and the line was taken out of service to avoid further flashover.

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THE WITNESS (Continuing): This is, in fact, the kind of occurrence we are aware of.

THE BOARD: How do you propose to handle this?

MR. NIXON: I do not propose to tender these. They are really reports on fires which should go back to the SEC. Mr. Dunne, who is the solicitor most vitally interested in the matter has had an opportunity of purusing the file over the week-end.
(To witness): You have the files there dealing with fires which have occurred from surge diverters, or probably have occurred from surge diverters in recent years, is that right?---Yes.

Is there anything of significance in those files, any pattern that can be formulated?---I think it is difficult to establish a pattern because very few, if any, of these cases have in fact been investigated to determine, in some cases, even the meteorological conditions at the time except for brief comments such as severe weather or lightning.

What about the Heywood incident where there was a fire. Is that of significance?---Yes, the Heywood one is the one that one could perhaps draw the direct parallel with Mingay in that a surge diverter exploded, the fire started in the vicinity of the base of the pole and all three fuses operated. The difference being you will remember at Mingay the 12.7 kV fuse was on the load side as opposed to the supply side of the diverter. At Heywood, the fuse was on the supply side of the surge diverter, thus one can explain the operation of all three fuses as a direct result of the surge diverter itself exploding.

In one of those files, I think it may have been the Heywood file, there is a reference, is there not, to fire being caused by the expulsion drop-out fuse with the fire choke fitted? ---Yes. I do not think that is the Heywood one, but there is in one of the files a reference to the surge diverter certainly exploding, the fire started at the next pole back along the line and this was fitted with an EDO and fire catcher.

And a fire started?---Yes.

Was that followed up by the SEC as to why the particles were not caught in the fire choke?---I cannot say in that instance whether it was followed up or not.

In Mr. Kirk's evidence, or in the documents that were produced, the Mingay fire was put down to allegedly being caused by the surge diverter or an EDO fuse?---Yes.

What is your view about the operation of the EDO fuse as a cause of that fire?---One cannot deny the possibility, but I do not think it is a prime suspect in this particular case.

THE BOARD: Which fire?---Mingay.

MR. NIXON: You will recall, Mr. Chairman, Mr. Kirk had the alternatives.

THE BOARD: Yes. So far, I agree with the witness, if I may say so. I think Mr. Kirk was only being cautious, was he not?

THE WITNESS: I think the only two pieces of electrical apparatus on that pole, which could be associated with starting a fire would be the surge diverter or fuses.

MR. NIXON: He put it down as a possible cause but not the prime suspect. What do you put as the prime suspect?---I think there is a possibility that the surge diverter exploded and the fire started as a result of remnants of that piece of apparatus falling into the grass. I can also, as I explained, explain the explosion of the surge diverter in relation to a prior fire. There is no direct evidence to contradict or back-up either of those theories.

There have been other operations of the fuses on this pole in the past?---Yes.

Have you investigated what the causes of the operation of this fuse were?---I personally have not investigated them.

Have you checked the records?---I have not personally checked the records. I have spoken to the regional people involved in the operation of that. There was a surge diverter of a different type further along that spur which has been removed. I cannot, and they cannot explain the previous operations on the basis of its condition. I am not aware of the detail of trees associated with this line at this time. In fact, I am awaiting a detailed report of that condition right at the moment.

MR. DUNNE: I take it, Mr. Wilson, and I think this has already been said previously, if the surge diverters are operating properly and are not defective in the way you have described, there should never be explosions?---That is correct.

So you have to have a defective surge diverter?---That is correct.

THE BOARD: Even in the event of a lightning strike, that is what the diverter is there for?---Yes.

..nd it should operate without exploding?---Yes.

MR. DUNNE: Those files in relation to the eight failures, I think that the situation is that there are four cases of surge diverters failing on the 11th February, three at Heywood, the Spittle 13, the Goodince 2, and Fogl?---Yes.

So there was those three on the Heywood line?---I am not sure of the three on the Heywood line. I would have to refresh my memory on this.

There was also, on the 13th, one at Bringalbert South. I think that is amongst the papers there. Then there is the one at Mingay on the 12th?---Yes.

There was one also Meringur North on the 4th February 1977?---That is correct.

That is, on my reading of the files, five in eight days?---Yes.

Does that suggest that they have passed - because of the defects you know they have, it would seem a lot of the diverters have passed their life and there might be fire hazards all over Victoria because of the defects with them?---We are aware of a number of these diverters around the State that could be a hazard.

That is becoming more and more a problem as time goes by?
---I was not aware it was becoming more of a problem than it has been. It has been and continues to be.

