

<p>1 Tuesday, 27 November 2018</p> <p>2 (10.00 am)</p> <p>3 SIR MARTIN MOORE-BICK: Good morning, everyone. Welcome to</p> <p>4 today's hearing.</p> <p>5 We are going to hear some more expert evidence today</p> <p>6 from the person who has been instructed to look into the</p> <p>7 electrical aspects of this matter.</p> <p>8 Yes, Mr Kinnier.</p> <p>9 MR KINNIER: Thank you, sir.</p> <p>10 May I call Dr Duncan Glover.</p> <p>11 SIR MARTIN MOORE-BICK: Thank you.</p> <p>12 DR J DUNCAN GLOVER (sworn)</p> <p>13 Questions by MR KINNIER</p> <p>14 SIR MARTIN MOORE-BICK: Thank you very much, Dr Glover. Sit</p> <p>15 down and make yourself comfortable.</p> <p>16 THE WITNESS: Thank you, sir.</p> <p>17 SIR MARTIN MOORE-BICK: Right. Yes, Mr Kinnier.</p> <p>18 MR KINNIER: Thank you, sir.</p> <p>19 First of all, would you mind confirming your name</p> <p>20 for the record.</p> <p>21 A. Yes, my name is John Duncan Glover.</p> <p>22 Q. Dr Glover, thank you very much for attending to give</p> <p>23 evidence today.</p> <p>24 First of all, can you confirm that you provided</p> <p>25 a report dated 15 October of this year, a damage</p> <p style="text-align: center;">Page 1</p>	<p>1 qualifications at section 1.3 of your report at page 4,</p> <p>2 and at appendix D of that report.</p> <p>3 I'm not going to go through all of that, but I would</p> <p>4 like to pick out some key points.</p> <p>5 First of all, is it right that you're a registered</p> <p>6 professional engineer in the Commonwealth of</p> <p>7 Massachusetts?</p> <p>8 A. That's correct.</p> <p>9 Q. Since 2004, you've been the president and principal</p> <p>10 engineer of Failure Electrical LLC.</p> <p>11 A. Yes, sir.</p> <p>12 Q. You hold a BS degree in electrical engineering from the</p> <p>13 University of Massachusetts.</p> <p>14 A. Yes, in Amherst, Massachusetts, correct.</p> <p>15 Q. You also hold an MS degree in electrical engineering</p> <p>16 from the Massachusetts Institute of Technology.</p> <p>17 A. Yes, that was in 1968. That's correct.</p> <p>18 Q. In addition, you were awarded a PhD in electrical</p> <p>19 engineering from MIT in 1971.</p> <p>20 A. Yes, sir.</p> <p>21 Q. Is it right that you're a life senior member of the</p> <p>22 Institute of Electrical and Electronic Engineers?</p> <p>23 A. Yes, sir.</p> <p>24 Q. You are also a member of the National Fire Protection</p> <p>25 Association.</p> <p style="text-align: center;">Page 3</p>
<p>1 assessment memorandum also dated 15 October of this</p> <p>2 year, and an addendum dated 16 November of this year; is</p> <p>3 that right?</p> <p>4 A. Yes, three separate documents.</p> <p>5 Q. For the avoidance of doubt, although headed "draft",</p> <p>6 both your report and the damage assessment memorandum</p> <p>7 are in fact the final versions; is that right?</p> <p>8 A. That's correct.</p> <p>9 Q. Do you confirm that the facts and matters set out in the</p> <p>10 report, the damage assessment memorandum and the</p> <p>11 addendum are true to the best of your knowledge and</p> <p>12 belief?</p> <p>13 A. Yes, I do.</p> <p>14 Q. Is it right that you have provided the report, the</p> <p>15 damage assessment memorandum and the addendum in the</p> <p>16 same way as you would've provided those documents to</p> <p>17 a court?</p> <p>18 A. Yes, sir.</p> <p>19 Q. Finally, does your report, damage assessment memorandum</p> <p>20 and addendum set out your opinions on the matters</p> <p>21 relevant to this inquiry?</p> <p>22 A. Yes, that's correct.</p> <p>23 Q. Thank you.</p> <p>24 Dr Glover, the first issue I'd like to cover with</p> <p>25 you is your qualifications. You set out those</p> <p style="text-align: center;">Page 2</p>	<p>1 A. I am.</p> <p>2 Q. Between 1977 and 1990, you were a tenured associate</p> <p>3 professor in the Electrical and Computer Engineering</p> <p>4 Department of Northeastern University.</p> <p>5 A. Yes, I started out as an assistant professor, but</p> <p>6 I worked myself up to a tenured associate professor.</p> <p>7 Q. Finally, you were also a principal engineer at Exponent</p> <p>8 Analysis Associates for a period of time.</p> <p>9 A. Yes, for 14 years, up to 1990, I was at Exponent.</p> <p>10 Q. Thank you.</p> <p>11 The next topic I'd like to discuss with you is the</p> <p>12 purpose of your report.</p> <p>13 Is it right that the purpose of the report, the</p> <p>14 memorandum and the addendum is to assess the fire origin</p> <p>15 within an area that has already been established by</p> <p>16 other investigators retained by the inquiry?</p> <p>17 A. Yes, that's correct.</p> <p>18 Q. As set out in section 1.1 of your report at page 3,</p> <p>19 non-electrical fire origins are outside the scope of</p> <p>20 your expertise; is that right?</p> <p>21 A. Yes, I'm not an expert in non-electrical fires, only</p> <p>22 electrical fires.</p> <p>23 Q. In relation to the identification of the area of origin</p> <p>24 of the initial fire within flat 16, as set out in</p> <p>25 section 2 of your report, at pages 6 to 8, you've relied</p> <p style="text-align: center;">Page 4</p>

<p>1 upon the analyses of Professors Bisby and Nic Daeid; is 2 that right? 3 A. Yes, I have. 4 Q. Accordingly, is it right to say that you've taken for 5 the purpose of your report, the memorandum and the 6 addendum, the area of origin to be the south-east end of 7 the kitchen, between the kitchen window and the edge of 8 the cooker? 9 A. Of flat 16, that's correct. 10 Q. Mindful of the limits of your expertise, have you seen 11 any other evidence which casts doubt over their 12 identification of the area of origin? 13 A. No, sir. 14 Q. Thank you. 15 The next topic I'd like to discuss with you is your 16 examination of the physical evidence. 17 First of all, as set out in the damage assessment 18 memorandum, is it correct you inspected 14 exhibits 19 retrieved from flat 16? 20 A. I inspected many more exhibits than that, but there were 21 14 exhibits that are specially referred to in my damage 22 assessment memo. 23 Q. In broad terms, the exhibits you examined were a variety 24 of electrical components and wiring; is that a fair if 25 broad summary?</p> <p style="text-align: center;">Page 5</p>	<p>1 is that damage to electrical components can occur as 2 a result of electrical and non-electrical events? 3 A. Yes. 4 Q. And that whether an event was electrical or 5 non-electrical can indicate whether the damage was part 6 of the cause or the result of a fire; is that a fair 7 summary? 8 A. Two options, yes, two possibilities there. 9 Q. Is it right to say that electrical damage can indicate 10 abnormal electrical activity? 11 A. That it would, yes. 12 Q. That was capable of causing a fire? 13 A. It's capable of causing a fire and also could be the 14 result of a fire. 15 Q. Before we turn to the characteristics of arc damage, 16 could you help us with an explanation of some basic 17 technical terms that you refer to in your report and 18 other documents. 19 First of all, and at its most basic, what's a short 20 circuit? 21 A. A short circuit is an abnormal electrical condition 22 where the electrical current becomes much higher than 23 what is normally expected for the device that's carrying 24 electrical current. It's usually caused by 25 an insulation failure, a failure of the electrical</p> <p style="text-align: center;">Page 7</p>
<p>1 A. Yes. 2 Q. Is it right that your examination also relied upon 3 a range of technologies, including CT scans, scanning 4 electron microscopy and energy dispersive X-ray 5 spectroscopy? 6 A. Yes, as well as optical microscopy. 7 Q. The range of technologies you've relied upon are set out 8 at section 1.1 of your memorandum; is that right? 9 A. The damage assessment memo, yes. 10 Q. The next topic I'd like to discuss with you is arc 11 damage. 12 Is it fair to say that the principal object of 13 examining the exhibits was to determine the existence of 14 arc damage? 15 A. That was the principal. I did have some other side 16 issues in terms of counting wire strands via the CT scan 17 and looking at some wire connectors, but one of the 18 primary objects was to evaluate the possibility of arc 19 damage for the 14 exhibits. 20 Q. In that respect, could I ask you to turn to section 2.1 21 of the damage assessment memorandum. It's up on the 22 screen, Dr Glover, which may be easier than trying to 23 plough through the various files. 24 Before we go into the meat of that particular 25 section, would you agree that the basic starting point</p> <p style="text-align: center;">Page 6</p>	<p>1 insulation that protects the wires and the components, 2 and normally you would have a very high current that 3 could possibly trip a circuit breaker, cause a circuit 4 breaker to operate, or a fuse to blow. 5 Q. Thank you. 6 Secondly, what's a high-current ground fault? 7 A. Excuse me? 8 Q. What's a high-current ground fault? 9 A. Okay, that would be a short circuit that involves 10 current flowing from an energised wire, a live wire, to 11 a grounding wire or some metallic path to ground. It's 12 out of the normal path of electricity. Normally 13 electricity will flow down the live wire from a consumer 14 unit or a fuse box, through an appliance or 15 an electrical device, and then will return through 16 a neutral wire. But when you have a problem, a short 17 circuit involving ground, the current is diverted to 18 another path, either the grounding wire or some 19 electrical metallic path to ground. 20 Q. Thank you. 21 Finally, in your report you refer occasionally to 22 an overcurrent; what's an overcurrent? 23 A. It would be not as severe as a short circuit, but it 24 would be higher than the normal load current that 25 a device carries.</p> <p style="text-align: center;">Page 8</p>

<p>1 Q. In relation to a short circuit, or a high-current ground 2 fault, can we say that the energy released by these 3 events is sufficient to melt metals, thereby creating 4 a gap of sorts? 5 A. Yes, especially if there is an arc involved, where the 6 electricity flows out of the wire, through insulation or 7 through an air gap, and you have a luminous discharge. 8 It becomes very, very hot, temperatures in thousands of 9 degrees that are capable of melting metals such as 10 aluminium, copper, even steel. 11 Q. It's that temperature and its consequences which are the 12 primary consequences of what I've called the gap? 13 A. Yes. 14 Q. You note that abnormal electrical activity is often 15 identifiable after a fire because it leads to arc 16 damage; is that a fair if basic summary? 17 A. That is, yes. 18 Q. Again, I turned earlier on to section 2.1 of your damage 19 assessment memorandum, and if I could ask you to look at 20 the bottom of page 5, there you've identified nine of 21 the characteristics of arc damage -- the ninth is 22 overleaf -- at the bottom of that page. If we could 23 just go through those. 24 First of all: 25 "(1) Sharp demarcation between damaged and undamaged</p> <p style="text-align: center;">Page 9</p>	<p>1 call a sharp line of demarcation between the arc area 2 where the melted or resolidified metal is observed, and 3 yet a short distance way, a centimetre or less, no 4 damage. 5 Q. Can we take it from the fact that the sharp demarcation 6 is the first of these characteristics that it's the 7 principal or most important characteristic of arc 8 damage? 9 A. It's the one that I look for. It's the most readily 10 recognisable characteristic. 11 Q. As we go through the list, number (2) is: 12 "(2) Round, smooth shape of artifact." 13 Can you explain in layman's terms what that 14 indicates? 15 A. Well, very often when you melt copper, say, from a wire, 16 that will result in a round -- what we call a copper 17 bead. The copper strands on the wire, if it happens to 18 be a stranded wire, will melt, and then they will 19 resolidify into a round copper bead. 20 Q. Indeed, later, when we come to look at photos of certain 21 exhibits, we'll see illustrations of copper beading, 22 I think; is that right? 23 A. We will, yes. 24 Q. Number (3) is: 25 "(3) Localized point of contact."</p> <p style="text-align: center;">Page 11</p>
<p>1 area of the energized copper conductor." 2 Again, can you give us a brief explanation of how 3 that result is caused? 4 A. First, I would say that these nine items are taken from 5 a document entitled the National Fire Protection 6 Association, NFPA, document that covers a guide to fire 7 explosions, and there is a chapter on electricity in 8 that document. This is excerpted, these eight -- maybe 9 there's a ninth one on the next page -- 10 Q. There is. 11 A. -- items are excerpted from the NFPA guide. 12 Q. As I understand it, this list of nine characteristics is 13 not exhaustive; it's illustrative only. 14 A. That's correct. 15 Q. Again, looking at the first characteristic, the sharp 16 demarcation between the damage and undamaged area of the 17 energised copper conductor, how does that happen in 18 straightforward terms? 19 A. Yes. Well, as I mentioned, in the area of the arc, the 20 temperatures can be very, very high, thousands of 21 degrees centigrade/Celsius. But those temperatures are 22 also very localised for a very small area in the 23 vicinity of the arc, so that if you go perhaps 24 a centimetre away from the arc location, you will not 25 have the melting and the arc damage. So that's what we</p> <p style="text-align: center;">Page 10</p>	<p>1 Again, that flows from the explanation you've 2 previously given as to what arc damage is, I assume. 3 A. Yes, it's very localised. 4 Q. Again, number (4): 5 "(4) Identifiable corresponding area of damage on 6 the opposing (neutral) conductor or opposing grounded 7 metal surface." 8 Again, that flows from the elemental explanation 9 you've given of arc damage? 10 A. That's mainly a fundamental concept of electric 11 circuits, where when current flows, it always flows in 12 closed paths. So normally current will flow from, say, 13 a consumer unit or a fuse box down a live wire, and it 14 will return, after it passes through the load, through 15 a neutral wire, back to the consumer unit. So you have 16 current flowing in a closed path. 17 When you have arcing, the current gets out of the 18 bag, so to speak. It flows through an abnormal path. 19 It may have a luminous discharge, the arc may be flowing 20 through air or gas or tracking through some damaged 21 insulation. That current still has to return to the 22 consumer unit. That's why you will often see 23 a corresponding identifiable area of arc damage on 24 a return wire or some metallic path. 25 Q. Again, that point is relevant when we come to look at</p> <p style="text-align: center;">Page 12</p>

1 the various appliances and remnants of wiring that you
 2 examined for the purposes of the memorandum?
 3 **A. Yes.**
 4 Q. "(5) Locally enlarged grain size.
 5 "(6) Resolidification waves."
 6 In respect of number (6), can you explain that for
 7 us in layman's terms, what that characteristic involves?
 8 **A. Normally I don't look at (6) too much, and that's**
 9 **described in some of the appendices and documents that**
 10 **are associated with the NFPA guide to fire explosions,**
 11 **but when there is a melting of -- in this case we're**
 12 **talking about copper, and then a resolidification, there**
 13 **would tend to be waves on the resolidified copper.**
 14 Q. Is it a characteristic that is relevant to your analysis
 15 set out in the report in the other documents?
 16 **A. I did not particularly look at any resolidification**
 17 **waves.**
 18 Q. Looking at number (7):
 19 "(7) Copper drawing lines visible outside the
 20 damaged area."
 21 Again, can you give us a brief explanation as to why
 22 that's looked for as a characteristic?
 23 **A. Yes. As I mentioned, when you're a short distance away**
 24 **from the arc damage, you don't have arc damage. You**
 25 **will have the copper wires, if they're stranded. When**

Page 13

1 **copper wires are manufactured, often there will be**
 2 **visible lines on these copper wires as manufactured, and**
 3 **you can often see that close to the arc damage.**
 4 **Again, it ties back to item 1. You get a fine line**
 5 **of demarcation. So if you look at the wires that are**
 6 **close, the copper wires that are close to the arc but**
 7 **not damaged, you can often see these lines that were**
 8 **part of the manufacturing process of the copper wires.**
 9 Q. Thank you.
 10 In respect of (8):
 11 "(8) Small beads and divots over a limited area."
 12 Again, am I right in assuming that would be
 13 a consequence of the cause of the arc damage that you
 14 outlined when explaining the nature of arc damage
 15 previously?
 16 **A. Yes, and there are examples of that, photographs that**
 17 **I have taken from the NFPA guide, that show the copper**
 18 **beads and divots or notches in the wires as a result of**
 19 **arc damage.**
 20 Q. Thank you.
 21 Paul, if we could turn over the page to the top of
 22 page 6, the ninth and final characteristic:
 23 "(9) High internal porosity when viewed in
 24 cross-section."
 25 Again, can you give us a brief explanation of why

Page 14

1 that's looked for as a characteristic of arc damage?
 2 **A. This is a more recent phenomena in addition to the**
 3 **current edition of the NFPA guide, using, I believe, the**
 4 **17th edition, and some researchers have looked at arc**
 5 **beads, copper beads that have arced, and they have**
 6 **cross-sectioned them in the laboratory and found that**
 7 **when you have arc beads caused by arc damage, the**
 8 **cross-section of those beads will show a high porosity,**
 9 **very porous, as opposed to fire damage.**
 10 **In the NFPA guide, when they talk about**
 11 **a fire-damaged copper, they call it a globule as opposed**
 12 **to a bead. Still round, looks very much similar, but**
 13 **when you cross-section a fire-heated globule of copper,**
 14 **you don't get the high porosity that you get from**
 15 **an arc-damaged bead.**
 16 Q. Thank you, Dr Glover.
 17 You adverted to the difference between the
 18 characteristics of arc damage and characteristics of
 19 fire damage, and if we could ask you to turn to
 20 section 2.2 of your memorandum, which is at
 21 JDGM000003_0010, we can see in the top of that section,
 22 you say:
 23 "Copper conductors may be damaged before or during a
 24 fire by other than electrical means and often these
 25 effects are distinguishable from arc damage ..."

Page 15

1 "When exposed to fire or glowing embers, copper
 2 conductors may melt (the melting temperature of pure
 3 copper is 1085°C/1984°F). At first, there is a
 4 blistering and distortion of the surface, as shown in
 5 Figure 8 ..."
 6 If Paul could de-amplify that and amplify figure 8
 7 for us.
 8 It may be fairly obvious, Dr Glover, but see on the
 9 big screen behind your shoulder, would you mind
 10 identifying for us the blistering and distortion to
 11 which you refer in the preceding paragraph?
 12 **A. Yes, sir. Again, this is a figure that's taken right**
 13 **out of the NFPA guide to fire explosions, and you can**
 14 **see --**
 15 Q. Don't worry, there's a microphone there.
 16 SIR MARTIN MOORE-BICK: They're quite good microphones,
 17 they'll pick you up. You don't have to get too close.
 18 **A. Thank you, sir.**
 19 **So you see instead of a copper wire that's been**
 20 **fire-heated, you can see the blistering and surface**
 21 **deformations. These are copper that is just beginning**
 22 **to see the effects of a high fire-heated copper.**
 23 **Blistering along the surface of the copper conductor.**
 24 MR KINNIER: Thank you, Dr Glover.
 25 After blistering and distortion, what happens next?