THE BOARD: I take it you are replacing them, examining them and replacing the ones that are likely to become defective?
---Yes. I think during my previous evidence on this subject I mentioned two devices we have in the field for checking the condition and also mentioned that we have a large number of them which are suspect which are currently discontinued.

MR. MARKS: Exhibit 10 is a more modern type.

THE BOARD: Yes. Those eight occurrences that you mentioned, all with surge diverters, they were within how many days of each other?---I do not think they were all within the same - the eight occurrences were 1969 to 1977.

MR. DUNNE: My reading was there were five between the 4th and 12th February 1977.

THE BOARD: Is that right?---Yes.

That seems to be a co-incidence, if it is a co-incidence, that you have so many in that period?---We certainly have not had the same numbers in any significant period.

You have eight in eight years?---Eight which started fires. We have a significantly larger number than that which have failed, nowhere near equivalent to five in eight days.

MR. MARKS: There was a lightning storm.

THE BOARD: There was a lightning storm which might account for some of them?---That would certainly increase the rate of failure significantly. Lightning would account for the larger number of failures on that day.

MR. DUNNE: The diagram you prepared relating to the connections on the Bucholz isolating sub-station which was Exhibit 190, of course, that only shows the electrical connections on the pole itself?---Yes.

It is trite to say, of course, there is a source and there is a load at the end of things?---Yes.

The source being the Camperdown sub-station?---Feeder eminating from the Camperdown sub-station.

That is the immediate source?---Yes.

That immediate source would be protected by circuit breakers or fuses?---A circuit breaker.

With a recloser?---I have the diagrams with me if you will permit me to check the information. Yes, with recloser, single shot recloser.

What does that mean?---That means that the circuit breaker will attempt to reclose once only.

The Bucholz isolating sub-station itself, what is the capacity of the transformer there, if capacity is the right word, what is the kVA?---25 kVA.

Are you able to say, on the load side of the s.w.e.r. line how many consumer sub-stations there would be?---About five.

What is the capacity of those. Are they all the same capacity? ---From memory, each is a 10 KV.A transformer.

If you could have a look at Sketch No. 1, that shows, does it not, the more complete picture of the sub-station and consumer.

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MR. DUNNE (Continuing): That shows a more complete picture, with the immediate source and where it all goes to?---It is a typical layout of such an installation, yes.

Do you know what the ratings of the fuses are - first of all the 22 kV fuse at the substation?---3.15 amperes.

They are the famous 3.15 amperes we are talking about, are they?---Yes.

And on the 12.7 side?---Also 3.15 amperes.

Have you any idea what the ratings of the fuses might be protecting the consumer substation?---10 kVA - they will be 2 ampere. The complete picture of the low voltage fuses would be 55 amperes.

Would you look at sketch No. 2 - does that demonstrate the way in which you see this on your ionisation theory - if I can call it that - that is the way you say things happen? ---Yes.

Could you look at sketch No.3? Would you agree that is a more likely demonstration of the way things happen, with current flowing in two directions?---That is, in fact, what will happen.

The fault current will divide?-- I remember explaining at the time, the current would flow through any earthed path on that 12.7 thousand volt line, yes.

So the current will, in fact, divide; some will attempt to go to earth in the transformer and some of it will attempt to run to earth at the consumer substation?---Yes.

Do you agree with that?---Yes.

That being the situation, is it not likely that there would be some damage caused at the consumer substation by this fault current?---No.

Why not?---Because the division of current in terms of impedence that it sees to earth would be such that the majority of current would flow in the direction I have intimated - that is back through the isolating transformer.

Is that right?---Yes.

Have you not got 25 kVA at the transformer on the isolating substation?---I am not talking about capacity I am talking about impedence.

Impedence or restriction to current flow?---Yes.

There is also resistance to current flow at the consumer substation end, is there not?---Yes.

You say there is more impedence at the isolating substation than at the consumer substation?---No, I am saying the effective impedence that that current sees as it enters the line at that point back towards the isolating substation is substantially less than the impedence it sees looking towards the consumers. The majority of the current will take the path of least impedence.

Of least impedence?---Yes.

Is not the situation that if you have got five lots of ten at the

consumer end, that is 50, and you have only 25 at the isolating substation, will not the current divide in proportions of 2 to 1, with the two going to the consumer? ---No, because you are talking about capacity of the transformers which is in no way related to the impedence they present to the path of the current. That impedence is really more the size of that transformer and its capability of transmitting power at that point. There is a relationship between impedence and size of transformer, but it is not anywhere near what you are suggesting.

Not that simple?---No, not by far.

In any event, you say the major direction of the current will be to the isolating substation?---Yes.

But you can see that some of the current will flow towards the consumer substation?---Yes.

Would you not expect that that current will cause some problems on the consumer substation?---Without doing a detailed calculation, that is extremely difficult in this case. I do not think so. We did look at that possibility, obviously.

Why do you not think so?---Because, as I said, the majority of the current will certainly flow back from the isolating transformer earth. You have between the point of the flashover and the earth, along back towards the isolating substation, what I would assume to be a few feet, or now a few metres of line which has a very low impedence; you have the impedence of the secondary side of the transformer and you have the impedence of the earth grid at the base of the isolating substation. In other directions, you have an impedence of the line which now, because it is in kilometres and not metres, it is significant impedence. You have the impedence of each transformer and its associated earth in parallel, which would be an impedence of some significance. Then you have the earth return path of that back to the area of the isolating substation.

But even despite that, you say there is less impedence on the isolating substation than further down the line, there is still going to be current flowing?---Certainly, yes.

The question is, why that fault current would not cause problems at the consumers substation?---It could not have been of such magnitude to have caused operation of any of the 2 ampere fuses. To be of such magnitude, the current would need to have been, in each case, 6 amperes through the fire transformers, that is five times this, which is at least 30 amperes, flowing in that direction. That is for minimum operation of the fuses, which occurs in several seconds. I do not consider that that magnitude of current would flow in that direction.

The other suggestion I want to make to you is that if the fault current occurred in the way you have described?---Yes.

You are getting 22 kV going down the 12.7 s.w.e.r. line, are you not?---You have 22 kV impressed on the 12.7 line, yes.

Is that the voltage which is flowing down the s.w.e.r. line, then? ---That is the voltage that is impressed on the s.w.e.r. line. Voltage does not flow, current flows.

That 12.7 kV s.w.e.r. line becomes a 22 s.w.e.r. line whilst the fault exists?---Yes.

And if you take that through to the consumers, if 12.7 becomes 240, 22 becomes 450, does it not?---No, it also becomes 240. The voltage between that 22 kV line and earth is, in fact, 12.7 kV. It is called at 22 kV line because the voltage between the two phases of that line is 22,000 volts. It is a 12.7 line, it is equivalent to one phase of a 22 kV fline. The isolating transformer is there to separate out the systems and enable a s.w.e.r. system to be established on the low voltage side of that transformer.

So what is eventually going through to consumer remains 240 regardless of the voltage of the s.w.e.r. line - is that what you are saying?---Yes, approximately.

What I was going to put to you and I think you have already answered it, is if what you say happened did, in fact, happen, you would expect damage to consumer appliances? ---No, because, as I have said, the voltage impressed would be no greater.

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MR. DUNNE: The other thing I want to suggest to is, if things happened the way you suggest, there would be a fault back at the zone sub-station?---There certainly would have been a fault current flowing in the feeder from the zone sub-station, yes.

Would you not expect that to cause the circuit breaker to operate?---No. Remembering that the 3.15 ampier fuse on the 12.7 side would blow and clear that fault well before the circuit breaker protection would have operated - it would have detected it but our co-ordination between those two devices is such that with faults in that area of the system, the three ampier fuse would be expected to blow first.

That is the three ampier fuse on the 12.7 s.w.e.r. line?---In addition to that fuse there is at least one other fuse in that line between there and the sub-station.

There has certainly been no evidence of any operation of any of those fuses?---No, it is not expected.

Why not?---Because of the fault being cleared by the operation of the three ampier fuse, the co-ordination is such that the other devices will not operate.

This is the crucial part of your evidence. You said at page 1353 (and I shall read the question): "But if the 12.7 fuse blows then the fault is flowing to a line which is not connected to anything, is that correct?" You replied, "The fault would therefore cease to flow. The current would cease to flow, it has nowhere to go." That is crucial to your postulation that once the 12.7 fuse blows, that is the end of the fault?---Yes.

I suggest to you that that is not the case and in fact the converse is the situation?---The current could still flow back through the other consumer s.w.e.r., the transformer but, again, it would not be of sufficient magnitude to be able to maintain an arc with the conductors at that point.

But the source of the arc, right up to the conductors on the pole, is still in existence?---Yes.

The blowing of the 12.7 fuse does not put that out?---It reduces the current in the arc and its ability to maintain the current.

Why?---Because the impedence to earth which was low when the isolating transformer was connected with the circuit, now becomes high.

Is it not a fact that once an arc has established itself it produces its own heat, it produces its own ionised gases and tends to maintain itself?---Yes, but the amount of ionisation and the peak being produced is proportionately square to the current so if one reduces the current by the mechanism I have described, it could well extinguish.