Page 16

1 **A. Then with additional fire-heating, you will get what is**
 2 **called a thinning of the wires, the wires diameter will**
 3 **become thinning, that's sometimes called necking, and**
 4 **you also see the formation -- we don't call them beads,**
 5 **we call them globules, but they're very similar.**
 6 **They're round globules of copper that has melted. You**
 7 **can see them in the figure here.**
 8 Q. Yes. I think if Paul first of all amplifies figure 9,
 9 and then if you could identify the globules for us.
 10 **A. Yes, you can see a globule here.**
 11 Q. Yes.
 12 **A. It's a round artefact of copper that has melted and then**
 13 **resolidified, and you can also see the thinning of the**
 14 **copper wire close to that globule as opposed to back**
 15 **further, where the wire maintains its original diameter.**
 16 Q. Thank you, Dr Glover.
 17 Looking at how you've summarised the differences
 18 between electrical damage and non-electrical damage, is
 19 it fair to say the most important characteristic of
 20 non-electrical fire damage is that, in contrast to arc
 21 damage, the damage is spread over a larger area and
 22 there is no sharp line of demarcation; is that a fair if
 23 general summary?
 24 **A. That's correct. If you can imagine a fire attacking**
 25 **a copper wire, it wouldn't be as localised as an arc,**

Page 17

1 **which is very localised.**
 2 Q. When you've determined that electrical arc damage has
 3 occurred to a segment of copper wire, is it right that
 4 your next step is to identify the origin of the segment
 5 by determining whether the following features of the
 6 wire match features at each possible location of origin,
 7 such as strands?
 8 **A. Yes.**
 9 Q. Is that right?
 10 **A. Yes.**
 11 Q. The first stage of that appears to be, on the basis of
 12 your report, a simple counting of the number of strands;
 13 is that right?
 14 **A. That's one method, yes.**
 15 Q. The next stage appears to be measuring the diameter of
 16 those strands.
 17 **A. Yes, sir.**
 18 Q. In addition to examining the exhibits themselves for
 19 physical damage, is it right that you've also looked at
 20 other sources of evidence that have helped you?
 21 **A. Yes.**
 22 Q. First and foremost, you've looked at the witness
 23 evidence of the former occupants of flat 16; is that
 24 right?
 25 **A. Yes.**

Page 18

1 Q. You've also looked at what evidence can be deduced from
 2 the associated circuit breakers in the fuse box; is that
 3 right?
 4 **A. Yes, I call it the consumer unit, but that would be the**
 5 **fuse box.**
 6 Q. You've also looked at whether the fuse in a relevant
 7 appliance or device's plug is intact or blown.
 8 **A. Yes, the fuses were looked at and examined for the**
 9 **various appliances to determine whether they were**
 10 **intact, as you say, or blown.**
 11 Q. Finally, you've looked at the extent and pattern of any
 12 heat damage to a particular appliance or device.
 13 **A. Yes, to all of the devices that were in the area of fire**
 14 **origin that were established by the other investigators,**
 15 **Professors Bisby and Nic Dauid.**
 16 Q. Thank you.
 17 Dr Glover, when we come onto it, we're going to have
 18 much discussion of the relevant circuit breakers and the
 19 main switch on the fuse box itself.
 20 But before we come on to that, can you help us, in
 21 relation to the fuse box consumer unit, why is it
 22 relevant whether a particular circuit breaker was found
 23 in the off position or not?
 24 **A. Now, it's a very interesting event that occurred, that**
 25 **the occupant of flat 16, Mr Kebede -- I hope that I'm**

Page 19

1 **pronouncing that correctly -- before he vacated the**
 2 **apartment, he turned off the main switch at the consumer**
 3 **unit, so that any other device at that consumer unit**
 4 **that was found in the off position would've had to have**
 5 **operated before Mr Kebede turned off the main switch.**
 6 **When he turns off the main switch, the consumer unit is**
 7 **now de-energised and there's no way that a circuit**
 8 **breaker could operate automatically after he does that.**
 9 Q. So it provides us with a snapshot of the circuits that
 10 had been tripped before the fuse box was turned off, and
 11 that's its importance; is that a fair summary?
 12 **A. That's correct. When you say the word "tripped",**
 13 **I mean, that would be a circuit breaker that operates to**
 14 **the off position automatically. We say in the**
 15 **engineering lingo that that means the circuit breaker**
 16 **tripped.**
 17 Q. Thank you.
 18 Finally, in relation to setting out the basics, in
 19 section 10.3 of your report -- we don't need to go to it
 20 unless you want to -- you refer to evidence of "other
 21 abnormal electrical activity", which appears to be
 22 evidence above and beyond arc damage.
 23 What evidence are you referring to here? What
 24 particular class of evidence are you thinking of here?
 25 **A. I'm sorry, are we in my report --**

Page 20

1 Q. In your report --
 2 **A. -- or the damage assessment memo?**
 3 Q. It's in section 10.3 of your report, page 39, and the
 4 reference is JDGR0000001_0039. It's point (3):
 5 "(3) There is no evidence of arc damage or other
 6 abnormal electrical activity ..."
 7 Do you have it there on the screen, Dr Glover? It's
 8 easier if you look at it on the screen, I think.
 9 **A. Okay.**
 10 Q. You see there 10.3?
 11 **A. Yes, sir.**
 12 Q. In subparagraph (3), you say:
 13 "(3) There is no evidence of arc damage or other
 14 abnormal electrical activity ..."
 15 Can you help us, it's just a general question, what
 16 other abnormal electrical activity are you referring to
 17 there above and beyond evidence of arc damage?
 18 **A. The main thing is the arc damage, in this case the**
 19 **copper wires that have melted in locations and that have**
 20 **been determined to be arc damage as opposed to fire**
 21 **damage.**
 22 **There are other abnormal electrical events. If you**
 23 **have, for example, printed circuit boards in the device,**
 24 **you could look at components on the board, capacitors or**
 25 **other electrical components, and look for arc damage or**

Page 21

1 **other types of abnormal electrical activity. Perhaps,**
 2 **for example, if the capacitor is punctured, that there**
 3 **was an internal event that caused a puncture that you**
 4 **could observe in that component.**
 5 **You could also look for something called electrical**
 6 **tracking, along a printed circuit board.**
 7 **So it would be a matter of examining the electrical**
 8 **components in addition to the wires.**
 9 Q. That's very clear, thank you.
 10 SIR MARTIN MOORE-BICK: Dr Glover, forgive me, I think
 11 you're getting a bit too close to the microphone. It
 12 will work very well at this sort of range. And will
 13 save you leaning forward as well. All right?
 14 **A. Thank you, sir.**
 15 **SIR MARTIN MOORE-BICK: Thank you.**
 16 MR KINNIER: Dr Glover, thank you.
 17 The next topic I'd like to come on to is evidence of
 18 electrical arc damage itself.
 19 We'll now turn to the principal points of the
 20 analysis which you've summarised in the memorandum.
 21 Starting at the outset, correct me if I'm wrong, but
 22 your essential conclusion is that only two of the
 23 exhibits that you examined showed evidence of electrical
 24 arc damage; is that correct?
 25 **A. Yes. There were two exhibits, MJS/1 and JDG/1, that**

Page 22

1 **I concluded suffered arc damage. All of the other**
 2 **remaining 12 exhibits did not suffer arc damage.**
 3 Q. Thank you.
 4 Turning to exhibit MJS/1, starting with the most
 5 basic question, what is MJS/1?
 6 **A. Okay, MJS/1 is -- first I'll go to it. Perhaps I could**
 7 **show a photograph of it.**
 8 Q. Yes, probably the easiest reference is that one which
 9 has just come up on the screen.
 10 **A. In my damage assessment memo, you will see MJS/1, which**
 11 **are basically two copper wires. There is one segment**
 12 **that is approximately 10 centimetres in length -- there**
 13 **is a scale there, the yellow scale that shows one of the**
 14 **wire segments. There is a separate wire segment, but**
 15 **the interesting one is the 10-centimetre length wire**
 16 **that has a fused area. What I mean by "fused" is there**
 17 **is melted copper between the two wires that is to be**
 18 **examined, and once I examined that, I determined that it**
 19 **was arc damage.**
 20 Q. Stopping there, might I invite you to do this in the
 21 old-fashioned way. Pointing on the big screen above
 22 you, can you identify for all of us the area which you
 23 consider to be fused?
 24 **A. Yes. So here is this approximately 10-centimetre length**
 25 **of two wires (Indicates). Both of them are stranded, by**

Page 23

1 **the way, each wire has 24 strands in it. But**
 2 **approximately 1.5 centimetres from this end**
 3 **(Indicates) -- it's kind of blurry here, so there will**
 4 **be other microscopic photos that will show the fused**
 5 **area -- the two wires are affixed to each other, and**
 6 **there is melted and then resolidified copper that fuses**
 7 **the two wires together.**
 8 Q. Thank you. Apologies for asking you to get up and down,
 9 but sometimes it's easier just to point on the screen.
 10 Can you remember from where MJS/1 was recovered
 11 within flat 16?
 12 **A. Yes, it was recovered in one of the bedrooms, and it was**
 13 **recovered some 27 days after the 14 June 2017 fire.**
 14 Q. Looking at the composition of MJS/1 itself, you've
 15 adverted to some of this, but you describe it as
 16 consisting of two stranded copper wire segments of
 17 approximately 10/11 centimetres length, with a separate
 18 stranded copper wire segment approximately 5 centimetres
 19 in length. Is that a fair summary of its composition?
 20 **A. Yes, and that's shown in the photo here on the screen.**
 21 Q. Am I right in saying that approximately 15 millimetres
 22 from the end of one segment, there's the fused area of
 23 3 millimetres in length to which you've just referred?
 24 **A. Yes, 15 millimetres or 1.5 centimetres away from the**
 25 **right end as shown in this screen.**

Page 24

<p>1 Q. The precise dimensions of the fused area is 2 3 millimetres or thereabouts. 3 A. The width of the fused area, yes. 4 Q. Can we now turn to exhibit JDG/1. 5 In respect of that, can you give us a basic 6 explanation. What is JDG/1, first of all? 7 A. Okay, and you've gone to figure A2? 8 Q. Yes. 9 A. Actually, is this out of my report or out of my damage 10 assessment memo? 11 Q. This is the report. 12 A. Okay. So, again, we have copper wires, and there is 13 a close-up of it. 14 Q. Looking at its composition, is it right to say that it 15 consists of stranded copper wire segments of 16 approximately 4 centimetres in length? 17 A. Yes. And you can see them along -- there's actually two 18 wires on the outside and there are segments of wire, 19 a third wire, in between, and then there is a cross-wire 20 here, with a -- now you can see a copper bead, 21 resolidified copper bead, at one end of JDG/1. 22 Q. The site of the copper bead, is that the evidence of arc 23 damage upon which you rely? 24 A. It is, yes. 25 Q. Thank you.</p> <p style="text-align: center;">Page 25</p>	<p>1 you set the cursor on the CT calliper tool. 2 But we were measuring diameters approximately 0.16 3 up to 0.18 millimetres for not only MJS/1 but JDG/1. 4 Q. Thank you. 5 Turning now to the final paragraph on that page: 6 "As noted in Section 8.2 of this report, Exhibit 7 MJD/38, the medium sized freezer includes wires with 24 8 strands and strand diameter of 0.16 — 0.18 m. Also, as 9 noted in Section 12.9, Exhibits BPS/3 and BPS/4, 10 components of the fridge freezer, include wires with 24 11 strands and strand diameter of 0.16 [and] 0.18 m." 12 Can you help us as to why you've set out that 13 information there, why you consider it to be relevant? 14 A. Well, the question is: where do we find wires with 24 15 strands? 16 As I said, MJS/1 was found lying on the floor in the 17 bedroom some 27 days after the fire, and JDG/1, by the 18 way, was found inside -- I found that in one of my April 19 inspections at Bureau Veritas down in the Bermondsey 20 area of London. I found that inside of the medium-sized 21 freezer. Okay? 22 So now I was interested in where you might find 23 other wires, particularly in the area of fire origin 24 within flat 16, that have 24 strands like these two 25 arc-damaged exhibits, and I found them in two locations.</p> <p style="text-align: center;">Page 27</p>
<p>1 Can I turn to the question of strand counts in 2 respect of both these exhibits. 3 First of all, am I right in understanding that 4 you've measured both the strand count and the diameter 5 of both of these exhibits? 6 A. Yes. 7 Q. If I ask you to turn to section 4.4 of your report, and 8 the penultimate paragraph on page 20 of your report -- 9 Paul, the reference you have, but is JDGR0000001_0020. 10 I think what you set out there in the penultimate 11 and final paragraph are the strand count, first of all, 12 and the dimensions of the two exhibits; is that right? 13 A. Are you referring to the last paragraph on page 20? 14 Q. The penultimate, first of all. 15 A. The penultimate, the next to last. 16 Q. Yes. 17 A. Okay. Yes, both MJS/1, which we looked at previously, 18 and now JDG/1, both of them, each wire in those two 19 exhibits, each one has 24 strands. Those are 20 24-stranded wires. We also measured the wire diameter 21 two different ways using calipers in the laboratory and 22 using the calliper tool at the CT scanner at Nikon up in 23 Tring. We measured the wire diameter two ways, and 24 there's some variability in diameter depending on how 25 tight you push your calipers against the copper, or how</p> <p style="text-align: center;">Page 26</p>	<p>1 I found them in the medium-sized freezer, for example 2 the power supply cord, or what you might call the main 3 supply flex, as well as other wires within the 4 medium-sized freezer. I also found 24-strand wires 5 within the fridge freezer of flat 16. 6 Q. Thank you. 7 The next topic I'm going to come on to is the 8 consumer unit and the circuit breakers. 9 If I could ask Paul to bring up a photograph, which 10 is at JDGR0000016_0001. If I could ask Paul to turn the 11 page. 12 Dr Glover, it's probably easier if I ask you to talk 13 us through these photographs. You can identify those 14 features which you consider to be pertinent. 15 First of all, what does figure A1-1 show us? 16 A. Yes, both of these figures, A1-1, show the consumer 17 unit, you might call it the fuse box, from flat 16. 18 These are not my photos; these are photos that were 19 in the file. 20 On the left side is the main switch, this red switch 21 here, and that's the switch that Mr Kebede turned off as 22 he vacated flat 16 on the night of the fire. 23 Then there are various circuit breakers to the right 24 of the main switch. There are better photographs as we 25 moved on, but two of them in particular were found in</p> <p style="text-align: center;">Page 28</p>

<p>1 the off position, two of these circuit breakers. One 2 was the circuit breaker for what we call circuit 7, 3 which fed the sockets in the kitchen of flat 16. There 4 will be better photos of that. Circuit 7 is just to the 5 right of this what we call an RCCB circuit breaker. 6 Q. Is circuit 7 that (Indicates)? 7 A. Yes. 8 Q. The penultimate from the right-hand side? 9 A. Yes. The last one is circuit 8, which was not off. 10 Circuit 8 was in the on position. 11 The second circuit breaker that was found in the off 12 position was just to the left of the circuit 7 breaker, 13 and that is a special breaker. It's called an RCCB, 14 a residual current circuit breaker. It's designed to 15 detect small ground currents that get out of the normal 16 path of flow of electricity. 17 Q. If I can take a step back and ask you a question about 18 circuit 7. 19 You mentioned that it served the sockets in the 20 kitchen. Is it right to say that the pertinent feature 21 of circuit 7 for our purposes is that was the circuit 22 upon which the large fridge freezer was plugged into? 23 A. I'm sorry, that was the circuit that what? 24 Q. The large fridge freezer was plugged into. 25 A. Yes, it was. The fridge freezer was plugged into</p> <p style="text-align: center;">Page 29</p>	<p>1 Switch) found in the OFF position operated automatically 2 ('tripped') as a result or a short circuit/over current, 3 rather than being manually operated to the OFF position, 4 as follows. First, Mr. Kebede stated that he turned off 5 the main red electricity switch; his interview 6 statements do not state that be turned off any other 7 circuit breaker. Second there is no record that any 8 fire brigade personnel, fire investigator or other 9 person manually timed off these two circuit breakers. 10 Third, evidence of arc damages to Exhibits MJS/1 and 11 JDG/1 provides an indication of a short circuit 12 sufficient to trip the 32A MCB for Circuit No.7 (See 13 Section 4)." 14 "After Mr. Kebede turned off the Main Switch, all 15 electrical circuits in Flat 16 were disconnected from 16 the electric utility power source. No circuit breaker 17 could have tripped after the Main Switch was turned off. 18 That is, both of the circuit breakers that tripped had 19 to have tripped OFF during the initiation or early 20 stages of the lire before Mr. Kebede turned off the Main 21 Switch." 22 Stopping there, does that remain your view? 23 A. Yes, and that's a key element of my conclusions. That 24 was a clue that was very important to me, that we have 25 two circuit breakers that tripped early on in the fire,</p> <p style="text-align: center;">Page 31</p>
<p>1 circuit 7 within the kitchen of flat 16. 2 Q. Okay. 3 If I can ask you now to go to -- over the page is 4 probably easier, now. Again, the top photograph, 5 figure A1-3, gives a close-up shot of the main switch in 6 the off position; is that right? 7 A. That's correct, that's the red one. 8 Q. If we can remove that, Paul. 9 Then if we can amplify figure A1-4, and we see the 10 second in from the right-hand side is the circuit 11 breaker for circuit 7; is that right? 12 A. Yes, and it's in the off position. 13 Q. Again, moving leftwards, we see the RCCB also in the off 14 position. 15 A. Correct. 16 Q. Thank you. 17 Paul, if we can put those photographs down, and if 18 I may ask you, Paul, now to turn to section 3.4 of 19 Dr Glover's report, which is JDGR0000001_0010. 20 It's section 3.4, which is the bottom of that page. 21 Paul, could I ask you to amplify that. 22 Under the heading "Circuit Breaker Operation, Timing 23 & Sequence", you say this: 24 "It is most likely that the two circuit breakers 25 (6th and 7th circuit breakers to the right of the Main</p> <p style="text-align: center;">Page 30</p>	<p>1 or in the initiation of the fire, and those would 2 provide a clue to find out what caused those circuit 3 breakers to trip and would lead me to the fire origin. 4 Q. Flowing from that, you set out on page 11 the two 5 possible sequences for the tripping of the two circuit 6 breakers. 7 If you could just talk us through, first of all, 8 sequence 1. 9 A. Okay, so we've got two tripped circuit breakers: the 10 RCCB and circuit 7 for the kitchen, and they could have 11 both tripped simultaneously for one event in the kitchen 12 affecting circuit 7, a short circuit that would involve 13 a live wire shorting to ground or arcing to ground. It 14 would have to involve ground or some metallic path to 15 ground in order for the RCCB circuit breaker to trip 16 simultaneously with the circuit breaker for circuit 7. 17 So that's option 1. You could have one event 18 affecting circuit 7, those are the sockets in the 19 kitchen and devices connected to those sockets, that 20 tripped both breakers at the same time. 21 Q. Thank you. Then compare and contrast sequence 2. Could 22 you talk us through the hypothesis there. 23 A. The second option is you would first have -- I'm going 24 to say first would be a short circuit in circuit 7 that 25 did not involve ground, it involved a live wire arcing</p> <p style="text-align: center;">Page 32</p>