It would not extinguish instantaneously with the blowing of the 12.7 fuse, would it?---It would extinguish itself within the next cycle of the 50 cycle operation, which would be 20 milli seconds.

Necessarily?---Perhaps within two or three cycles.

What I am suggesting to you is that if things happened as you suggest they did happen then the blowing of the fuse, indeed, all the fuses on the isolating sub-station need not have necessarily any effect at all on the arc and, if the arc

is maintained, almost certainly you must get faults in the consumer sub-stations?---I doubt whether you would maintain an arc, 22 - 12.7 with only the impedence of the consumer sub-stations in the circuit.

That doubt is crucial if it is in fact possible for the arc to maintain, because there was no damage in the consumer sub-station; your postulation is not on?---There is a difference in the word "damage". There would not be any damage anyway, even should the arc be maintained. The amount of current flowing would still not be sufficient to blow the fuses.

How can you be sure of that?---Because it was not sufficient to blow the fuses in the first place, even when the isolating sub-station current was in existence. The current is not changed so the impedence through the fuses will still be maintained. There are no fuse operations and the oppressed voltage is such that the consumers installations have seen no difference in the oppressed voltage - so, there is no damaging effect on the consumer installations until this eventually extinguishes itself, and that would certainly happen.

Do you not think the absence of any fuses on consumer sub-stations, or upstream causes some problems for your postulation?---No, my postulation is still that following flashover the operation of the 3.15 ampier fuse on the 12.7 side was sufficient to cause extinction of the arc.

But you agreed with me before that arcs tend to generate themselves?---They create heat and ionisation which provides a path for current flow.

Arcs with powerpaths, 50 cycle a.c. power arcs, each time the current passes through current zero on the cycle, the ionisation and heat in that area must still be sufficient to maintain the arc when the current tries to return to current zero. I would suggest or postulate that once that 3.15 ampier fuse has blown, insufficient current would be able to flow through the circuit to maintain an arc.

Are you certain?---I cannot be certain.

So it is possible that the sorts of things I am suggesting should have happened but did not?---If that was the case, the next fuse back in the system should have operated.

But if Mr. Nixon's theory about the tree across the powerline causing a solid fault is right, then the only things you would expect to operate would be the three fuses on the isolating sub-station and the surge diverter?---A tree across the line could have caused the three fuses to operate. It is not possible for the surge diverter at this stage to explode but it is possible that a tree across the line could have caused the 12.7 fuse to operate and the switch circuit, as a result of that operation, could have caused the diverter to - - -

If that is the way it happened with the tree, then you do not expect these faults at the consumer sub-stations?---I would not expect them in either case.

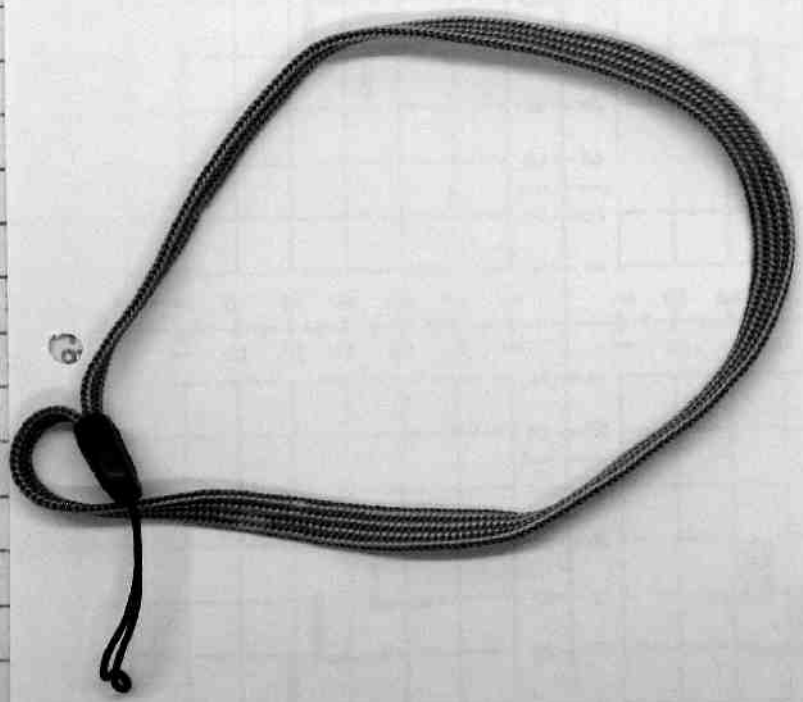
You have admitted the possibility, given certain things.

THE BOARD: Is there any evidence of any failure of any consumer sub-stations?

MR. DUNNE: No, the only evidence was the faulty cap type arrester.

THE BOARD: That has nothing to do with it, anyway, as I understand.