1 to the neutral wire, not to a ground path. So that
 2 would not trip the RCCB that's only looking at ground.
 3 So that would be the first event. You could have
 4 a short circuit, again in the kitchen, circuit 7,
 5 affecting the sockets in the kitchen, that did not
 6 involve ground, that would cause the circuit 7 MCB to
 7 trip.
 8 But then how does the second breaker, the RCCB,
 9 trip? That would be a later event. Now circuit 7 is
 10 de-energised. The RCCB is looking at two circuits,
 11 circuit 7 and circuit 8. So circuit 7 has now
 12 de-energised, so the second event would happen in
 13 circuit 8. Circuit 8 are the flat sockets, the sockets
 14 in the remaining portion of the flat, not involving the
 15 kitchen. So that would be the second one.
 16 I do say that that RCCB would have to have occurred
 17 after circuit 7 trips; it could not have been before.
 18 Q. Flowing from that point, of these two hypotheses, which
 19 one do you consider to be more likely?
 20 A. At this point, I'd have to fast forward to other
 21 evidence that I looked at. It's more likely now that
 22 I've looked at all of the evidence that there were two
 23 separate events, that circuit 7 tripped first for a line
 24 to neutral fault, affecting that circuit, or some device
 25 connected to circuit 7 in the kitchen, and then the

Page 33

1 second event occurred at a later time. That's my
 2 opinion now. At this point in the report, I just leave
 3 the two options, there are two possibilities.
 4 Q. So cutting to the chase, you consider sequence 2 to be
 5 more likely?
 6 A. I do, yes.
 7 Q. Okay.
 8 Having regard to the evidence, in the final
 9 paragraph of page 11 of your report, so staying on that
 10 page, you say this:
 11 "Based on the above analysis of the timing and
 12 sequencing of the two circuit breakers that tripped, it
 13 is probable that the fire origin is: (1) within the area
 14 of fire origin; and (2) at the electrical component that
 15 caused the circuit breaker for Circuit No.7 to trip."
 16 First of all, does that remain your view?
 17 A. It does, yes.
 18 Q. Putting it somewhat differently, to what extent does
 19 identifying the circuit breakers which did not trip
 20 provide useful evidence in ruling out certain appliances
 21 in relation to origin?
 22 A. Could you repeat that?
 23 Q. Of course.
 24 Looking at the alternative analysis, to what extent
 25 does looking at the circuit breakers which did not trip

Page 34

1 help you in identifying origin?
 2 A. Well, that would be looking at the circuit breakers that
 3 did not trip would be very helpful to rule out items as
 4 a probable fire origin.
 5 Just to give you an example, there is a cooker in
 6 the kitchen. The cooker is adjacent to the fridge
 7 freezer -- we may look at that later -- and that cooker
 8 was supplied by a dedicated circuit, actually circuit
 9 number 1. So the cooker in the kitchen was not supplied
 10 by circuit 7.
 11 So that would allow me, just from that, along with
 12 many other things, pieces of evidence, to rule out the
 13 cooker as a probable fire origin.
 14 Then you could go on to other devices that were not
 15 connected to circuit 7 that could also be ruled out.
 16 Q. Dr Glover, that's useful. We will come on to the
 17 individual appliances. As you say, that point becomes
 18 more vividly illustrated there.
 19 Before we leave the issue of the consumer unit and
 20 circuit breakers, one point has arisen in relation to
 21 which it would be very useful to have your help and
 22 guidance, and that's understanding the role of circuit
 23 breakers in the prevention of an electrical fire.
 24 First of all, can you help us with the most basic
 25 question: what's the purpose of a circuit breaker?

Page 35

1 A. It is a safety device.
 2 Q. Being more specific about it, is the aim to prevent
 3 I think what you've described elsewhere as a violent
 4 event, or, alternatively, is it to cut the violent
 5 event, or is it both?
 6 A. It is both. You would hope that a circuit breaker would
 7 trip when there is an abnormal electrical event, a short
 8 circuit or an overload, and you would hope that it would
 9 trip before a fire occurs, but that's not always the
 10 case.
 11 Q. One question that's arisen that your views would be
 12 sought on is: is there a reason why the circuit breakers
 13 were not able to prevent the fire starting in the first
 14 place?
 15 A. Circuit breakers take time. They have to detect the
 16 short circuit and then, after they detect the short
 17 circuit, it takes time for them to open their contacts,
 18 to de-energise the circuit. So there is a time delay
 19 involved. Again, if the short circuit is not too
 20 violent, or it doesn't immediately ignite combustibles
 21 in the area of the short circuit, then the circuit
 22 breaker is successful in de-energising the circuit
 23 before a fire.
 24 However, it's possible that if you have combustibles
 25 in proximity to the short circuit, to the arcing, that

Page 36

<p>1 those would ignite very quickly before the circuit</p> <p>2 breaker or a fuse has an opportunity to de-energise the</p> <p>3 circuit.</p> <p>4 Q. I don't know whether you're able to express a view on</p> <p>5 this, given what you've seen, but are you able to help</p> <p>6 as to whether you think the circuit breaker operated</p> <p>7 sufficiently quickly here or insufficiently quickly?</p> <p>8 A. I didn't notice any defects in the circuit breaker. It</p> <p>9 did its job. But circuit breakers are not perfect.</p> <p>10 They can't pre-predict a fire; they have to wait until</p> <p>11 the short circuit occurs, until the arcing occurs, until</p> <p>12 there's enough overcurrent sufficient to trip the</p> <p>13 breaker.</p> <p>14 Q. Do you have any cause to believe there was any fault or</p> <p>15 defect of any sort in the consumer unit?</p> <p>16 A. No, I have no reason to see any defects in the consumer</p> <p>17 unit.</p> <p>18 Q. Thank you.</p> <p>19 Dr Glover, I now want to turn on to the analysis you</p> <p>20 conducted of the various electrical appliances and other</p> <p>21 electrical items.</p> <p>22 The first electrical appliance I'd be grateful for</p> <p>23 your help in relation to is the kitchen extractor fan.</p> <p>24 For that purpose, first of all, it would probably be</p> <p>25 useful if, Paul, you could draw up section 11.7 of</p> <p style="text-align: center;">Page 37</p>	<p>1 fan. Various other items were collected and I examined</p> <p>2 all of them.</p> <p>3 Q. That's useful. If we look at 11.7 itself, you say this:</p> <p>4 "The following observation supports a fire origin at</p> <p>5 the extractor Pan in Flat 16:</p> <p>6 "(1) Most of the components are missing from the</p> <p>7 control board, including a (rectangular shaped)</p> <p>8 capacitor from the ... power supply section of the</p> <p>9 control board."</p> <p>10 Can you help us, why does that support a fire origin</p> <p>11 at the extractor fan? To the lay reader, it looks</p> <p>12 neutral at best.</p> <p>13 A. Sometimes when you have a fire that initiates on</p> <p>14 a control board, a printed circuit board, you will see</p> <p>15 components missing, and you also see, perhaps,</p> <p>16 non-uniform fire damage. One section of that control</p> <p>17 board, that printed circuit board, would be more heavily</p> <p>18 fire damaged than another section. So that's the type</p> <p>19 of things you look for.</p> <p>20 Missing components. If you have missing components,</p> <p>21 you have no way to evaluate them for abnormal electrical</p> <p>22 activity. For example, if you have a capacitor where</p> <p>23 there's been an internal short circuit within the</p> <p>24 capacitor and it's been a catastrophic failure that</p> <p>25 punctures the enclosure of the capacitor, you would only</p> <p style="text-align: center;">Page 39</p>
<p>1 Dr Glover's report.</p> <p>2 First of all, Dr Glover, that sets out the summary</p> <p>3 of your views in relation to the examination of the</p> <p>4 extractor fan; is that right?</p> <p>5 A. Yes.</p> <p>6 Q. Can you confirm whether the extractor fan formed part of</p> <p>7 circuit 7 or not?</p> <p>8 A. Yes, the extractor fan is located in the window on the</p> <p>9 east side of the kitchen, and the wires that supply the</p> <p>10 extractor fan come from circuit 7. There's a spur that</p> <p>11 taps off of a socket behind the fridge freezer that</p> <p>12 supplies power to the extractor fan.</p> <p>13 Q. Am I right in understanding you examined five exhibits</p> <p>14 originally forming part of that fan for the purposes of</p> <p>15 your report?</p> <p>16 A. Five exhibits? This is all related to the extractor</p> <p>17 fan?</p> <p>18 Q. All related to the extractor fan. Can you remember now?</p> <p>19 A. I'd have to count them.</p> <p>20 Q. Don't worry. But you certainly examined components and</p> <p>21 wiring relating to the extractor fan?</p> <p>22 A. Yes, I examined all the exhibits that were associated</p> <p>23 with the extractor fan, and they were in different</p> <p>24 categories. The fan motor, for example, is MJS/6.</p> <p>25 There was debris found in the window below the extractor</p> <p style="text-align: center;">Page 38</p>	<p>1 be able to determine that if you had the capacitor to</p> <p>2 examine.</p> <p>3 So when you have missing components or if you have</p> <p>4 non-uniform fire damage, that would be a possibility of</p> <p>5 a fire origin there.</p> <p>6 Q. Understood.</p> <p>7 You then go on to say:</p> <p>8 "Conversely, the following observations do not</p> <p>9 support a fire origin at either the extractor fan or the</p> <p>10 wiring and switches from the spur to the extractor fan.</p> <p>11 "(1) No arc damage or abnormal electrical activity</p> <p>12 is observed on any of the following Exhibits related to</p> <p>13 the extractor fan ..."</p> <p>14 You referred earlier on to MJS/6 in particular:</p> <p>15 "(2) The short eh-cult/overload that caused the</p> <p>16 circuit breaker for Circuit No. 7 - Kitchen in Flat 16</p> <p>17 to trip on the night of the fire did not occur in the</p> <p>18 extractor fan or any wire or electrical/electronic</p> <p>19 component downstream of the isolator switch. If it had,</p> <p>20 the 3A fuse in the isolator switch would have blown more</p> <p>21 quickly than the circuit breaker, which did not occur."</p> <p>22 Does that remain your view there?</p> <p>23 A. Yes. That's a long sentence, but that was actually</p> <p>24 a key component of my analysis for the extractor fan.</p> <p>25 The extractor fan is protected by a fuse that's</p> <p style="text-align: center;">Page 40</p>

1 located below the extractor fan. The extractor fan
 2 itself is in the window, but the wires run through
 3 an isolator switch, and within that isolator switch that
 4 feeds the extractor fan there is a 3-ampere fuse.
 5 Earlier on in my report, I discuss the timing of
 6 fuses versus circuit breakers, and I show that the 3-amp
 7 fuse will always blow more quickly than the 32-amp
 8 circuit breaker for circuit 7.
 9 This is one of the main reasons I ruled out the
 10 extractor fan, because that 3-ampere fuse, which always
 11 would've tripped first, which would've blown first
 12 before the 32-amp circuit breaker for circuit 7, was not
 13 blown.
 14 So that was a key element of my analysis for the
 15 extractor fan.
 16 Q. That's clear, thank you.
 17 Looking at subparagraph (3), you say:
 18 "(3) Arc-damaged Exhibits MJS/1 and JDG/1 are not
 19 associated with the extractor fan from Flat 16 or any of
 20 the wiring associated with that extractor fan."
 21 Again, you're able to say that because you examined,
 22 first of all, the number of strands within the wires
 23 that form part of MJS/1 and JDG/1, and they weren't the
 24 type of wiring you found in relation to the extractor
 25 fan.

Page 41

1 A. Yes. So we looked, by the way, at an exemplar extractor
 2 fan from flat 13. The fire was in flat 16, but one of
 3 the items of exhibits that I looked at was an exemplar
 4 fan from flat 13, and then we looked at the remains of
 5 the extractor fan from flat 16. We looked at all the
 6 wires in both of those exhibits, we counted the strands,
 7 and I found, as well as my other investigators, no wires
 8 associated with the extractor fan that had 24 strands.
 9 Remember, those two arc-damaged exhibits, MJS/1 and
 10 JDG/1, both have 24 strands. Those were not associated
 11 with the extractor fan.
 12 Q. Thank you.
 13 The final point you set out at subparagraph (4), and
 14 then you set out the basic point that Nuairé, the
 15 manufacturer of the fan, had received no report
 16 confirming that a Cyfan/Cyfan-C was the source of
 17 a fire. That's your final observation there: the
 18 absence of previous instance of fire.
 19 A. Correct. As you see, Nuairé is the company that
 20 manufactures the extractor fan, Cyfan, and they had sold
 21 some 113,000 of them since, I believe, 2013, none of
 22 which -- there were no reported fires for any of those
 23 fans.
 24 Q. Just to help us, what weight do you attach to the
 25 absence of previous incidents generally compared to the

Page 42

1 specific analyses set out in subparagraphs (1) to (3)?
 2 A. It's just another key element. I think when you look at
 3 the possibility of a component having failed, it's
 4 important to look at the history of failures of the
 5 component, the history of any fires, the history of any
 6 recalls, the history of any legal suits, to see if there
 7 had been any prior incidents.
 8 So that is a component. I don't know if I'd attach
 9 more weight to that than the actual evidence that I did
 10 look at.
 11 Q. It's simply a relevant factor; is that fair?
 12 A. It is relevant, yes.
 13 MR KINNIER: Sir, it's 11 o'clock. We've been going for
 14 an hour. Would that be a convenient place for a brief
 15 break?
 16 SIR MARTIN MOORE-BICK: It is convenient to you, I take it?
 17 MR KINNIER: It is, yes, thank you.
 18 SIR MARTIN MOORE-BICK: Well, Dr Glover, we have a short
 19 break roughly once an hour, so we're going to take one
 20 now.
 21 I have to ask you not to talk about your evidence
 22 while you're out of the room, if you don't mind.
 23 We'll come back at 11.10.
 24 If you go with the usher, she'll look after you.
 25 THE WITNESS: Thank you, sir.

Page 43

1 SIR MARTIN MOORE-BICK: All right? Thank you very much.
 2 Yes, you can go now.
 3 Right, 11.10, please. Thank you.
 4 (11.00 am)
 5 (A short break)
 6 (11.10 am)
 7 SIR MARTIN MOORE-BICK: All right, Dr Glover, ready to carry
 8 on?
 9 THE WITNESS: Thank you, sir.
 10 SIR MARTIN MOORE-BICK: Good.
 11 Yes, Mr Kinnier.
 12 MR KINNIER: Dr Glover, welcome back.
 13 We were covering in this particular part of the
 14 examination analysis of the electrical appliances and
 15 relevant electrical items in the kitchen.
 16 The next one I want to talk to is the cooker, which
 17 you were adverting to earlier on in the evidence.
 18 First question, to be clear, the cooker was serviced
 19 by circuit 7; is that right?
 20 A. The cooker was served by circuit 1, not circuit 7,
 21 circuit 1.
 22 Q. Apologies, circuit 1.
 23 If we could identify where the cooker was. Paul, if
 24 you could bring up figure 2 at JDGR0000001_0008.
 25 Just so that we can orientate ourselves, that is

Page 44

<p>1 a sketch plan produced by Mr Kebede upon which you 2 relied; is that right? 3 A. Yes, this is Mr Kebede's figure, yes. 4 Q. If we look at the top left-hand side we see "mop & 5 bucket", then "A", which is the large fridge freezer, 6 and next to it is "B", which is partially obscured by 7 the four rings. 8 A. Correct. 9 Q. The B there is the cooker. 10 A. It is. 11 Q. Thank you. As you said correctly, it's served by 12 circuit 1. 13 A. Yes. 14 Q. If we remove that and, Paul, if I could ask you to go to 15 section 5.5 of Dr Glover's report, which is at page 23 16 of that report, and if you could amplify 5.5, here you 17 set out a summary of your observations: 18 "The following observations do not support a fire 19 origin at the Cooker or Circuit No.1 Cooker in Flat 16. 20 "(1) The Cooker is supplied by Circuit No. 1 at the 21 Consumer Unit in Flat 16. The circuit breaker for 22 Circuit No.1 was bound in the ON position, confirming 23 that there was no short circuit or overcurrent 24 sufficient to trip the 32A breaker for the Cooker 25 circuit.</p> <p style="text-align: center;">Page 45</p>	<p>1 To the lay reader, that looks like an important 2 feature. Is that a fair observation to make? 3 A. Yes, it is. There's no arc damage to the wires that 4 supply the cooker located behind the cooker, and if you 5 look at the sides and the front of the cooker, they are 6 fire damaged only. There's also no foodstuffs found in 7 the cooker, in the oven, for example. 8 Q. Would you have expected foodstuffs to have survived the 9 fire? 10 A. In the oven, possibly, yes. 11 Q. Turning to a new and separate appliance, the bread 12 maker, the "m'tad", and you deal with this at section 10 13 of your report, which at pages 37 to 39. 14 Paul, could I ask you to turn to page 39 in 15 particular. 16 Just to get some context, Dr Glover. 17 First of all, the bread maker was found on the 18 kitchen floor next to the large fridge freezer; is that 19 right? 20 A. Yes. 21 Q. You set out your conclusions here at paragraph 10.3: 22 "The following observations do not support a fire 23 origin at the bread maker in Flat 16: 24 "(1) Mr. Kebede states that the Bread Maker 25 ("M'tad") was not plugged in. Ms. Afeworki states that</p> <p style="text-align: center;">Page 47</p>
<p>1 "(2) The circuit breakers that did trip at the time 2 of the fire, the circuit breaker for Circuit 3 No.7-Kitchen and the RCCB Circuit Breaker for the 4 RCD-protected circuits, are unrelated to the Cooker 5 circuit. 6 "(3) Arc-damaged Exhibits MJS/1 and JDG/1 are not 7 associated with the Cooker Circuit wiring." 8 They're the first three. Are those the principal 9 observations upon which you rely, first of all? 10 A. Those are the first three or four of eight observations. 11 Q. Are those the principal ones? I know there are others 12 that follow, but are those the primary matters you rely 13 upon? 14 A. I would point to (6), the possibility that someone was 15 cooking on top of the cook top and that a fire could've 16 started from non-electrical means by cooking oil or 17 something. But I did examine the switches for the four 18 hobs on the cook top and found those were all in the off 19 position, verifying that, in my opinion, there was no 20 cooking going on on the night of the fire. There were 21 also no cooking pans found on top of the cook top. 22 Q. Thank you. 23 Looking at (8), you say: 24 "(8) There is only superficial heat/fire damage to 25 the front, sides and rear of the Cooker."</p> <p style="text-align: center;">Page 46</p>	<p>1 she never used the bread maker ("injera pan") and never 2 saw it used. 3 "(2) There is no evidence that the bread maker had 4 been plugged into any socket at the time of the fire. 5 "(3) There is no evidence of arc damage or other 6 abnormal electrical activity to the bread maker power 7 supply cord/mains supply flex internal wiring, or 8 heating coil. 9 "(4) Arc-damaged Exhibits MJS/1 and JDG/1 arc not 10 consistent with the bread maker power supply cord and 11 wiring. 12 "(5) The three wires of the bread maker power supply 13 cord remain flexible (they are not brittle/not 14 friable)." 15 Stopping there, can you help us -- it's probably 16 a question that goes to the obvious -- why is the 17 absence of brittle or friable material a useful 18 consideration or a relevant consideration to have regard 19 to here? 20 A. Yes, well, I tried to imagine this scenario where this 21 bread maker would've been plugged in, and since its 22 location is adjacent to the fridge freezer, the likely 23 socket, if it had been plugged in, would've been 24 a socket behind the fridge freezer. That would be the 25 closest to where the bread maker was found on the day of</p> <p style="text-align: center;">Page 48</p>

1 **the fire.**
 2 **Now, when you look at the other wires that were**
 3 **found behind the fridge freezer, those were quite**
 4 **friable, quite brittle segments of wires that had been**
 5 **broken off as a result of fire heat – not arc damage,**
 6 **but fire heat.**
 7 **I did not see that for the bread maker. The power**
 8 **supply cord, the main supply flex, was intact, including**
 9 **the plug and the fuse. And, as I said, the three wires**
 10 **were not brittle.**
 11 **So I would conclude that this bread maker was not**
 12 **plugged in behind the fridge freezer.**
 13 Q. Thank you.
 14 Finally, for completeness, you have:
 15 "(6) The fuse in the plug for the bread maker power
 16 supply cord is intact/not blown."
 17 **A. Correct.**
 18 Q. Does that remain your view, as set out in section 10.3
 19 of your report?
 20 **A. It does.**
 21 Q. Next, can we deal with the small fridge.
 22 First of all, could I ask Paul to bring up the
 23 sketch, page 8 of your report.
 24 Thank you.
 25 If that could be amplified again, Paul.