LUNCHEON ADJOURNMENT



UPON RESUMING:

MR. DUNNE: Perhaps before I start those three diagrams should be tendered.

MR. MARKS: Who did them?

MR. DUNNE: They were prepared for me.

THE BOARD: Have you not seen them, Mr. Marks?

MR. MARKS: Yes, I have seen them.

EXHIBIT 222.....Three sketches illustrating current paths at Mingay.

MR. DUNNE: Mr. Wilson, when I was asking you for various ratings and capacities earlier, I neglected to ask you what the trip current for the circuit breaker would be?---100 amperes is the minimum operation for the protection on the Camperdown feeder.

THE BOARD: Mr. Dunne, I suppose - I "confess" perhaps is a better way of putting it, but you dazzle me with science - I am following, I hope, faint but pursuing, this line of argument, but I must confess I do not quite see what you are putting, what all this is directed to.

MR. DUNNE: The suggestion is that if things had happened as Mr. Wilson suggests, with ionisation and so on, there would have been operations of fuses and so on elsewhere in the system than on the Bucholz sub-station, and that there is no evidence of that having been the case; in fact, the contrary.

THE BOARD: The evidence is quite to the contrary, yes. Yes, I see what you are getting at. Thank you.

MR. DUNNE: The suggestion, of course, is that if there is no other damage, it did not happen that way, it happened in Mr. Nixon's way.

THE BOARD: That is right. On the other hand, it happened. The important thing is that it happened. Yes, I see your point.

MR. DUNNE: With the sort of fault you have postulated would you expect an operation of that circuit breaker?---No.

Why not?---The total current involved in a fault of that order of magnitude would be perhaps 20, 30 amperes, no more, because the total impedence in the circuit would be such as to limit the current to that sort of order.

You are saying that the fault current caused by this arcing would be in the vicinity of 20 to 30 amperes?---Yes.

Do you realize you have said earlier in your evidence it would be in order of 100 to 150 amperes?---No, I was not aware.

At page 1355 of the transcript you were asked this question: "When a flashover occurs, what sort of order of magnitude would you describe that sort of fault, especially between a 22 kV line and a 12.7 line?" Answer: "The magnitude of the current that would pass between those conductors is determined by the impedence or the resistance of the system that is supplying that fault. A fault at that particular point would result in current of the order of 100 to 150 amperes"?---Could be.

Are you changing your mind about the 20 or 30? Do you still agree with the 100 to 150?---It could still be in the order of 100 to 150. Without doing the precise calculation - which I have not done - and without knowing the earth grid impedance at that isolating station, it is impossible to say.

THE BOARD: Would you mind explaining "impedence"? It might help me to follow a little bit. I understand, I think, resistance. Impedence, you said the other day - or somebody said, - was something different from resistance? ---Mr. McCutchan.

Would you mind trying to tell me - in the words of the old hymn - in simple language as to a little child, what impedence means?---I will attempt to. In a direct current circuit, that is, where current is flowing in a continuous path in one direction only, the resistance to the flow of current is purely, as we term it, resistive; it is the resistance of wires and bits and pieces. When we get into alternating current, that is, current that changes direction frequently, there is also an impedence to the flow of current due to the establishment of magnetic and electrical fields. This is not resistive in the same way as direct current, but it does impede the flow of current in the same way.

Thank you. That is an admirable explanation.

MR. DUNNE: What you are saying is that you cannot say whether the 20 or 30 is nearer the mark than 100 or 150 without doing some calculations which you have not done?---No, but the blowing of any fuses along that network would occur prior to operation of the circuit breaker. Regardless of whether the current were 30 or 150 amperes, I would still not expect that circuit breaker to operate.

That assumes that the fault does not continue for a number of seconds?---It does not continue for long enough for the circuit breaker protection to pick it up. It has a time lag of .35 of a second initially That is, at the minimum operation, quite a long time.

It has to have .35 of a second before - - - ?---At that current level.

At that current level before it is picked up at all?---Yes.

And then a further period of time before it will operate?---Yes.

What is the further period of time?---I could not say without going into the circuitry of the circuit breaker, but probably another .1 of a second, that order of magnitude. That is the operating time of the mechanism itself.

So you are looking at a continuance of the fault at that level for something like half a second?---Correct.

You said this morning that there is less impedence at the isolating sub-station than at the consumer sub-stations?---Yes.

And that therefore the majority of the current would flow to the isolating sub station?---Yes.