Page 49

1 I think the position of the small fridge is
 2 identified with capital letter "I" at the bottom
 3 left-hand corner; is that right?
 4 **A. Yes, and I would emphasise that this sketch was drawn by**
 5 **Mr Kebede. This was his memory of where these various**
 6 **items were located within the kitchen prior to the fire.**
 7 Q. And that's what you've relied upon, as you indicated
 8 earlier.
 9 **A. Yes, yes.**
 10 Q. If, Paul, we could de-amplify and go to page 30
 11 internally.
 12 Dr Glover, section 7.3, you set out again your
 13 summary in relation to the observations you make
 14 concerning the small fridge.
 15 You say:
 16 "The following observations do not support a fire
 17 origin at the small fridge or its power supply cord
 18 (mains supply flex) in flat 16:
 19 "(1) Mr. Kebede and Ms. Afeworki both state that the
 20 small fridge was not in use and not plugged in.
 21 "(2) Post-fire examination of Exhibit MJD/33, the
 22 four-gang extension lead that could have been used for
 23 the small fridge, showed that it had no plugs inserted
 24 into any of its four sockets (see Section 6).
 25 "(3) There is no evidence that the small fridge had

Page 50

1 been plugged into any socket at the time of the fire.
 2 "(4) There is no arc-damage to the small fridge's
 3 power supply cord or to any internal wire or component
 4 within the small fridge.
 5 "(5) The fuse in the plug associated with the power
 6 supply cord is intact/not blown.
 7 "(6) There were no foodstuffs found in the small
 8 fridge.
 9 "(7) The underside of the small fridge is largely
 10 intact/undamaged, including one of the plastic feet."
 11 Does that remain your view?
 12 **A. Yes, sir.**
 13 Q. Thank you.
 14 Could we now turn to the medium-sized freezer.
 15 Paul, apologies for jumping around, could we go back
 16 to page 8 internally of this report. If we could
 17 amplify Mr Kebede's sketch plan.
 18 The medium-sized freezer is identified by the
 19 capital letter "H" in the bottom left-hand corner; is
 20 that right?
 21 **A. Yes, the "H" is the medium freezer and the small fridge**
 22 **we just talked about is "I", which would've been on top**
 23 **of the medium freezer.**
 24 Q. Just to confirm evidence you gave earlier on, I think
 25 I'm right in understanding you accept the stranding

Page 51

1 found in relation to the arc-damaged exhibits, MJS/1 and
 2 JDG/1, is consistent both in strand-count and diameter
 3 with the medium-sized freezer's power cord.
 4 **A. Yes, as well as a couple of other internal wires that**
 5 **had 24 strands.**
 6 Q. Paul, if we could de-amplify Mr Kebede's sketch plan and
 7 turn to page 33 internally.
 8 Dr Glover, there we find the summary of your
 9 conclusions in relation to the medium-sized freezer.
 10 First of all:
 11 "The following observations support a fire origin at
 12 the medium sized freezer or its power supply cord (mains
 13 supply flex) in Flat 16:
 14 "(1) Exhibit JDG/1, which I found inside the medium
 15 sized freezer during my 27 April 2018 examination at
 16 Bureau Veritas, consists of stranded copper wire
 17 segments with arc-damaged copper beads at one end. Each
 18 wire segment for JDG/1 has 24 strands, with an
 19 approximate strand diameter of 0.16 mm (See Section
 20 4.31).
 21 "(2) The medium sized freezer's power supply cord as
 22 well as other cords within the medium sized freezer,
 23 include wires with 24 strands and an approximate strand
 24 diameter 0.16 [to] 0.18mm. This stranding is consistent
 25 with arc damaged Exhibits JDG/1 and MJS/1."

Page 52

<p>1 Then you set out factors which do not support a fire 2 origin at the medium-sized freezer: 3 "(1) Mr. Kebede and Ms. Afeworki both state that the 4 medium sized freezer was not in use and not plugged in 5 at the time of the fire." 6 You note the support provided by the Bureau Veritas 7 report: 8 "(2) In his witness statement, Mr. Kebede states 9 that the medium sized freezer stopped working about nine 10 years ago so it was unplugged. He had not bought it 11 long before it stopped working so called in a fridge 12 technician from the Yellow Pages who told him the fuse 13 had gone (see Section 7). 14 "(3) Post-fire examination of Exhibit MJD/33, the 15 four-gang extension lead that could have been used for 16 the medium sized freezer, showed that it had no plugs 17 inserted into any of its four sockets (see Section 6.1). 18 "(4) There is no evidence that the medium sized 19 freezer had been plugged into any socket at the time of 20 the fire. 21 "(5) There were no traces of foodstuffs found in the 22 medium sized freezer. 23 "(6) Other than Exhibit JDG/1, there is no arc 24 damage to any component or any other internal wire 25 within the Medium Sized Freezer. Either JDG/1 arced at</p> <p style="text-align: center;">Page 53</p>	<p>1 stages of the fire when it was located in the area of 2 fire origin, electrically connected to Circuit No.7 — 3 Kitchen; or (2) at a prior time unrelated to the fire 4 (Mr. Kebede reported that the freezer stopped working 5 nine years ago and a bad fuse was found)." 6 Does that remain your view? 7 A. Yes. I have further concluded, if you go to my addendum 8 later, that in my opinion the JDG/1 arced at a prior 9 time unrelated to the fire. 10 Q. We'll come on to that, but essentially your view remains 11 the same in terms of excluding -- 12 A. Yes. 13 Q. -- the freezer. Thank you. 14 The penultimate appliance or wiring that I would 15 like to take you to, the extension lead, this is dealt 16 with at section 6 of your report. 17 First of all, before we go to the summary at page 18 27, could I ask Paul to go to figures A4-8, there we go. 19 First of all, this is the extension lead with which 20 you're concerned in section 6 of your report; is that 21 right? 22 A. Yes, sir. 23 Q. Can you help us as to where the extension lead was 24 found, can you remember? 25 A. Yes, the extension lead was found -- and there are some</p> <p style="text-align: center;">Page 55</p>
<p>1 a prior time unrelated to the fire or it was relocated 2 into the medium sized freezer during or after 3 firefighting efforts. 4 "(7) There is no arc-damage to the remains of the 5 Medium Sized Freezer's power supply cord. 6 "(8) The medium sized freezer's plug was initially 7 found attached to the power supply cord, but later 8 became separated from the cord. 9 "(9) In my opinion Exhibit MJD/34, the remnants of a 10 plug, is the medium freezer plug that became separated 11 (See Section 9). 12 "(10) The fuse in Exhibit MJD/34 is intact/not blown 13 (See Section 9). 14 "(11) A paper label on the compressor and the 15 plastic enclosure of an electrical junction box, both 16 located within the medium sized freezer remain largely 17 intact. It is implausible that the fire origin could be 18 within the medium sized freezer with a paper label and a 19 plastic junction box enclosure largely intact." 20 Then you go on in the final paragraph: 21 "In my opinion observations (1) [to] (11) above 22 strongly support a conclusion that the medium sized. 23 Freezer was not plugged in at the time of the fire. As 24 such, it is probable that arcing to Exhibit JDG/1 25 occurred either: (1) during the initiation or early</p> <p style="text-align: center;">Page 54</p>	<p>1 photos in that I could refer to, A4-1 and 2 perhaps -- 2 on the east side of the kitchen, very close to the 3 living room, okay? There were wooden sliding doors that 4 separated the kitchen from the living room. Those panel 5 doors were consumed during the fire, but this extension 6 lead was found by fire investigators on the day of the 7 fire, right in that vicinity where the wooden panel 8 doors separated the living room from the kitchen on the 9 east side. 10 Q. Thank you, Dr Glover. 11 Paul, if we could put down these photographs and 12 return to Dr Glover's report, and page 27 within that 13 report. 14 Dr Glover, there you set out the observations that 15 led you to conclude that they don't support fire origin 16 at the extension lead of its power supply cord: 17 "(1) No plug was found in any of the Four sockets 18 of the extension lead. If there were no devices plugged 19 into the extension lead at the time of the fire, the 20 extension lead delivered zero load current with no heat 21 dissipation due to load current. Further, with no 22 connected devices, the extension lead would not have 23 delivered any short-circuit current or any overcurrent 24 to such a device. 25 "(2) There is no arc damage to the internal</p> <p style="text-align: center;">Page 56</p>

<p>1 current-carrying components of the extension lead, and 2 there is no arc damage to the remains of the power 3 supply cord (mains supply flex) for the extension lead. 4 "(3) Arc-damaged Exhibits MJS/1 and JDG/1 are not 5 associated with extension lead's power supply cord/mains 6 supply flex. 7 "(4) There is a missing portion of the power supply 8 cord and a missing plug for the extension lead. 9 Therefore, it is unknown whether the extension lead was 10 plugged into an electrical socket at the time of the 11 fire. 12 "(5) If at the time of the fire the extension lead 13 had been plugged into a socket, the most likely socket 14 would have been the one on the living room east wall 15 approximately 18 inches from the sliding door panels 16 that separated the kitchen from the living room. As 17 shown in Figure A4-3, taken on 14 June 2017 in flat 16, 18 the severed end of the extension lead power supply cord 19 is near that living room socket. 20 "(6) That living room socket is supplied by Circuit 21 No.8 — Flat Sockets, not Circuit No.7. If at the time 22 of the fire the extension lead had been plugged into 23 that living room socket, then it is unrelated to the one 24 event or the first of two events that caused the circuit 25 breaker For Circuit. No.7 - Kitchen to trip.</p> <p style="text-align: center;">Page 57</p>	<p>1 section 13.5. If you could amplify that Paul, please. 2 You there set out again the summary of your 3 observations: 4 "The following observations do not support a fire 5 origin at any of the following items in the ceiling of 6 the kitchen in Flat 16 ... 7 "(1) Lighting was supplied by Circuit Nos. 2 and 3 8 at the Consumer Unit in Flat 16. Both of the circuit 9 breakers for Circuit Nos. 2 and 3 were found in the ON 10 positions, confirming that there was no short circuit or 11 overcurrent sufficient to trip either of the 6A breakers 12 for these lighting circuits. 13 "(2) The circuit breakers that did trip at the time 14 of the fire, the circuit breaker for Circuit 15 No.7-Kitchen and the RCCB Circuit Breaker lot the 16 RCD-protected circuits (Circuit Nos. 7 and 8), are 17 unrelated to the lighting circuits and these exhibits. 18 "(3) No arc damage or other abnormal electrical 19 activity is observed for any of the wiring in Exhibits 20 MJD/49, MJD/63, and MJD/64. 21 "(4) Arc-damaged Exhibits MJS/1 and are not 22 associated with any of the wiring for Exhibits MJD/49, 23 MJD/63 and MJD/64." 24 Does that remain your view? 25 A. Yes, sir.</p> <p style="text-align: center;">Page 59</p>
<p>1 "(7) If at the time of the fire the extension lead 2 had been plugged into that living room socket, the 3 missing portion of the power supply cord and missing 4 plug would then have been located in the living room, 5 which is outside the area of fire origin as established 6 by fire investigators. 7 "(8) In my opinion it is implausible that a fire 8 could begin in the living room where Mr. Kebede was 9 sleeping at the time, then progress through the sliding 10 door panels into the kitchen, and not awaken him until 11 the kitchen smoke detector alarmed." 12 Dr Glover, does that remain your view? 13 A. Yes. 14 Q. Thank you. 15 The final element of wiring that I'd like to discuss 16 with you before we get on to the large fridge freezer is 17 the fluorescent light and wiring from the ceiling of the 18 kitchen. You deal with this in section 13 of your 19 report. That's at pages 63 to 64. 20 I think it's right to say that you've examined 21 four exhibits comprising the wiring from the ceiling 22 above the kitchen counter and near the window, as well 23 as a fluorescent light; is that right? 24 A. Yes, sir. 25 Q. If, Paul, I might ask you to turn to page 64, and</p> <p style="text-align: center;">Page 58</p>	<p>1 Q. Thank you. 2 Dr Glover, I'd like to turn to the question of the 3 large fridge freezer which is considered at section 12 4 of your report. 5 Just so that we can orientate ourselves as to what 6 you looked at, is it right to say that you examined the 7 remains of the large fridge freezer, which was 8 a Hotpoint FF175BP, which you understood to be 9 manufactured in or about October 2008? 10 A. October 2008, yes. 11 Q. Is it right that you also examined what's been describe 12 as an exemplar? 13 A. Yes, I did. 14 Q. That exemplar was provided by Whirlpool, and it was 15 a model number FF175BP, but manufactured in or 16 about November 2006; is that right? 17 A. Yes. 18 Q. Can you help us, what differences were there between the 19 large fridge freezer that was in flat 16 and the 20 exemplar fridge that you also examined? 21 A. There were a number of differences. For example, within 22 the fridge freezer is a device called a motor run 23 capacitor, a capacitor. 24 Q. If I could stop you there, again asking a basic 25 question: what's the motor run capacitor?</p> <p style="text-align: center;">Page 60</p>

<p>1 A. A capacitor is an electrical device that stores charge 2 and is utilised in this case to help the refrigerator 3 run more efficiently. 4 Q. Apologies, I interrupted you in full flow. You were 5 identifying the differences between the exemplar and the 6 large fridge freezer, and you referred to the motor run 7 capacitor. 8 A. So in my understanding, reviewing the records and the 9 documents, Whirlpool changed their capacitor from 10 a so-called P0 capacitor to a P2. A P0 capacitor is one 11 that is not protected against fire or against electrical 12 shock. So for the earlier model, the exemplar that 13 I looked at, which was manufactured in 2006, that had 14 the unprotected motor run capacitor, the so-called P0 15 capacitor. 16 The subject fridge freezer that was in flat 16 was 17 manufactured in October 2008, and according to the 18 Whirlpool documents, by that time Whirlpool had switched 19 over to a so-called P2 capacitor that is protected 20 against fire, and it's designed and manufactured so that 21 if there is a problem within the motor run capacitor, it 22 will be a fail-safe device, whether it be it failing 23 from a fire or from an electric shock point of view. 24 So that's one example. 25 Q. Is this difference material to your analysis of origin</p> <p style="text-align: center;">Page 61</p>	<p>1 five wires, but there were some differences. One of 2 them all five wires were in a cord, so to speak, with 3 an outer jacket, whereas in the other the wires were 4 separate wires. 5 So those were three differences. 6 Q. And they're the principal material ones, you consider? 7 A. Yes. 8 Q. If I could turn to the conclusions in your report 9 regarding the large fridge freezer. 10 Paul, could I ask you to turn up page 61 of 11 Dr Glover's report and, in particular, section 12.10. 12 At the top of the page, you say this: 13 "Exhibits reviewed in this section are segregated 14 into three possible fire origins: (1) within the fridge 15 freezer, Exhibit BPS/1; (2) at the fridge freezer power 16 supply cord (mains supply flex); and (3) components 17 associated with the fixed wiring for Circuit No. 7 - 18 Kitchen." 19 If we can start, first of all, with 20 subsection 12.10.1 within BPS/1, that's the large fridge 21 freezer, you found the following observations supported 22 fire origin within BPS/1: 23 "(1) There is a missing run capacitor, which would 24 have been mounted on the compressor mounting plate to 25 the left of the compressor ..."</p> <p style="text-align: center;">Page 63</p>
<p>1 and cause? The difference between the exemplar and the 2 subject large fridge freezer, is it relevant, is it 3 material, to your analysis of origin? 4 A. There was some relevance, but the exemplar fridge 5 freezer that I looked at was very helpful to me in 6 understanding the basic components within the fridge 7 freezer, and then when I went to the subject fridge 8 freezer, I was well aware of the differences. I've 9 talked about one, the capacitor. There are other 10 differences. 11 Q. Can you help us what the other principal differences are 12 that are material? 13 A. Yes. Both fridge freezers have a compressor, that is 14 the device that is used to compress the refrigerant, 15 that is part of the refrigeration cycle for the fridge 16 freezer. The compressor is located at the bottom rear 17 of the fridge freezer, either one. 18 The compressor that I looked at for the exemplar was 19 manufactured by a company called Tecumseh, whereas the 20 subject fridge freezer from flat 16 had a compressor in 21 manufactured by Embraco. That's the second difference. 22 The control boards were slightly different. The 23 number of wires. There was a wiring harness within the 24 exemplar fridge freezer and the remains of a wiring 25 harness in the subject fridge freezer. Both of them had</p> <p style="text-align: center;">Page 62</p>	<p>1 Stopping there, why does that support a fire origin 2 internal to BPS/1, the large fridge freezer? 3 A. Well, whenever you have a missing electrical component, 4 that's a concern. You can't evaluate a missing 5 component, you can't look at the device to see if there 6 was abnormal or electrical activity. 7 There had been some prior fires with these fridge 8 freezers. It involved run capacitors. However, we do 9 know that the subject fridge freezer had a P2, 10 a fail-safe device in it. 11 But that's always a concern, when you have a missing 12 component that is perhaps completely consumed during the 13 fire that you cannot evaluate. 14 Q. Turning to (2): 15 "(2) Arc-damaged Exhibits MJS/1 and JDG/1 are 16 consistent with the remains of two wires found within 17 the relay compartment of the fridge freezer ..." 18 You give the reason next for that consistency. It's 19 that: 20 "Each of these wires, which has 24 strands, is 21 either a run capacitor wire or an internal jumper wire 22 within the relay compartment." 23 Is that right? 24 A. Yes. We looked at the remains of the connectors within 25 the compressor relay compartment. We found two</p> <p style="text-align: center;">Page 64</p>

1 connectors that had 24 strand wires in them, and by
 2 process of elimination, concluded that those connectors
 3 served wires for either the missing run capacitor or for
 4 an internal wire within the compressor relay
 5 compartment.