How do you base that?---As I explained this morning, if we are looking at the direction of the isolating sub-station,

we have virtually no line impedence as such, but imedpence of the secondary winding on the isolating transformer and its earth grid. Looking in the other direction, we have the impedence of the line itself, plus the impedence of the transformers and their earth grids, plus the earthing impedence back to that point. If, for example, the 22 kV flows to the 12.7, the current that will pass towards those transformers is of about the same order of magnitude as the normal load current, because it is the normal load voltage that is, in fact, being impressed on it.

I shall take you up on that again in a minute. But is it not true to say that you have to do some quite complicated mathematical calculations to work out the impedences at either end?---No. The complicated calculation is for the resistive voltage transient that is associated with the cessation of that arc. The calculations associated with the impedence are relatively simple.

(Page 1785 follows)

WILSON REC.

23.JB.DE.
Fire.

MR. DUNNE: But you would need to do some calculations before you could say the proportion of current which will flow in one direction, and the proportion in another? ---To say it precisely, yes.

You have not done those calculations?---No.

Does that mean that your statement that more of the fault current will flow to the isolating substation is a calculated guess?---

THE BOARD: It is a guess as to how much more, but it is not a guess as to your basic statement that some will?---That is the case.

MR. DUNNE: It will certainly be more than 50 per cent?---Most certainly.

But how much more, you do not know?---No.

If we are talking of a fault current of 150 amperes, then you would only need 20 per cent flowing down to the consumer substations to cause operation of a fuse?---Yes, but you will not get anywhere near 20 per cent. As I said before, with 12.7 kV, which is the line voltage to earth of the 22, you only get something of the order of magnitude of the normal line current which is perhaps 5 amperes at the most.

You said this morning, and you just repeated it, that the voltage impressed on the 12.7 s.w.e.r. line is 12.7 volts?---Yes.

That is the situation if the transformer is isolated from the circuit, is it not?---Yes.

That assumes that the transformer is not playing any part in the circuit?--- Yes.

If the transformer is still in the circuit, the voltage on the s.w.e.r. line will then be 22 kV, will it not?---Once the flashover has occurred, the transformer is effectively isolated because the voltage is passing from the 22 kV to the 12.7, not to the transformer.

What about the other 22 kV line?---Because there is no earth in that transformer winding, it requires both those 22 kV connections to be valid for the transformer to be performing its normal function.

What you are saying is that there is no voltage coming from the transformer at all?---There would be some small amount of voltage coming through because you do not get a complete shortcircuit.

What order of magnitude would we be talking of?---A few hundred volts,perhaps. It is difficult to estimate.

So there is going to be something in excess of 5.7 kV on the s.w.e.r. line?---If those voltages are additive, and I would have to check that out.

What I am suggesting to you is that there would be an increased voltage on the s.w.e.r. line of sufficient magnitude to cause over-voltage problems with consumer appliances? ---There certainly would not be any voltage of that order of magnitude because even the normal 240 volt

appliances in the home are capable of withstanding 500 volts anyway, and you would get nowhere near that order of magnitude of voltage impressed. Further, as you raise the 12.7, if you get to around 15 kV, that transformer saturates. That is, it ceases to perform its normal function as a transformer, and the voltage on the secondary side just is not capable of being raised any higher.

The other thing I wanted to examine you about again was this question of the temperature required to cause ionistation? ---Yes.

You said when you gave your evidence last week, or whenever it was, that it was in the order of hundreds of degrees celsius, that you could give a figure which at best would be an estimate, but at that time you did not have the figure available?---Yes.

Do you have it available today?---No, there was no request for that piece of information.

When you say hundreds of degrees celsius, I suggest many hundreds, into the thousands, at least into one thousand would be necessary to cause this ionisation?---I am not prepared to say.

You have not made this calculation yourself; it is a figure you could look up?---I do not know whether that figure would be readily available. I am assuming combustible products in the air, not just clean dry air raised to a certain temperature?

I put it to you when you gave your evidence earlier, that if that sort of temperature were present in the vicinity of the top of the pole, it wouldhave caused much more damage to the tops of trees and we disagreed. If you had a temperature of hundreds of degrees centigrade, that would have caused melting of the insulation material on the line going to Eddy's, and there are also wires insulated on the top of the pole?---I am only talking about - as a bushfire goes along, there is only a brief incident or time of exposure of the conductors to this sort of temperature condition. You are describing a much more longthy exposure to that sort of temperature causing significant damage.

Of course, that depends on the temperature?---Precisely.

That is why I wanted to see if you could give it to us today. It has been suggested to me that it would be in the thousands rather than the hundreds?---For dry clean air, that is probably a reasonable estimate, but as I have already said, with burning products, particularly carbon, in that sort of area, I do not think that figure would be anywhere near reliable.

THE BOARD: Suppose there was all the ionisation a that the heart of an SEC officer could desire and that, in fact, caused a flashover, the flashover in turn creates a surge of current, does it not?---Yes.

That is what your surge arrester is there to arrest, is it not? ---That is one of the types of surge arrester.

Yes, they are also there for lightning and sodden switch-ons along the line?---Yes.

WILSON, Rec.

and it should do that without blowing up?---It most certainly should.

MR. DUNNE: I suggest to you that for your theory to be regarded as a likely possibility here, a lot of conditions have to be present which we have not got any evidence about, which you assume were present but which I suggest you are not entitled to assume were present. For example, the necessary temperature, that is the key to it all, is it not?---No, we have had, as I presented here today and they were only for the EHV lines, admittedly, we have had examples of lines flashing over, no burning off, and bushfire type conditions, so I do not count that as an unlikely event, postulating that the bushfire was there first, that is the one piece of evidence about which I have no direct or indirect evidence.

The first thing you have to have is that the fire must have started somewhere else?---The fire started in the vicinity of the pole.

You have to have sufficient temperature, then once the arc has been established and caused all these things to happen on the pole, it has to distinguish itself quickly to prevent faults occurring elsewhere in the system? ---No, as I said, even if the arc maintains itself across that gap, you still only have impressed on that remaining part of the system a voltage close to its normal 12.7, plus a few on the transformer.

(Page 1788 follows)

MR. DUNNE: What about going back the other way, towards the source current, what would the current be there if the arc maintained itself?---As I said, perhaps the arc is facing current which I have said is of the order of five amperes on the 12.7 end, down the side of the arc, that current is the same current as in the top arc.

That would not cause any alterations upstream?---Most certainly not.

MR. LLOYD: I think I started this - did I not? Is what you are saying, you say it is at least possible that what took place at Mingay was a flashover between conductors caused by ionisation?---Yes.

Resulting from fire?---Yes.

And from smoke?---Yes.

I think what I was putting to you is if that is what happened and it resulted in the explosion of a surge diverter, you would expect to find more than just one incident of an explosion of a surge diverter, resulting in a number of fires?---We are talking about different things. The explosion of a surge diverter as a result of switching surges or lightening is one event that can and does happen on the system. The flashover of lines due to smoke combustion products is another type of event. The two are only associated with this particular type of installation where we have a 12.7 conductor in the centre of a span between two 22 kV conductors and the associated isolating transformer installations, of which there are very few installations.

Is the effect of your further researches that the sequence of events here was not isolated in the sense that you have been able to find similar, if not identical, sequences of events in other places in Victoria?---No, I cannot go that far. I think the first event, that is the flashover between conductors, I have been able to find evidence of the type for Mr. Nixon. The associated explosion of a surge diverter, I am well aware surge diverters of this type, particularly in this condition, can and do fail in these conditions.

But you have not been able to find another instance of these sequences of events?---No.

MR. MARKS: The fallacy in what Mr. Lloyd put to you, is that you must have a combination of the flashover plus a surge diverter which has a weakness in it, to enable it to explode?---That is correct.

If things work properly, any surge of voltage following a flashover should be absorbed, should it not, by the surge diverter? ---That is correct.

And whilst we hear about the surge diverter that failed, are there some that, in fact, do their job?---A large number of them, in fact, operate efficiently.

Therefore, if, in fact, over a period of nineteen years you have only got eight or so instances of surge diverter failing, I suppose it is no surprise to you that you do not have the coincidence Mr. Lloyd is looking for?---That would be a reasonable conclusion.

It may be suggested hereafterwards that here you have a 3.15 amp.fuse, when at Glenthompson we have been saying it would not work to have a 3.15 amp. fuse. Are the two situations similar or not?---No, they are entirely different. First, at Glenthompson, we are talking about the fuse on the s.w.e.r. customer sub-station; here we are talking about a fuse on the isolating sub-station and it is, in fact, this 3.15 ampere fuse which has to co-ordinate with the 2 ampere fuses which would be on the customer s.w.e.r. sub-station.

In fact, naturally, in the system you do use 3.15 ampere fuses, do you not?---We have a number in the system, yes.

Here it is being associated with an ISO system, is it not?---Yes, associated with the isolating transformers.

It was suggested that if the fuse blows and an arc takes place, there is a surge of voltage to some extent down the s.w.e.r. line, even past the blown fuse - I think that was what Mr. Dunne was putting to you?---No, I think what he was suggesting to me was that it was 22 kV that would be impressed on that line following the arc, and that is not the case, it is 12.7 kV, that is the normal service voltage.

At one stage, you said it was the same thing, I think, in effect? ---Yes.

What do you mean exactly?---Normally, in service, that line is 12.7 kV to ground.