6 Q. Looking at the third observation you make:
 7 "(3) Arc-damaged Exhibits MJS/1 and JDG/1 are also
 8 consistent with Exhibit SLW/111, a wire segment with a
 9 soldered end from BPS/3."
 10 Taking each element of that, first of all, what is
 11 exhibit BPS/3?

12 A. BPS/3 are wires that were found below the fridge
 13 freezer, basically, subject to review, and that should
 14 be BPS/3 and page 50. Conductors from fridge freezer
 15 base, that's what BPS/3 is.
 16 One of those wires was SLW/111, basically a wire
 17 segment, that was found to have 24 strands.

18 Q. The fourth point, you mention the previous incidents
 19 involving a P0 run capacitor and also two reports of
 20 fire potentially involving a P2 run capacitor, and
 21 that's the reason you adverted to earlier on.
 22 You then go on to set out observations that don't
 23 support fire origin within BPS/1. At number (1) you
 24 say:
 25 "(1) No arc damage was observed within BPS/1."

Page 65

1 To the lay reader, that looks like a significant
 2 factor pointing against the fire origin within the large
 3 fridge freezer.
 4 What would be your response to that lay observation?

5 A. Yes. As I mentioned, we're particularly focused on
 6 MJS/1. That was found in the second bedroom. We looked
 7 at that earlier today, a wire segment approximately
 8 10 centimetres in length with a fused section.
 9 I concluded that MJS/1, there is no way that that
 10 could have arced in the second bedroom on the night of
 11 the fire for various reasons. There was a lady sleeping
 12 in the room, for one reason.
 13 Number 2, the bedroom is served by circuit 8. Okay?

14 Q. Which didn't trip.

15 A. Circuit 8 didn't trip. Mr Kebede turned off the main
 16 switch -- which is very helpful in my analysis -- before
 17 he vacated, so that when the fire eventually got into
 18 the second bedroom later on, after he vacated, there was
 19 no energised facilities there, so you couldn't have had
 20 arc damage at that time.
 21 So for a number of reasons, I concluded that MJS/1
 22 could not have arced in the second bedroom.
 23 So that means you have two possibilities: one is
 24 that it was electrically connected to circuit 7 in the
 25 kitchen, because that's the circuit breaker that

Page 66

1 tripped, or it arced at some prior time and it has been
 2 there for months or years, some time unrelated to the
 3 fire.
 4 Those are your two possibilities.

5 Q. Moving on to subparagraph (2), you say:
 6 "(2) The [3-amp] fuse for the fridge freezer power
 7 supply cord is intact/not blown."
 8 Again, to the layperson looking at this, that seems
 9 like a significant factor pointing against the large
 10 fridge freezer being the origin.
 11 What would be your response to that lay observation.

12 A. Yes. I want to point out that that's a 13 ampere fuse,
 13 1-3, not 3 amps. Earlier I had mentioned that there is
 14 no way the extractor fan could've been the origin of the
 15 fire because the 3-ampere fuse did not blow, the 3-amp
 16 fuse that protected the extractor fan.
 17 Here, for the fridge freezer, we have a 13-ampere
 18 fuse. Earlier in my report, I compare the operating
 19 times of the 32-amp circuit breaker for circuit 7,
 20 compared that with the fuse blowing time for a 13-ampere
 21 fuse, and the analysis shows that either one could go
 22 first. It's possible that the 32-amp circuit breaker
 23 could trip before the 13-amp fuse in a wide range of
 24 currents, I believe, ranging from -- the numbers are in
 25 there -- 100 to a few hundred amperes. Either one could

Page 67

1 go.
 2 So the fact that a 13-amp fuse for the fridge
 3 freezer is intact, it's not blown, that doesn't mean
 4 that there was no short circuit within the fridge
 5 freezer, because the 32-amp circuit breaker quite likely
 6 could have tripped first, leaving that 13-ampere fuse
 7 intact.

8 Q. Thank you.
 9 Finally, we have subparagraph (3):
 10 "(3) Whirlpool has reported that there have been no
 11 recalls and no legal proceedings/claims against
 12 Whirlpool, Indesit, or its representatives involving a
 13 Hotpoint FF175BP or FF175BG."
 14 Just for the sake of completeness, I note that.
 15 Do the views you set out there at 12.10.1 remain
 16 your view?

17 A. Yes, sir.

18 Q. Paul, if we can turn over the page to section 12.10.2.
 19 At this point, you go through the various
 20 observations you identified in relation to the fridge
 21 freezer power supply cord.
 22 I won't read them out, but essentially your
 23 conclusion is that the evidence does not support a fire
 24 origin within the power supply cord for the reasons
 25 you've set out in subparagraphs (1) and (2); is that

Page 68

<p>1 right?</p> <p>2 A. Yes, sir.</p> <p>3 Q. That remains your view?</p> <p>4 A. It does.</p> <p>5 Q. Similarly, if we go on to subsection 12.10.3, which</p> <p>6 deals with fixed wiring for circuit number 7, the</p> <p>7 kitchen, you say this:</p> <p>8 "The following observations do not support a fire</p> <p>9 origin at the fixed wiring for Circuit No.7-Kitchen in</p> <p>10 Flat 16:</p> <p>11 "(1) No arc damage or abnormal electrical activity</p> <p>12 is observed on any of the following items related to the</p> <p>13 fixed wiring: (a) remains of a double-socket busbar with</p> <p>14 two receivers from MCL-06 ...</p> <p>15 Again, for those of us less technically minded,</p> <p>16 what's a busbar?</p> <p>17 A. A busbar is within a socket. If you remove the</p> <p>18 enclosure of a socket, you will see metal devices. They</p> <p>19 are basically current-carrying devices that carry the</p> <p>20 current from the consumer unit, through the socket, to</p> <p>21 the plug that it is plugged into.</p> <p>22 Q. Thank you:</p> <p>23 "... (b) remains of single-socket busbar</p> <p>24 And double-socket busbar from BPS/5; and (3) wires</p> <p>25 on kitchen ring main side of spur ...</p> <p style="text-align: center;">Page 69</p>	<p>1 But then turning to subsection 16.2, under the</p> <p>2 heading "Devices in Area of Fire Origin Confirmed to Be</p> <p>3 Electronically Connected to Circuit No.7-Kitchen", you</p> <p>4 rehearse the analysis we've just undergone, and then by</p> <p>5 a process effectively of elimination, you conclude that</p> <p>6 the large fridge freezer is implicated or probably</p> <p>7 implicated in the origin of the fire.</p> <p>8 Is that a fair if general summary?</p> <p>9 A. Yes, I concluded that the internal large fridge freezer</p> <p>10 was the most probable fire origin.</p> <p>11 Q. Following on from the use of the word "probability", can</p> <p>12 I ask you to turn to page 77, of your report, and you'll</p> <p>13 see in the preamble to section 16, the third line, you</p> <p>14 use the phrase "a reasonable degree of engineering</p> <p>15 certainty".</p> <p>16 Can you help us, what does that phrase mean? Are</p> <p>17 you indicating there that you applied the balance of</p> <p>18 probabilities or some other standard?</p> <p>19 A. When I say "reasonable degree of engineering certainty",</p> <p>20 nothing is 100 per cent certain, okay? But based on all</p> <p>21 my training and education and experience investigating</p> <p>22 electrical fires, my conclusions are to a reasonable</p> <p>23 degree of engineering certainty. Most probable.</p> <p>24 Q. Most probable.</p> <p>25 If I could turn to the addendum you prepared. Just</p> <p style="text-align: center;">Page 71</p>
<p>1 "(2) Arc-damaged Exhibits MJS/1 and JDG/1 are not</p> <p>2 consistent with the kitchen ring main wires (Circuit No.</p> <p>3 7), each of which has 7 stands/wire.</p> <p>4 "(3) The fixed wiring is protected from mechanical</p> <p>5 damage via wire trunking and socket/switch/spur</p> <p>6 enclosures."</p> <p>7 Just looking at the third and final one, is that to</p> <p>8 say that you found no damage to the fixed wiring? Is</p> <p>9 that what subparagraph (3) is getting at?</p> <p>10 A. No arc damage to the fixed wiring. There's certainly</p> <p>11 fire damage, the insulation is burned off, but there's</p> <p>12 no arc damage or evidence of abnormal electrical</p> <p>13 activity.</p> <p>14 Q. Paul, would you mind turning to page 77 of the report.</p> <p>15 This sets out your essential conclusions in relation</p> <p>16 to the large fridge freezer.</p> <p>17 At 16.1, under the heading "Relationship Between</p> <p>18 Fire Origin and Circuit No.7-Kitchen", you say this:</p> <p>19 "Within the area of fire origin, it is probable that</p> <p>20 the fire origin is at the electrical component that</p> <p>21 caused the circuit breaker for Circuit No.7-Kitchen to</p> <p>22 trip ..."</p> <p>23 You refer back to section 15.1, which we don't need</p> <p>24 to go to, because it effectively replicates what we just</p> <p>25 looked at at section 12.10.</p> <p style="text-align: center;">Page 70</p>	<p>1 by way of context, on 16 November this year you provided</p> <p>2 an addendum to your report which reviewed a CT scan of</p> <p>3 exhibit JDG/6B, a wire connector recovered from the</p> <p>4 compressor relay compartment of the large fridge</p> <p>5 freezer.</p> <p>6 Am I right thus far?</p> <p>7 A. Yes, sir.</p> <p>8 Q. In short, your conclusion is that the wire connector had</p> <p>9 a poor crimp which led to an overheated connection,</p> <p>10 which you posit as a hypothetical fire initiation</p> <p>11 scenario; is that a fair summary?</p> <p>12 A. Yes.</p> <p>13 Q. In relation to the addendum, Dr Glover, my questions</p> <p>14 will fall essentially into three parts, first of all</p> <p>15 dealing with basic factual matters relating to</p> <p>16 exhibit 6B; secondly, some contextual points in relation</p> <p>17 to that exhibit; finally, some specific questions</p> <p>18 relating to the analysis set out in the addendum.</p> <p>19 So starting, first of all, with the first part,</p> <p>20 that's the basic factual matters, Paul, could I ask you</p> <p>21 to turn up the addendum, which is at JDGR0000019_0001.</p> <p>22 That's the addendum; is that right, Dr Glover?</p> <p>23 A. Yes.</p> <p>24 Q. If I could ask Paul to turn to page 5, and if you could</p> <p>25 amplify figure 1, the exhibit with which we are</p> <p style="text-align: center;">Page 72</p>

1 concerned is 6B, which is more precisely identified on
 2 the right-hand side; is that right?
 3 **A. Yes.**
 4 Q. And then we see it together with other exhibits on the
 5 left-hand side, and it's at the bottom left-hand corner
 6 of that photo.
 7 **A. Yes.**
 8 Q. Can you just help us, the other exhibits on the
 9 left-hand side, they are extracted from the large fridge
 10 freezer as well; is that right?
 11 **A. Yes. All of these exhibits marked JDG/6 were collected**
 12 **from within the compressor relay compartment that was**
 13 **attached to the compressor for the fridge freezer in**
 14 **flat 16.**
 15 Q. Can you help us, are you able to gives us a precise idea
 16 from where within the large fridge freezer exhibit 6B
 17 was recovered?
 18 **A. So at the rear of the fridge freezer, at the rear**
 19 **bottom, there is a compressor, and attached to that**
 20 **compressor is a small compartment that would've had**
 21 **a plastic enclosure for it, and that compartment is**
 22 **called the compressor relay compartment.**
 23 **Within that compartment, the fire investigators**
 24 **recovered JDG/6.**
 25 Q. You outlined for us earlier on what the compressor was;

Page 73

1 it compressed refrigerant; is that right?
 2 **A. Excuse me?**
 3 Q. You defined earlier on what the compressor is, and
 4 I think you said it compressed the refrigerant; is that
 5 correct?
 6 **A. The compressor compresses the refrigerant that provides**
 7 **the cooling, yes.**
 8 Q. Yes.
 9 **A. Was that your question?**
 10 Q. Yes.
 11 **A. Okay.**
 12 Q. Secondly, the relay compartment. Just so people
 13 understand at the outset, what is the relay compartment
 14 and what does it do?
 15 **A. Okay. It would be a small explanation.**
 16 **The relay compartment is attached to the compressor,**
 17 **and basically the wires, the electrical wires, that**
 18 **provide electricity to the compressor motor run through**
 19 **this relay compartment.**
 20 **Within that compartment are therefore wires. You're**
 21 **seeing some of the remains in JDG/6 here, wire**
 22 **connectors. There are also two what we call relays.**
 23 **Those are switching devices that are used to control the**
 24 **operation of the compressor.**
 25 **I could spend a little time on that just to be more**

Page 74

1 **helpful.**
 2 **The two relays, one of them is a so-called PTC**
 3 **relay, and that relay is used to start the compressor**
 4 **motor, so that when the compressor is first turned on,**
 5 **when the control board within the refrigerator decides**
 6 **that it's time to provide some cooling, the electrical**
 7 **current flows through this PTC relay to a start winding**
 8 **within the motor that gets the compressor motors**
 9 **started.**
 10 **Then as the compressor motor comes up to speed and**
 11 **draws the full load current, this PTC relay switches the**
 12 **current over to a second relay, which is an overload**
 13 **relay. So there are two relays within the compressor**
 14 **relay compartment. The second one is an overload relay.**
 15 **It has a trade name Klixon. You are going to find**
 16 **Klixon relays in thousands of refrigerators and other**
 17 **appliances throughout the world.**
 18 **So once the motor is up to speed, the electricity**
 19 **will flow through the overload relay, the Klixon**
 20 **overload relay, and if there is any short circuit or**
 21 **electrical problem within the compressor motor, that**
 22 **Klixon relay will disconnect power and safely remove any**
 23 **overload current.**
 24 **So what you're talking about is wires, wire**
 25 **connectors, and two relays or switching devices in this**

Page 75

1 **compressor relay compartment that is affixed to the**
 2 **compressor itself.**
 3 Q. That's useful context. We'll be coming on to the
 4 particular operation of these wires and the various
 5 components when we come to look at figure 7.
 6 **A. Okay.**
 7 Q. But dealing with basic matters at this stage, am I right
 8 in understanding that exhibit 6B was a wire connector?
 9 **A. Not only a wire connector, but a small section of**
 10 **wire -- actually, two wires -- that are affixed, that**
 11 **are connected, to that connector.**
 12 Q. What purpose does that serve?
 13 **A. Those two wires are part of the wiring harness that**
 14 **comes from the internal part of the refrigerator up**
 15 **where the control -- the control board is higher up in**
 16 **the refrigerator, but the wiring harness comes down.**
 17 **There are five wires. Two of them are associated with**
 18 **JDG/6B, what we're focusing on here.**
 19 **Those would be live wires when the compressor calls**
 20 **for power, when it's time to energise the compressor,**
 21 **JDG/6B would be energised wires.**
 22 Q. That's useful, thank you.
 23 Looking at its composition, as you've adverted to,
 24 6B consists of two wires, and each with a strand
 25 diameter of 0.17 millimetres; is that right?

Page 76

1 **A. Yes.**
 2 Q. But one consisting of 23 strands and another of 14
 3 strands; is that right?
 4 **A. Yes, sir.**
 5 Q. I now move to the second part of my questioning in
 6 relation to the addendum, and that's really in respect
 7 of certain contextual points.
 8 Looking at how you've set out the reasoning in the
 9 at addendum, a central element of the hypothesis you
 10 advance is the poor crimp connection.
 11 Is that a fair summary, before we proceed any
 12 further?
 13 **A. Yes.**
 14 Q. It may be useful if we go to page 6 of the addendum.
 15 Can you help us, first of all, with what figure 2
 16 shows?
 17 **A. Yes. Could you blow that up a bit?**
 18 Q. Paul, could you amplify it. Thank you.
 19 **A. So this is a result of a CT scan that was performed at**
 20 **Nikon Tring, at their computer tomography facilities up**
 21 **in the Tring area. We did that in September 2018. This**
 22 **is the resulting CT scan of that connector, JDG/6B. The**
 23 **top part of that is actually the connector.**
 24 Q. If you could return to your former role as a professor
 25 and identify where on the photograph that connector is?

Page 77

1 **A. So you can see two wires, they're entering the**
 2 **connector, and this area of the connector is called the**
 3 **wire barrel (Indicates).**
 4 Q. That is, for the stenographer's purposes, the two
 5 barrels which are alongside each other in the middle of
 6 that scan.
 7 **A. Correct. This is where the connector is crimped. It's**
 8 **a pressure connection, a tool or a machine that provides**
 9 **a compression force to that wire barrel. That basically**
 10 **grips the wire strands and keeps them inside of the**
 11 **barrel.**
 12 Q. If I can stop you there, the essential purpose of
 13 a crimp connection is to keep the wires within the
 14 barrel; is that it?
 15 **A. Tightly affixed within the barrel, yes.**
 16 Q. It has to be tight within the barrel -- apologies, it's
 17 a question to the obvious -- why do the wires have to be
 18 kept tight within the barrel?
 19 **A. Because you could have a problem. If they're loose**
 20 **within the barrel, you could get some overheating, which**
 21 **I have concluded happened for this JDG/6B.**
 22 Q. We can come on to that.
 23 **A. Yes.**
 24 Q. What we have set in the bottom half of this figure is
 25 what you've described as cross-sectional slices; is that

Page 78

1 right?
 2 **A. Yes.**
 3 Q. There are five identified there; is that right?
 4 **A. One, two, three, four, five -- these are cross-sections**
 5 **taken by the computer tomography, the CT scan, that**
 6 **I observed.**
 7 Q. How many cross-sectional slices did you examine in
 8 total?
 9 **A. Okay, so the CT scan starting from the left-hand of the**
 10 **barrel to the right-hand of the barrel goes at**
 11 **approximately 0.03-millimetre intervals, and if you**
 12 **count them up from the left-hand side to the right-hand**
 13 **side of the barrel, there were approximately 80, 8-0,**
 14 **slices, five of which I am showing here.**
 15 Q. To what extent are the five slices set out there
 16 exemplars of the other cross-sectional slices you
 17 reviewed?
 18 **A. Well, you would have to look at all 80, which I did, but**
 19 **basically what I found was a lot of void spaces,**
 20 **an indication of a loose crimp that has not been**
 21 **properly crimped when the compression was applied during**
 22 **the application of this wire.**
 23 **What I also mention, there is a space up here**
 24 **(Indicates). If you blow this up, you can probably see**
 25 **it a little bit better on this figure. But there is**

Page 79

1 **a space, and it's a tapered space that tapers down to no**
 2 **space on the right side, and that's another indication**
 3 **that the crimp was not nice and tight. It wasn't a good**
 4 **compression crimp.**
 5 Q. If I could just stop you there. When you said there is
 6 a space there, you are referring to a space in between
 7 the two wire barrels.
 8 **A. Yes, sir.**
 9 Q. If I can go back to the bottom half of this figure,
 10 figure 2 -- Paul, if you could go back to figure 2,
 11 please -- you've identified on four of the five what
 12 you've describe as voids.
 13 **A. Yes, and there are even voids here (Indicates), but it's**
 14 **somewhat blurry. There are actually voids in all five**
 15 **of these sections. In fact, I found voids in all 80**
 16 **cross-sections.**
 17 Q. And --
 18 **A. Some of them much larger than the others. You have some**
 19 **very serious ones here on the left. Here it appears**
 20 **that the -- by the way, inside of this crimp of the**
 21 **connector are the wire strands, the individual strands.**
 22 Q. If I could stop you there. If we could take this stage
 23 by stage.
 24 Reading from left to right, Dr Glover, looking at
 25 the slide on the furthest left-hand side, to the lay

Page 80

1 eye, there appear to be voids not only between the wires
 2 themselves and the wire barrel, but also between the
 3 wires themselves.
 4 Is that a correct observation?
 5 **A. Yes, and it's an important one too, because you need the**
 6 **wire strands to be in contact with each other so as to**
 7 **provide an easy way for the current to flow among all of**
 8 **the strands and to reduce the so-called resistance of**
 9 **this contact here. Resistance, if it's too high, can**
 10 **lead to overheating.**
 11 Q. Stopping there, if we just examine each of these slices.
 12 The second slice from the left to the lay eye
 13 appears to show voids as between wires; is that correct?
 14 **A. Yes. It's somewhat blurry, but there are definitely**
 15 **voids between the wire strands.**
 16 **Another feature here, you see the two ends of the**
 17 **barrel are not projecting down into the wire strands,**
 18 **another indication that we have a loose crimp, a loose**
 19 **compression force here.**
 20 Q. Is the consequence of there being voids as between wires
 21 the same as the consequences of there being voids
 22 between wires and the wire barrel itself?
 23 **A. Yes, because the electrical current that is flowing in**
 24 **these wire strands eventually has to get out through the**
 25 **connector. This connector then connects on to a spade**

Page 81

1 **connection which provides current to the compressor**
 2 **motor.**
 3 **So the current is coming from these wire strands,**
 4 **down the wire. It has to come through the wire strands,**
 5 **and through the contact surface of the barrel of the**
 6 **crimp connector, and then the current will flow through**
 7 **the connection, eventually getting to the motor.**
 8 **So you want a nice tight connection, to prevent**
 9 **basically overheating. If you have poor contact, you**
 10 **will get overheating.**
 11 Q. Thank you.
 12 Paul, if you can take down figure 2 and then put up
 13 figure 3.
 14 This is essentially a compare and contrast exercise,
 15 Dr Glover, isn't it, because what you describe figure 3
 16 as "a good crimp".
 17 If we again move from left to right, even though you
 18 describe this as a good crimp, on the left-hand side,
 19 there still appear to be voids, certainly to this lay
 20 eye. Are there voids there?
 21 **A. There are, actually. If I were to change this, I would**
 22 **say it's a better crimp than 6B, and we're looking at 6A**
 23 **now, but I actually have some concerns about this crimp**
 24 **also.**
 25 Q. So it's relatively better than figure 2, but it's not

Page 82

1 a "good" crimp?
 2 **A. That's my opinion, yes.**
 3 Q. The reason why you don't think it's a good one -- it may
 4 well be the middle slice, the third from the left,
 5 illustrates I think the point you want to make -- is
 6 that there are still voids as between the wires
 7 themselves and query between the wires and the wire
 8 barrel; is that a fair observation?
 9 **A. Yes, you can still see void spaces.**
 10 **By the way, these barrel curvature are much better**
 11 **than if you looked up at 6B, you can see them projecting**
 12 **more into the wire strands, especially over here, but**
 13 **you still have some void spaces here that would be of**
 14 **some concern.**
 15 Q. Thank you.
 16 Dr Glover, those are the points I want to draw out
 17 in respect of figures 2 and 3.
 18 Could I ask you now to turn to page 7 of the
 19 addendum and, in particular, the third paragraph on that
 20 page, which starts "Poor crimping leads". I'll let you
 21 refresh your memory and read that paragraph to yourself,
 22 first of all.
 23 (Pause)
 24 **A. Yes.**
 25 Q. You say there that there is a decrease in contact area

Page 83

1 between the wire strands and the connector.
 2 Is the connector the wire barrels you have annotated
 3 in figures 2 and 3?
 4 **A. Excuse me?**
 5 Q. You say there that there's a decrease in the contact
 6 area between the connector and wire strands.
 7 **A. Yes.**
 8 Q. My question is: what is the connector, essentially? Is
 9 it what we've just seen in figures 2 and 3?
 10 **A. Yes, JDG/6B is the connector.**
 11 Q. You go on to say in this paragraph that it is
 12 "accompanied by an increase in the associated contact
 13 resistance".
 14 My first question, just to help us understand the
 15 analysis, is: can you explain, first of all, what
 16 contact resistance is?
 17 **A. Okay. You're talking about an electrical term,**
 18 **"resistance". Copper is a very good conductor. It can**
 19 **carry current quite easily. It has what we call low**
 20 **resistance.**
 21 **Other devices are not very good conductors of**
 22 **electricity. For example, air. Air is a poor conductor**
 23 **of electricity, especially dry air. If you have voids,**
 24 **an electrical current has to pass through those void**
 25 **spaces, that means you have an increase in resistance.**

Page 84

1 **It's obviously not as good as the copper itself.**
 2 **So the more voids you have, the higher the**
 3 **resistance. The lower the contact area between the wire**
 4 **strands themselves and between the wire strands and the**
 5 **connector, the more voids you have, the higher the**
 6 **resistance, and that leads to power losses and**
 7 **overheating when you do have high resistance.**
 8 Q. When you say connector power loss, that's what you're
 9 just referring to now?
 10 **A. Yes, and there's a formula that I provide there that**
 11 **when you have current flowing through a resistance,**
 12 **electrical current, then there is a formula for the**
 13 **power loss at that connector, which is the square of the**
 14 **current times the contact resistance. So the higher the**
 15 **resistance, the more power loss, and when you have power**
 16 **losses at a connector, you have heat.**
 17 Q. Thank you.
 18 Staying with this paragraph, you say this phenomenon
 19 can cause oxidation of the connector itself, and
 20 presumably that oxidation itself increases resistance
 21 and has the consequences you just outlined; is that
 22 a fair summary?
 23 **A. Yes. So when you have voids, you have the possibility**
 24 **of oxides. Voids around the strands themselves and also**
 25 **voids between the wire strands and the crimp. When you**

Page 85

1 **have those voids, you have the possibility of oxide**
 2 **build-up. It's an electrochemical reaction,**
 3 **electrolysis, which creates oxides, which provides more**
 4 **resistance, that further increases the contact**
 5 **resistance, leading to additional power loss and higher**
 6 **heat.**
 7 Q. Is that a process -- I'm assuming it is, given the use
 8 of the word "build-up" -- a problem which gets worse
 9 with time?
 10 **A. Yes.**
 11 Q. Am I right in understanding that prolonged overheating
 12 can lead to the ignition of nearby wire installations?
 13 Is that a fair if general summary?
 14 **A. Yes. What you end up with in a loose connector like**
 15 **this is basically a glowing connection. It's hot, it's**
 16 **glowing, current is trying to pass through the voids,**
 17 **and any wire insulation in proximity to that is suspect**
 18 **to ignition, igniting in the insulation of the wires.**
 19 Q. It's the insulation around the wires, so here it would
 20 be the insulation which would've been around exhibit 6B;
 21 is that right?
 22 **A. The wires that enter the crimp, the connector, have**
 23 **insulation on them. The insulation is stripped off**
 24 **inside the barrel, but outside of the connector, you**
 25 **have the insulation on the wires, which is no longer**

Page 86

1 **visible here because the fire has burned off all the**
 2 **wire insulations.**
 3 Q. Can you help us -- apologies, a further level of
 4 detail -- what material the insulation to the wire is
 5 made of?
 6 **A. It's basically typically a PVC-type of insulating**
 7 **material. Electrical insulation.**
 8 Q. What sorts of temperature can PVC withstand?
 9 **A. They have different ratings, but a typical one is**
 10 **90 degrees C.**
 11 Q. Thank you.
 12 Apologies, Dr Glover, are you able to keep on going
 13 until 1 o'clock or would you like a break?
 14 **A. At your pleasure, I can continue.**
 15 Q. You have been going for an hour. I just wonder whether
 16 you'd appreciate a break at this juncture.
 17 **A. It's your decision, sir.**
 18 **SIR MARTIN MOORE-BICK: Can I suggest that if you are**
 19 **comfortable keeping going, we'll keep going and see how**
 20 **we get on. If necessary, we can stop for lunch a bit**
 21 **early. But if not, we can run until 1 o'clock. All**
 22 **right?**
 23 MR KINNIER: Thank you, sir.
 24 Dr Glover, thank you for that.
 25 If I may now turn to the topic of the short circuit

Page 87

1 and the fridge freezer. If I could ask you to turn to
 2 page 13 of the addendum and, in particular, figure 7,
 3 which I referred to earlier on.
 4 Again, just so that I can orientate myself and those
 5 listening at the outset, am I right to describe your new
 6 hypothesis thus: that there was a short circuit between
 7 an energised internal wire and a neutral wire?
 8 **A. I'm sorry, could you repeat that?**
 9 Q. Of course.
 10 Is it right to characterise your hypothesis thus:
 11 there was a short circuit between an energised internal
 12 wire and a neutral wire, and that process is illustrated
 13 in figure 7?
 14 **A. Yes, sir.**
 15 Q. Thank you.
 16 Apologies, could I ask you to turn back to page 12
 17 of the addendum and the third paragraph on that page,
 18 which starts with the words "Figure 7".
 19 If I may invite you just to read that to yourself,
 20 first of all.
 21 (Pause)
 22 **A. Okay.**
 23 Q. There you refer to the Klixon overload relay, and that's
 24 the Klixon overload relay you referred to earlier on in
 25 your evidence when describing the relay?

Page 88

1 **A. Yes, sir.**
 2 Q. You also say in this paragraph on page 12 that the
 3 result of the short circuit you identify there is that
 4 the magnitude of current:
 5 "... is not limited by the compressor motor or
 6 Klixon overload relay, would therefore be on the order
 7 of hundreds of amperes, sufficient to trip the 32-A
 8 miniature circuit breaker (MCB) for Circuit No.7 ..."
 9 Now, I think it would be useful just at this
 10 juncture to understand again: how does the compressor
 11 motor and the Klixon overload relay serve to limit the
 12 magnitude of the current under normal operation?
 13 **A. Okay, if we could go to figure 7, I could explain that.**
 14 Q. Paul, could we go to page 13.
 15 Dr Glover, before you take us through the process,
 16 the stenographer has to valiantly identify for the
 17 record that which is visible to all of us, so if you are
 18 able to describe each stage before you take us to it,
 19 that would greatly help the stenographer, I think.
 20 **A. Yes. So just to familiarise ourselves, this is the**
 21 **power supply wires, or two of them, that come from the**
 22 **power supply cord or the main supply flex that supplies**
 23 **power to the refrigerator. The energised wire goes up**
 24 **and connects to the control board, and if there were**
 25 **current going to the compressor -- by the way, here is**

Page 89

1 the compressor, it's CO (Indicates).
 2 You can see the flow of electrical current goes up
 3 to the control board, and when the control board so
 4 chooses, it provides current that comes down through
 5 an energised wire, goes through the Klixon overload
 6 relay into the compressor motor, and then returns
 7 through that motor run capacitor, down here, that's the
 8 normal path of current. I'm showing a different path
 9 for a short circuit.
 10 Now, before talking about the short circuit that I'm
 11 showing here, let's talk about a short circuit over at
 12 the motor capacitors. Suppose the motor run capacitor
 13 had a short circuit, then the current would flow through
 14 the Klixon relay, through the compressor and then
 15 through the shorted motor run capacitor wires.
 16 However, you've got two limiting factors here: the
 17 overload relay would sense that and then shut off or
 18 switch down, and also the compressor itself is a large
 19 resistance that would limit the short circuit current,
 20 if you did have a short circuit over in this region, to
 21 a very small amount, perhaps a few amperes, that would
 22 not be sufficient to melt the wires or cause an arc
 23 problem. It would be limited.
 24 Here, however, I'm showing a different short
 25 circuit. I'm showing a short circuit on the front end

Page 90

1 of the compressor relay compartment between an energised
 2 wire and a neutral wire, and you can see that this short
 3 circuit path bypasses both of the Klixon relay, the
 4 overload relay, as well as the compressor itself and the
 5 run capacitor.
 6 In that case, what do you have to limit the current?
 7 You have the wiring of circuit number 7, small fraction
 8 of an ohm. You have the power supply cord for the
 9 fridge freezer, again, small fraction of an ohm. You
 10 have the internal wiring harness, a small fraction of an
 11 ohm.
 12 In fact, the majority of the resistance is in the
 13 arc itself, within the short circuit, typically about
 14 one ohm, much larger than all of those other limiting
 15 factors which are small fractions of an ohm.
 16 So if you think of 1 ohm -- now I have to give you
 17 another formula: current is voltage divided by current.
 18 Ohms -- well, it's a pretty simple circuit. We're
 19 supplying this fridge freezer with 230/240 volts, the
 20 standard voltage in the United Kingdom, and if you think
 21 of 240 volts in one ohm, Ohm's law would give you
 22 240 amperes, 240 volts by 1 ohm.
 23 So this path, you're not limited by the compressor,
 24 you're not limited by the Klixon overload relay, you're
 25 going to have a large amount of current, and that's

Page 91

1 either going to cause the 32-amp circuit breaker for
 2 circuit 7 to trip, or the fuse, the 13-ampere fuse, to
 3 blow. As I mentioned earlier, there are many cases
 4 where the 32-ampere circuit breaker will operate, will
 5 trip, before the fuse blows.
 6 Q. Flowing on from that last answer, you say in the same
 7 paragraph on page 12 that the 32-amp circuit breaker
 8 would trip:
 9 "... without a thirteen-ampere fuse in the plug for
 10 the fridge freezer mains supply flex."
 11 Just to deal with it point by point, because these
 12 matters are quite technical, can you explain why you say
 13 you would expect this scenario not to result in a 13-amp
 14 fuse in the plug for the fridge freezer to blow?
 15 **A. It's very common when you have 13-ampere fuses for**
 16 **appliances not to blow, simply because the 32-amp**
 17 **circuit breaker operates faster. It's going to be**
 18 **a race. One of them is going to operate first. But in**
 19 **many cases, the circuit breaker will trip before the**
 20 **13-ampere fuse blows. I did explain that in section 1**
 21 **of my report, but that does bear some analysis.**
 22 Q. Thank you.
 23 Can we now turn to the relationship between the
 24 scenario you've posited here and arc-damaged MJS/1.
 25 In this short circuit scenario, where would you

Page 92

1 expect to find the electrical arc damage?
 2 **A. So here is the run capacitor. We saw that the run**
 3 **capacitor in the exemplar fridge, as well is in the**
 4 **subject fridge from flat 16, the run capacitor wires had**
 5 **24 strands. Okay? So they run along the neutral here.**
 6 **So when you have an arc here from the energised wire --**
 7 **by the way, that was 23 strands and 14 strands, if you**
 8 **recall JDG/6B -- arcing to 24 strand wires.**
 9 **As I mentioned before, MJS/1 was not found within**
 10 **the subject fridge freezer, it was found in the bedroom,**
 11 **but these wires that go with the fridge freezer for the**
 12 **run capacitor, are consistent with that MJS/1.**
 13 **SIR MARTIN MOORE-BICK: So I understand this, you are**
 14 **postulating that the energised wire shown in your**
 15 **diagram is sufficiently close to the neutral wire in**
 16 **terms of physical proximity for an arc to occur between**
 17 **them?**
 18 **A. Yes, no, this is a circuit diagram.**
 19 **SIR MARTIN MOORE-BICK: Of course.**
 20 **A. So you see what appears to be a large space, but all of**
 21 **these wires enter the relay compartment in close**
 22 **proximity to each other.**
 23 **SIR MARTIN MOORE-BICK: Yes. Thank you.**
 24 **MR KINNIER: Thank you.**
 25 That dealt with the next questions I was going to

Page 93

1 ask, so could I ask you to turn to page 13 of the
 2 addendum, and it's the only paragraph on that page.
 3 Here you note that, in your view, the short circuit
 4 scenario you've outlined on the previous page would not
 5 cause the RCCB to trip; is that a fair summary?
 6 **A. Yes, it is.**
 7 **Q. Could you take us through your reasoning for coming to**
 8 **that conclusion?**
 9 **A. Okay, once again --**
 10 **Q. Would it help if we put up figure 7 for you again?**
 11 **A. That's good. If you could blow figure 7 up, expand it.**
 12 **You see the arc, which is that red short circuit**
 13 **that I've annotated in red. The blue and the red is my**
 14 **artwork, the rest of the diagram is a Whirlpool circuit**
 15 **diagram.**
 16 **So I've annotated a short circuit from an energised**
 17 **wire to a neutral wire (Indicates).**
 18 **And now I've lost track, what was your question?**
 19 **Q. It's just really understanding your reasoning for**
 20 **concluding why, in the short circuit scenario, it**
 21 **wouldn't cause the RCCB to trip. It's just**
 22 **understanding why.**
 23 **A. Thank you so much.**
 24 **So here we have a short circuit from an energised**
 25 **wire to a neutral wire. RCCB circuit breakers do not**