That is the s.w.e.r.?---Yes. It happens that the 22 kV system, so called 22 kV, has 22,000 volts between phases and each phase to ground has a voltage of 12.7 kV.

Phases being represented each by two conductors?---Normally by three conductors - or two conductors, as in this particular system. In other words, the voltage impressed on that line to ground would be the same under either condition.

Yes. Well then, what you are saying is that there was only normal voltage energized, if anything was energized, in the s.w.e.r. line at the time of the arcing?---That is following the blowing of the 3.15, yes.

And that came from the arcing, is that right?---Yes.

Which arcing?---The arc between the 22 and the 12.7 conductors caused the current to flow and, as Mr. Dunne pointed out, to divide; in fact, some will flow towards the customer sub-station.

Assume Mr. Dunne's assumption was correct, and some increase in voltage takes place through that arcing, from the normal rate voltage, you deny that?---There would be some small increase because of the small associated voltage from the transformer.

Assuming that there is some, would this increased voltage, in any event, blow the fuse on its own?---No.

Its increased rate of flow?---Current is the only thing that will blow a fuse.

Can you get, associated with that increased voltage, some increase in the rate of flow?---You will get a proportion of increased voltage, as you get increased current.

Would it be likely, in your view, to blow a fuse?---No, not in that sort of condition.

(THE WITNESS WITHDREW)

MR. NIXON: I propose to read into the transcript a summary of the document handed to me by Mr. Wilson. I do not propose to tender it. This is portion of an article written by A.J. Webb, who is the Supervising Engineer, State System Control Centre, Electricity Commission of New South Wales, Sydney. It reads:

"SUMMARY: To reduce the environmental impact of high voltage overhead lines, the extent to which easements are cleared of trees and foliage is reduced to a minimum. The result has been an increase in the incidence of line faults due to high winds and bushfires, accompanied by the phenomenon of resistive faults which may not be cleared by high speed distance protection. The power dissipated in these faults can give rise to large frequency excursions which affect the control systems employed on the system plant."

In the introduction, he goes on to say:

"To meet current environmental standards it has become the policy of electric utilities to endeavour to minimise the visual impact of H.V. transmission lines by several means. One such way is to reduce the clearing of line easements (right-of-ways) to a minimum in natural bushland."

It would appear that New South Wales has its troubles, as well as Victoria.

THE BOARD: Would you read that last sentence again?

(Page 1791 follows)

MR. NIXON (Reads) To meet current environmental standards, it has become the policy of electric utilities to endeavour to minimize the visual impact of HB transmission lines by several means. One such way is to reduce the clearing of line easements - - -". It is not necessarily recommended.

JOHN DANIEL HAMILTON, sworn and examined:

MR. NIXON: What is your full name?---John Daniel Hamilton.

Where do you live?---At Inverleigh.

Where abouts is Inverleigh?---20 miles west of Geelong on the Hamilton Highway.

What is your occupation?---Farmer and grazier.

The submission that has been put in has been submitted by Mr. John Stewart Hamilton, your son?---Yes, and secretary of our brigade.

Are you a member of the Inverleigh Brigade?---Yes.

Have you read the submission put in by your son to this Inquiry? ---Yes.

Do you agree with it?---Yes.

You are in fact the Captain of the Brigade, are you not?---Yes.

You have put in in effect a copy of a letter which was sent to the C.F.A. by your brigade. You say, "Please find enclosed copy of a letter being sent to the CFA by our brigade."?---The first letter you received?

Yes, the letter which says, "Now that the fire season is drawing to a close"?---Yes.

Firstly, I shall read the letter your son sent to this Inquiry which is dated 21st April, 1977. (Reads) "Dear Sir, Please find enclosed a copy of a letter being sent to the CFA by our brigade. We do not believe this affected our brigade on February 12 because the magnitude of the fires seemed to be too large for the officers of the CFA as they were hardly heard from all day. However, we are concerned about the action of the officers in normal day to day fires. Small fires can become large fires even on reasonable days. Trusting this may help you in your Inquiry. Yours sincerely (Sgd) J. S. Hamilton Hon. Sec.

The copy of letter included with that letter reads: Now that this fire season is drawing to a close, this brigade feels that this is the time to review this season's work. At the present time inquiries are being held regarding the disastrous fires in the western district and into the effectiveness of our fire fighting organisation. We feel it is time to express our concern regarding the manner in which R.F.B. are being treated by group officers and group communication officers and all higher authorities. Unfortunately, most of these officers have learned fire fighting from behind a desk and have had little practical experience in the field whereas the fire fighter of today is now in the fifth generation of the country and every generation has had their own fires to combat.

J. D. HAMILTON.