Page 94

1 **trip, do not operate, for what we call an energised line**
 2 **to neutral short circuit. They only trip when the**
 3 **grounding wire or some metallic path to ground is**
 4 **involved. So if electrical current leaves an energised**
 5 **wire and somehow flows to ground, or to a grounded metal**
 6 **plate, then the RCCB would pick that up, it would detect**
 7 **it, and it would trip.**
 8 **But in this case, the RCCB would see current coming**
 9 **in, current coming out, even though it's a very high**
 10 **value, could be a short circuit, it's coming in the**
 11 **energised wire, going out the neutral wire, the RCCB**
 12 **sees a balance of 0, it doesn't see a net current**
 13 **flowing to a ground path, and so it does not trip.**
 14 **Q. Understood.**
 15 I think I'm right in saying that your view is that
 16 the RCCB tripped later, but before Mr Kebede turned off
 17 the main switch; is that, again, a fair if general
 18 summary of your view?
 19 **A. Yes.**
 20 **Q. You say it's probable that this was a result of**
 21 **essentially smoke and smoke particles attacking**
 22 **an energised socket; is that right?**
 23 **A. Yes. So circuit 7 has tripped, so all of the sockets in**
 24 **the kitchen and the circuit 7 wiring are now**
 25 **de-energised, but the RCCB is looking at two circuits, 7**

Page 95

1 **and 8.**
 2 **Circuit 8 are the other flat sockets, so if those**
 3 **other flat sockets in circuit 8, if one or more of them**
 4 **were attacked by fire, by smoke, by smoke particles,**
 5 **then knowing that smoke, smoke particles, soot, are all**
 6 **electronically conductive, carbonaceous material, if**
 7 **a socket in circuit 8 which is still energised before**
 8 **Mr Kebede turns off that main red switch is attacked by**
 9 **smoke and smoke particles, then you can have a small**
 10 **current.**
 11 **By the way, the RCCB circuit breaker operates for**
 12 **a very small threshold of current, 30 milliamperes.**
 13 **That would be 0.03 amperes. It doesn't take much for**
 14 **that RCCB circuit to trip. In my opinion, smoke and**
 15 **soot particles quite likely caused a socket in circuit 8**
 16 **to trip at a later time, before Mr Kebede turns off the**
 17 **red main switch.**
 18 **Q. Looking at that, Dr Glover, you've noted that smoke and**
 19 **smoke particles are conductive. What is less clear is**
 20 **how precisely smoke and smoke particles are likely to**
 21 **have led the current flow to the ground receiver. Could**
 22 **you help us understand that process?**
 23 **A. So if you look within a socket, or if you think of when**
 24 **you plug your 3-pin, your 3-pronged plug into a socket,**
 25 **one of them is the ground prong. It's the single one**

Page 96

<p>1 and above it are the energised prong, the live wire 2 prong and the neutral prong. They're all in fairly 3 close proximity, the receivers within the socket that 4 accept those prongs. Okay? 5 So let's suppose you have a socket where nothing is 6 plugged into it. Smoke gets into that socket, the holes 7 for the three prongs of the plug, and the smoke deposits 8 bridge the gap between the receiver for the energised 9 portion to the ground. Then you have that ground path 10 that would trip an RCCB. 11 Q. Are you able to give us an idea as to the quantity of 12 smoke or smoke particles that would be necessary to 13 produce this effect? 14 A. I don't think I could quantify it for you. All you need 15 are smoke particles, soot, to get into the socket 16 receivers and bridge that small gap distance. I guess 17 I'll have to go back to the 30 milliamperes. It would 18 have to be enough soot and smoke deposits to cause the 19 conduction of at least 30 milliamperes. 20 But if you want milligrams, I would not be able to 21 quantify that without doing some experiments. 22 Q. Staying with this question of the density of smoke. 23 Could I ask you, Paul, to turn to page 14 of the 24 addendum. It is really the third line of the third 25 paragraph on that page, and it's a point we've adverted</p> <p style="text-align: center;">Page 97</p>	<p>1 something different, not normal air, different. It was 2 like a burning smell and like a chemical smell and 3 I could taste it. I could not smell it in my room when 4 the door was closed. I went into the corridor of the 5 flat and saw smoke. The smoke was near to the front 6 door which is at the other end of the corridor from the 7 kitchen. I could still see the front door. I was 8 shocked and I can't recall if I could see the other end 9 of the corridor near the kitchen. The lights in the 10 flat were off but light was coming in through the front 11 door and everything seemed cloudy." 12 So you have quite an explicit memory that she is 13 recording here, three different ways that she observed 14 smoke. 15 Now, the other two witnesses -- Mr Kebede, 16 I remember he was preoccupied with waking up his fellow 17 roommates, Ms Kinfu and Ms Afeworki, and also going 18 outside to wake up the other occupants of the other 19 flats on the 4th floor, and then going back into his 20 apartment and getting dressed, picking up his cellphone, 21 turning off the main red switch and then vacating. He 22 was also calling -- it's not 911, what is it? 23 Q. 999. 24 A. 999 here. So there were other things on his mind. 25 Ms Kinfu, however, is very explicit in her recalling</p> <p style="text-align: center;">Page 99</p>
<p>1 to earlier on. You say this: 2 "It is probable that smoke and smoke particles, 3 having exited the kitchen ... attacked an energized 4 socket ..." 5 Then you quote an extract from Ms Kinfu's witness 6 statement. 7 At the bottom of page 14, at footnote 4, you 8 acknowledge that the two other occupants of flat 16 9 didn't necessarily agree with Ms Kinfu's recollection 10 that smoke was in the corridor. 11 Can you help us with this point: why have you placed 12 greater weight on the evidence of Ms Kinfu as opposed to 13 the two other former residents of flat 16? 14 A. Yes. So when I read Ms Kinfu's statement, she was very 15 explicit in her perception that there was smoke in the 16 corridor. She was awoken from her bedroom, and she says 17 in her statement that she didn't smell or sense any 18 smoke in the bedroom, but once she opened the bedroom 19 door and entered the corridor within flat 16, then she 20 sensed smoke. She sensed it in three ways: she smelled 21 it, she said she even tasted it, if you read her 22 statement, and she saw it. Okay? And all of this is 23 going on. 24 So you can see: 25 "I opened the bedroom door and I could smell</p> <p style="text-align: center;">Page 98</p>	<p>1 the smoke in that corridor before she vacated. 2 Q. Following on from that point, if I could ask Paul to 3 de-amplify that but amplify footnote 4. 4 In the second sentence, in respect of Mr Kebede, you 5 say: 6 "He also states that he is not sure if he closed the 7 kitchen door behind him or not ..." 8 Stopping there, were you aware of the thermal 9 imaging camera footage taken by the firefighter first 10 responders when they entered flat 16, and that it 11 certainly appeared from that footage that the kitchen 12 door was closed? 13 Were you aware of that footage is the first 14 question? 15 A. I was, yes. 16 Q. Given that footage, what effect does that have on your 17 analysis of the amount of smoke that could've escaped 18 the kitchen and got into the hallway, thereby triggering 19 the scenario which you've posited in the addendum? 20 A. Well, you have to consider the possibility -- certainly 21 it was open at one time when Mr Kebede looked into the 22 kitchen and observed the fire on the east end of the 23 kitchen near the fridge freezer. He doesn't remember 24 whether he closed it. Was it fully closed or was it 25 ajar when the fire department came in?</p> <p style="text-align: center;">Page 100</p>

<p>1 So those are issues I have.</p> <p>2 Could somehow, in some other means, that kitchen</p> <p>3 door have been left open by Mr Kebede, and then closed</p> <p>4 in some other way due to fire, heat, or someone else?</p> <p>5 That's possibilities. I don't have an answer.</p> <p>6 Q. Presumably it flows from that, you aren't able to assist</p> <p>7 us on the amount of smoke that may have escaped the</p> <p>8 kitchen into the hall between the time of Mr Kebede</p> <p>9 first identifying the fire and making the 999 call?</p> <p>10 A. That's right. I'm not quantifying that, not able to.</p> <p>11 Q. Equally, you're not able to give us any idea about the</p> <p>12 amount of smoke that would have escaped the kitchen into</p> <p>13 the hall between the first 999 call and Mr Kebede</p> <p>14 leaving the apartment?</p> <p>15 A. No, I can't --</p> <p>16 Q. Okay.</p> <p>17 A. -- distinguish.</p> <p>18 Q. Looking at trying to understand the mechanism by which</p> <p>19 the short circuit occurred, are you able to assist us</p> <p>20 with how long smoke would need to be at or in the area</p> <p>21 of the socket in order to penetrate the inner workings</p> <p>22 and trigger the scenario you've posited?</p> <p>23 A. It's almost instantaneous. Once the smoke and soot</p> <p>24 particles enter the socket and bridge the gap between</p> <p>25 the ground receiver and the energised receiver, the RCCB</p> <p style="text-align: center;">Page 101</p>	<p>1 are in close proximity to each other within the relay</p> <p>2 compartment, and it's just a matter of time before the</p> <p>3 installations are burned off both of those wires,</p> <p>4 causing a line to neutral short circuit.</p> <p>5 Q. Apologies for asking what might be a simple question,</p> <p>6 but is it the overheating which causes the ignition or</p> <p>7 is it the electrical arcing, or is that a false</p> <p>8 distinction?</p> <p>9 A. The overheating in the crimp starts the fire.</p> <p>10 It overheats, it glows, it ignites. We don't have</p> <p>11 a short circuit yet. It's kind of what you call</p> <p>12 a series arcing through those voids. You have glowing</p> <p>13 electricity, luminous electricity, flowing through those</p> <p>14 voids. It creates heat that ignites the insulation on</p> <p>15 the wires before you have a short circuit that would</p> <p>16 trip the circuit breaker.</p> <p>17 Q. Thank you very much, Dr Glover.</p> <p>18 I now turn to part 3 of the questions that I'd like</p> <p>19 to ask you in respect of the addendum, and that's more</p> <p>20 specific questions regarding the reasoning.</p> <p>21 Paul, if you could put down the addendum and return</p> <p>22 to Dr Glover's report, and page 57 of that report, if</p> <p>23 possible.</p> <p>24 You say in the substantive paragraph underneath the</p> <p>25 halfway point, and I quote:</p> <p style="text-align: center;">Page 103</p>
<p>1 trips very rapidly, within milliseconds.</p> <p>2 Q. Could we now come on to the separate topic of the role</p> <p>3 of 6B in your scenario.</p> <p>4 You conclude -- we can turn to page 15 of the</p> <p>5 addendum just to orientate you in your conclusions --</p> <p>6 that it's probable that the overheating of 6B caused the</p> <p>7 fire in flat 16. Is that a fair summary of the</p> <p>8 conclusion you reached in the addendum?</p> <p>9 A. Yes, sir.</p> <p>10 Q. Can you explain for us the relationship between the</p> <p>11 overheating of 6B and the short circuit you've set out</p> <p>12 in figure 7, or do you think you've covered it in the</p> <p>13 evidence you've already given?</p> <p>14 A. Okay, so you have the overheating within the crimp</p> <p>15 for --</p> <p>16 Q. Yes.</p> <p>17 A. -- exhibit JDG/6B, and that becomes a glowing connection</p> <p>18 over time as the oxide builds up and the resistance</p> <p>19 builds up and the power losses increase. Once you get</p> <p>20 that glowing connection, you have the possibility of</p> <p>21 igniting the wire installations. Now you have a fire</p> <p>22 going on within the compressor relay compartment.</p> <p>23 So now it's a matter of time to bridge that gap</p> <p>24 between the energised wire, that's JDG/6B, and the</p> <p>25 neutral wire, to cause a short circuit. And those wires</p> <p style="text-align: center;">Page 102</p>	<p>1 "It is concluded that arc-damaged Exhibits MJS/1 and</p> <p>2 JDG/1 are consistent with a wire from either the run</p> <p>3 capacitor or an internal jumper wire within the relay</p> <p>4 compartment of BPS/4."</p> <p>5 I think this is an extract we looked at earlier when</p> <p>6 discussing your analysis of the large fridge freezer.</p> <p>7 Having read that, could I ask you to turn back to</p> <p>8 your addendum, and page 9 of the addendum.</p> <p>9 If we look at the top paragraph, it says this:</p> <p>10 "Figure 6 shows arc-damaged Exhibit JDG/1, which I</p> <p>11 found within the medium-sized freezer during my 27 April</p> <p>12 2018 inspection at Bureau Veritas. There are two</p> <p>13 possibilities for the location of JDG/1 at the time of</p> <p>14 the fire: either (1) JDG/1 remained within the medium</p> <p>15 sized freezer; or (2) JDG/1 was initially located</p> <p>16 outside the medium sized freezer at the time of the</p> <p>17 fire, and was (inadvertently) moved into the medium</p> <p>18 freezer during or after subsequent firefighting</p> <p>19 efforts."</p> <p>20 To the lay reader, that suggests that you are less</p> <p>21 definite that JDG/1 formed part of the large fridge</p> <p>22 freezer.</p> <p>23 What would be your response to that observation?</p> <p>24 A. Okay, so at the time that I concluded my 15 October</p> <p>25 report, I hadn't focused on the crimp connector with the</p> <p style="text-align: center;">Page 104</p>

<p>1 voids JDG/6B. Once I saw the voids, when I was able to 2 produce my addendum, I went back and considered the two 3 arc-damaged exhibits that were found in flat 16: MJS/1, 4 JDG/1. 5 JDG/1 I found in the medium-sized freezer, and we 6 know that there was a problem, Mr Kebede had a problem; 7 a fuse was blown many years before the 2017 fire. And 8 putting that together, and now further looking at JDG/1, 9 that arc-damaged wire which has really three wires with 10 24 strands in them, that would be not quite as 11 consistent as MJS/1, which had only two wires. 12 Now, that goes back to the motor run capacitor in 13 the fridge freezer that has two wires in it, and both of 14 those have 24 strands. 15 So upon looking at JDG/1, which had two wires but 16 then a third wire, segments in between, that to me made 17 it less likely that that could've been in the fridge 18 freezer, more likely that that came from the 19 medium-sized freezer due to a prior event many years 20 before the 2017 fire. 21 So I ended up concluding that the likelihood of arc 22 damage would've been associated with MJS/1 within the 23 fridge freezer. 24 Q. Thank you. 25 What would be your responses to the suggestion that</p> <p style="text-align: center;">Page 105</p>	<p>1 time unrelated to the fire ..." 2 Stopping there, can you identify for us what the 3 evidence is that you rely upon for concluding that JDG/1 4 arced before the fire? 5 A. This would be basically Mr Kebede's statement that he 6 had a problem with the medium freezer many years before 7 the fire. He called in a technician from the Yellow 8 Pages and he had a specific memory that this technician 9 told him there was a bad fuse. Mr Kebede didn't want to 10 fix the problem at that time, but he continued to 11 preserve the medium freezer. That would be the basic 12 evidence we have that there was a prior event that 13 caused a fuse to blow. 14 Q. Apologies for pressing the point, but given you've 15 considered that JDG/1 arced before the fire, why do you 16 exclude the possibility that the damage to MJS/1 was arc 17 damage sustained before the fire? 18 A. What I'm saying is that, once again, we're left with one 19 piece of arc damage that would've been sufficient to 20 trip the circuit breaker for circuit 7. That's MJS/1. 21 So that's how I conclude that it was somehow, at one 22 point, connected to circuit 7, that it was energised 23 from circuit 7 within the kitchen. 24 Now, I am assuming that this is an electrical fire. 25 As I mentioned, I'm not a cause and origin expert.</p> <p style="text-align: center;">Page 107</p>
<p>1 it's at least a possibility that MJS/1 was once part of 2 the medium freezer? 3 A. First of all, go back to that basic clue. We have 4 circuit 7 that tripped on the night of the fire, okay? 5 We only have two arc-damaged exhibits that would be 6 sufficient to trip the circuit breaker for circuit 7 number 7. We just have two: we have MJS/1 and JDG/1. 8 Now having excluded JDG/1 as having come from 9 a prior event, we are only left with one arc-damaged 10 exhibit from that flat, from flat 16, that could've 11 tripped circuit number 7. 12 Q. Following on from that, is the wire you've identified as 13 MJS/1 the only electrical component that you believe is 14 from the fridge freezer that wasn't found near the large 15 fridge freezer? 16 A. Yes. 17 Q. Yes. 18 A. First of all, it's the only arc-damaged one, excluding 19 JDG/1, and all these other exhibits like JDG/6B, all 20 those were found within the fridge freezer. 21 Q. Apologies for jumping around. We're at the addendum at 22 the moment. If I could ask Paul to turn to page 10 of 23 at the addendum. 24 You state there in the third paragraph on that page: 25 "With evidence that exhibit JDG/1 arced at a prior</p> <p style="text-align: center;">Page 106</p>	<p>1 I have no opinion on whether this was a non-electrical 2 fire caused by a lit candle or a smouldering cigarette. 3 I'm assuming we have an electrical fire here, and I'll 4 leave it to the fire investigators to tell the inquiry 5 whether this was a non-electrical fire. 6 So if we have an electrical fire, we're left with 7 MJS/1, the only arc-damaged exhibit that in my opinion 8 could've tripped circuit 7 for the kitchen. 9 That would happen before the fire, obviously. We 10 have an abnormal electrical event, trips a circuit 11 breaker, fire starts. 12 Q. Maybe I should've asked this question earlier on, but it 13 flows from what you've just said. 14 Whilst we have the benefit of the guidance you 15 identify in the damage assessment memo, we have the 16 listing of the nine characteristics of arc damage, how 17 straightforward is it to identify arc damage as 18 a general proposition? 19 A. It does take experience. If it's someone who has 20 experience in looking at arc-damaged wires, has reviewed 21 the literature -- I've mentioned NFPA 921, the guide to 22 fire investigations, and there are some very explicit -- 23 we listed nine of them -- things look for. The fine 24 line of demarcation between the localised damage and the 25 undamaged, the copper beads, arc beads, the opposing</p> <p style="text-align: center;">Page 108</p>

1 **wire, you've got to have arc from one to another -- all**
 2 **of these things I saw are the clear evidence of arc**
 3 **damage to MJS/1.**
 4 Q. Can I move on to a separate topic, which is looking more
 5 particularly about MJS/1 again.
 6 It may well assist if we put up a photo, Paul, which
 7 can be found at WPL000003234 and internal page 23.
 8 SIR MARTIN MOORE-BICK: Can I just intervene, are you still
 9 happy going on?
 10 THE WITNESS: Yes, sir.
 11 SIR MARTIN MOORE-BICK: You don't need a break now?
 12 MR KINNIER: It is a convenient place to stop if that helps.
 13 SIR MARTIN MOORE-BICK: I just wanted to make sure that
 14 Dr Glover was not sitting there thinking he had had
 15 enough of the morning.
 16 THE WITNESS: I'm fine.
 17 SIR MARTIN MOORE-BICK: Are you fine with that? Whatever
 18 time suits you.
 19 MR KINNIER: I think we're having some difficulties locating
 20 the photo at the moment.
 21 (Pause)
 22 Paul, do you have the reference? It's WPL000003234.
 23 There we go.
 24 If we could go to page 29, using the Relativity
 25 numbering.

Page 109

1 If we can amplify figure 8.
 2 Apologies, just for context, it's necessary to
 3 rehash a question I asked earlier, but is the design of
 4 the compressor in the exemplar which is shown there
 5 different to the one you found in the large fridge
 6 freezer in flat 16?
 7 **A. Yes, this is an exemplar, and the way you identify this**
 8 **particular compressor is there is a blue logo that's**
 9 **actually, in this company -- the logo of this company**
 10 **is -- the company is Tecumseh.**
 11 Q. Sorry to interrupt you, Dr Glover. There's the
 12 compressor unit which sits roughly in the middle of the
 13 photograph, there's two labels in the centre of the
 14 compressor.
 15 **A. Yes.**
 16 Q. We're looking at the top label, and there's a blue logo
 17 to the far left-hand side.
 18 **A. Correct. So this is the compressor. There are two**
 19 **labels on the compressor. There's a warning label below**
 20 **and there is a manufacturer's label. In the upper left**
 21 **corner, there is what I call a blue logo. That is the**
 22 **logo of Tecumseh, it's actually a native American**
 23 **headdress, Tecumseh is a Native American name.**
 24 **So this is not the Embraco compressor that was**
 25 **within the subject fridge freezer from flat 16.**

Page 110

1 Q. Understood.
 2 Is the design of the exemplar different to the
 3 design of the index fridge that was in the kitchen at
 4 flat 16?
 5 **A. Not significantly, no. I mean, you have the compressor.**
 6 **To the left of that you have what we've been calling the**
 7 **compressor relay compartment. This is a plastic**
 8 **enclosure that plugs into the compressor. Both of these**
 9 **features, there might be some small differences would be**
 10 **applied to the Tecumseh model that you see here as well**
 11 **as the Embraco, and you also have the run capacitor over**
 12 **here which runs into the compressor relay compartment.**
 13 **These are all general. They would apply to both**
 14 **models.**
 15 Q. Would there be any difference in the wiring layout of
 16 the index fridge freezer and the exemplar fridge
 17 freezer?
 18 **A. There are some differences, as I mentioned. The wiring,**
 19 **harness with five wires that come down from within the**
 20 **freezer is slightly different from this exemplar. It's**
 21 **still five wires, but one of them, the wires are within**
 22 **a cord with an outer jacket, and for the other they're**
 23 **not.**
 24 **The actual size of the compressor relay compartment**
 25 **might be different for both, but generally they're**

Page 111

1 **similar.**
 2 Q. Are the components within the compressor relay
 3 compartment enclosed within the housing? I think the
 4 housing is to the left of the compressor.
 5 **A. Yes.**
 6 Q. That's a yes?
 7 **A. Yes. Those would be the two relays, the PTC relay and**
 8 **the Klixon relay, and the wires and wire connectors.**
 9 Q. Okay.
 10 Paul, can you put away that photograph and put up
 11 a separate photograph, which is MET00009047.
 12 I think and hope and expect this is a post-fire
 13 photograph of a compressor relay; is that right?
 14 **A. Yes. So this is not one of my photos, but this is the**
 15 **compressor.**
 16 Q. If I can stop you there, hopefully that also shows
 17 exhibit 6B; is that right?
 18 **A. On this front, as we're visualising here, if you looked**
 19 **at the rear of the refrigerator, it would be on the**
 20 **left, but we're facing the compressor relay compartment.**
 21 **The plastic enclosure is now missing, it's been consumed**
 22 **in the fire, and what you are looking at are -- up here**
 23 **I believe is the Klixon relay, up here, and down here is**
 24 **the PTC (Indicates), it's hard to see, and there are**
 25 **a number of wires with connectors on them. One of them**

Page 112

1 is JDG/6B, as well as JDG/6A and 6C, and all of those
 2 wires came from this area, which was exhibit BPS/4, the
 3 compressor from the fridge freezer fridge in flat 16.
 4 Q. Thank you.
 5 Just to flow from that, are you able to confirm that
 6 you examined all the wires that are illustrated in this
 7 photograph?
 8 **A. Okay, now, I never saw this as it is in this photo.**
 9 **This was then disassembled during laboratory**
 10 **investigations that I was not present at, and certain**
 11 **items were put into certain evidence bags, zip-locked**
 12 **bags, and labelled with different components. So I was**
 13 **looking at various components that were taken from this**
 14 **compressor relay compartment.**
 15 **Were they all there? I looked at everything that**
 16 **was shown to me, and I carefully examined everything**
 17 **that was presented to me. Can I say that there's**
 18 **something here that I didn't look at? I can't say that.**
 19 Q. I suppose the next question is: did you find any arc
 20 damage on the wires that you believe to have come from
 21 the compressor relay?
 22 **A. No, there was no arc damage. The only arc damage was**
 23 **MJS/1 and JDG/1.**
 24 Q. Can I ask Paul to put away that photograph and return to
 25 your addendum, Dr Glover, and could I ask you to turn to

Page 113

1 page 5 of that addendum.
 2 If we now turn to some specific questions regarding
 3 the various exhibits illustrated there in figure 1.
 4 First question is this: were 6A and 6C and the
 5 longest wire from 6F from the run capacitor as they're
 6 all 24 strand conductors?
 7 **A. Short answer to that is yes. If you look at JDG/6A in**
 8 **the lower right corner, that's a connector, and the CT**
 9 **scans that show that there were 24 strands of the wire**
 10 **within JDG/6A. Moving to the centre, JDG/6C is another**
 11 **connector with a wire in it, and the CT scans show there**
 12 **were 24 strands associated with that connector and wire.**
 13 **And then there is a third wire up here, JDG/6F,**
 14 **I believe it's this one (Indicates), one of the other**
 15 **wires that did not have a connector associated with it,**
 16 **it was just a wire segment, also had 24 strands.**
 17 **By process of elimination, I concluded that those**
 18 **were basically run capacitor wires.**
 19 Q. Would those wires have been contained within the
 20 compressor relay compartment?
 21 **A. In my opinion, yes. JDG/6C and A are definitely right**
 22 **in the compressor relay compartment, and of course**
 23 **they're wire segments now. I would associate this**
 24 **24-strand wire over here with this connector (Indicates)**
 25 **because it's simply -- there's nothing left. So there**

Page 114

1 **had to be a wire here. It's most likely it was this F,**
 2 **which also has 24 strands.**
 3 **This JDG/6C has a connector but also has a wire with**
 4 **24 strands.**
 5 **So I would put these definitely right within the**
 6 **compressor relay compartment.**
 7 Q. Tying this together with MJS/1 and previous answers,
 8 you've confirmed that the length of MJS/1 was
 9 10 centimetres, or approximately thereabouts.
 10 Do you think or have you concluded that MJS/1 was
 11 located within the compressor relay compartment?
 12 **A. I have concluded that it is most likely, it is probable,**
 13 **that the fused area of MJS/1 was located in the**
 14 **compressor relay compartment. To the left of that fused**
 15 **area are 7, 8, 9 centimetres that most likely projected**
 16 **out of the relay compartment and were headed toward the**
 17 **run capacitor.**
 18 Q. Would it help if we went back to look at some photos of
 19 MJS/1?
 20 **A. Yes.**
 21 Q. Paul, could you go back to JDGR0000006_0002.
 22 If we could amplify I think the top figure,
 23 Dr Glover, is probably the most helpful; is that right?
 24 **A. I would take the bottom figure, simply because there is**
 25 **a scale on there.**

Page 115

1 Q. Okay, if we could amplify the bottom one, Paul.
 2 Dr Glover, can you confirm for us the fuse section?
 3 I think you were saying -- correct me if I'm wrong --
 4 the fuse section was contained, you think, within the
 5 relay?
 6 **A. Yes, here is the fuse section about 1.5 centimetres from**
 7 **this end of MJS/1 (Indicates). In my opinion, that was**
 8 **located within the compressor relay compartment of the**
 9 **fridge freezer.**
 10 Q. And the rest extruded.
 11 **A. At some point this would have exited the compressor**
 12 **relay compartment and continued on to the run capacitor,**
 13 **which is further over to the left at the lower rear of**
 14 **the fridge freezer.**
 15 Q. Paul, take away that photo and return to the addendum,
 16 and figure 1, at page 5.
 17 **A. May I ask a question: is it possible to have a split**
 18 **screen and show both of those figures at the same time?**
 19 Q. It is, he says optimistically!
 20 (Pause)
 21 **A. Thank you.**
 22 Q. Thank you, Paul.
 23 Given the analysis you've carried out, Paul, if
 24 I could ask you to amplify -- thank you -- figure 1 on
 25 the left-hand side, are you able to say whether MJS/1 is

Page 116

1 the continuation of the capacitor wires 6C and 6F?
 2 **A. Basically, yes.**
 3 Q. Can you help us why you can say that, or why you think
 4 you can say that?
 5 **A. So, 6C and 6A, these are connectors, these are the crimp**
 6 **connectors. Those will plug in within the relay**
 7 **compressor compartment. These connectors had to be**
 8 **within the compressor relay compartment. That's to**
 9 **start.**
 10 Q. The next question, therefore, is which end of MJS/1,
 11 illustrated in the right-hand box, would've been closer
 12 to the broken wires 6C and 6F?
 13 **A. Okay, so here's my analysis. Let's take 6C. This is**
 14 **within the relay compartment. Here is the wire**
 15 **(Indicates), it's about 7 centimetres, if you look at**
 16 **this scale, about 7 centimetres of wire. That would've**
 17 **been connected, in my opinion, to the right end, which**
 18 **itself is 1.5 centimetres from the fused area of MJS/1.**
 19 **So here is 6C (Indicates), this wire would connect**
 20 **to one of these wires, and here is 6A, which connects to**
 21 **this wire (Indicates), also with 24 strands, which then**
 22 **connects to the other wire on the right end of MJS/1.**
 23 Q. Understood.
 24 **A. So what you end up with is about 7 centimetres here,**
 25 **another 1.5 centimetres here, 8.5 centimetres, that's**

Page 117

1 **about 3.2 inches.**
 2 **3 inches of wire in my opinion would fit quite**
 3 **comfortably within the compressor relay compartment.**
 4 MR KINNIER: Dr Glover, thank you.
 5 Sir, that is a very convenient point at which to
 6 break.
 7 SIR MARTIN MOORE-BICK: Yes. All right. And you seem to be
 8 getting on quite rapidly.
 9 MR KINNIER: We are. Not much further to go.
 10 SIR MARTIN MOORE-BICK: Right, Dr Glover, we'll stop at that
 11 point so we can all have some lunch. There will be some
 12 more questions when we come back.
 13 THE WITNESS: Thank you, sir.
 14 SIR MARTIN MOORE-BICK: I'm going to ask you not to talk
 15 about your evidence over the break, and if you would
 16 like to go with the usher, we'll start again at
 17 2 o'clock. All right?
 18 THE WITNESS: Thank you, sir.
 19 SIR MARTIN MOORE-BICK: Thank you very much.
 20 Good, 2 o'clock, please. Thank you.
 21 (1.00 pm)
 22 (The short adjournment)
 23 (2.00 pm)
 24 SIR MARTIN MOORE-BICK: Do sit down, Dr Glover.
 25 Yes, Mr Kinnier.

Page 118

1 MR KINNIER: Thank you, sir.
 2 Dr Glover, thank you very much for coming back.
 3 We were discussing wire MJS/1 before the break. Can
 4 we return to that and, in particular, refer to a photo
 5 MET00009077.
 6 Can you just confirm for us what this photograph
 7 shows?
 8 **A. This is the remains of the compressor from the fridge**
 9 **freezer in flat 16. On the front view, this would**
 10 **actually be the left side of the compressor if you were**
 11 **behind the fridge looking at it. You're looking at the**
 12 **compressor relay compartment, the remains of it and the**
 13 **components within it.**
 14 Q. As we're looking at it, is the wire on the left 6C?
 15 **A. I cannot answer that. Again, I was not present when the**
 16 **compressor components were still affixed to the**
 17 **compressor, I only saw them in separate bags, so**
 18 **I cannot tell you which is 6B or 6C. I don't have**
 19 **a scale to measure things there.**
 20 **So I could try to do an analysis in the future, but**
 21 **I cannot identify which is 6B, which is 6C or --**
 22 Q. Understood.
 23 If the one on the left is 6C for the purposes of
 24 a hypothesis, would the arc-damaged part of MJS/1 need
 25 to be located at the end of 6C?

Page 119

1 It's a hypothetical question, given your previous
 2 answer.
 3 **A. Well, 6C is approximately 7 centimetres in length,**
 4 **and -- could you repeat that question?**
 5 Q. Yes, of course.
 6 On the hypothesis that the wire on the left is 6C --
 7 **A. Okay.**
 8 Q. -- would the arc-damaged part of MJS/1 be located after
 9 the end of 6C?
 10 **A. Yes, it would.**
 11 Q. Can I ask you to turn back to your addendum and
 12 figure 7, which is at page 13.
 13 The path of the short circuit is illustrated with
 14 the red zigzag in the bottom right-hand corner, I think;
 15 is that right?
 16 **A. Yes, sir.**
 17 Q. Are the wires that participate in the short circuit that
 18 you say was caused by the overheated crimp located
 19 inside the compressor relay or not?
 20 **A. Yes.**
 21 Q. Yes.
 22 **A. They were located inside the compressor relay**
 23 **compartment, yes.**
 24 Q. Looking at figure 7 itself, where would you place MJS/1?
 25 **A. Considering the number of wire strands in MJS/1, 24**

Page 120

1 strands per wire, okay, which is consistent with the run
 2 capacitor wires, here you have the run capacitor, okay?
 3 Here is one run capacitor wire here, another one here
 4 (Indicates).
 5 Now, these look like short sections to you.
 6 Remember that the run capacitor is not within the relay
 7 compartment. It's over here (Indicates), okay?
 8 Q. Yes.
 9 A. So you pull this run capacitor out and bring these two
 10 wires -- here is one, here is two, both of which -- and
 11 here's a continuation of it (Indicates) -- bring these
 12 two wires out and then bring them into the compressor
 13 compartment then hook them up to these two locations.
 14 Does that explain it?
 15 Q. To an extent. Apologies, this may be me, but you have
 16 the path of the short circuit shown by the means of the
 17 zigzag on the left-hand side.
 18 A. Yes.
 19 Q. If you place MJS/1 in or near the run capacitor, which
 20 is what I understood you were saying --
 21 A. Yes.
 22 Q. -- why is the path of the short circuit not near the run
 23 capacitor?
 24 A. Well, again, this is just a circuit diagram. These two
 25 wires, the run capacitor wires, extend out. So even

Page 121

1 though I'm showing the short circuit here, if I could
 2 run this over here (Indicates) -- I'm just trying to
 3 illustrate here a short circuit that bypasses the Klixon
 4 overload relay in the compressor itself.
 5 Now, again, these two wires for the run capacitor
 6 are running out of the relay compartment. So if you
 7 wanted to, I could bring this over here (Indicates),
 8 okay? And you get the same effect.
 9 Q. I understand.
 10 Could I now deal with the fire initiation scenario
 11 itself.
 12 Looking at the mechanism of overheating, what
 13 testing have you done to ascertain the electric current
 14 that flows through 6B when the fridge freezer is running
 15 normally?
 16 A. That would be the compressor load.
 17 Now, we'll start with the power supply cord for the
 18 fridge freezer. It has a 13-ampere fuse on it. So
 19 we're talking about a normal load current for the entire
 20 fridge freezer of, let's say, 10 amperes, just to give
 21 you a rough number approximately.
 22 When the compressor is on, I would estimate that --
 23 and it's my estimate -- in the range of 5 to 10 amperes
 24 for the compressor load current, under normal
 25 conditions.

Page 122

1 When it starts up, it's much higher. A compressor
 2 motor, when it starts, could be five or six times that.
 3 But after it gets into the normal running current,
 4 I would estimate the compressor load current in the
 5 range of 5 to 10 amperes.
 6 Q. Were you able to measure the post-fire electrical
 7 resistance of the connection within 6B?
 8 A. No, I did not do that.
 9 Q. Would that be possible?
 10 A. Well, you could certainly allow a device, an electronic
 11 meter, to try and measure resistance, but how meaningful
 12 that would be, I would question. You have a connector
 13 that has gone through a fire. It's heavily fire
 14 damaged, and then after the fire it was exposed to
 15 moisture and the possibility of additional corrosion,
 16 rust. So in my opinion, that would be -- it certainly
 17 could be tried, but I wouldn't find that too meaningful
 18 of a measurement.
 19 Q. Thank you.
 20 Turning now to the wire crimp, just understanding
 21 its basic design.
 22 Does it include internal serrations?
 23 A. On the barrel of the crimp?
 24 Q. Yes.
 25 A. I wouldn't call them serrations; I'd call them ribs,

Page 123

1 perhaps.
 2 Q. These are used to clamp the wire strands together in the
 3 electrical connector, just to understand?
 4 A. Excuse me?
 5 Q. The basic crimp design has serrations; is that right?
 6 A. Yes.
 7 Q. The purpose of those serrations is to clamp the wire
 8 strands together in the connector?
 9 A. Yes, and clamp them to the wire barrel itself.
 10 Q. Looking at 6A and 6B, are they two different crimp
 11 designs?
 12 SIR MARTIN MOORE-BICK: Do you think we should see them?
 13 MR KINNIER: Yes. Having said that, I am now trying to
 14 remember what the reference would be. It may well be
 15 that you don't need it just to deal with 6A and 6B.
 16 A. The only difference -- 6B, as I mentioned, has 14 plus
 17 23, that's 37 wire strands in it. 6A has 24 strands.
 18 So whether they're the identical connectors, I can't
 19 answer that. They look very similar in design, but they
 20 may have different model numbers in order to accommodate
 21 different size wire strands.
 22 But they are similar in design.
 23 Q. If we go back in your addendum at page 6, does this
 24 provide any help -- it may not, actually -- to
 25 illustrate the point you've made?

Page 124

<p>1 A. Again, they look very similar. However, I would have to 2 do a dimensional analysis, perhaps even look -- I don't 3 know if you could find some model numbers on the remains 4 of these crimps. They're very, very similar, but 5 I can't say they're of the identical model. 6 Q. Staying with this page, and looking in particular at 7 figure 2, the top suite of pictures, is it fair to say 8 there are multiple points where the wires in 6B are 9 tightly clamped, just looking at what we see in those 10 cross-sectional slices there? 11 A. Okay, so we're looking within the wire barrel itself. 12 Q. Yes. 13 A. And now we have to look at cross-sections. 14 Q. Yes. 15 A. And that's where we're looking about the clamping. 16 My opinion, looking at the shape of the connector 17 not projecting -- not the curved portion of the barrel 18 projecting inwards, also looking at this space 19 (Indicates) which is wide over here and then narrows 20 down -- 21 Q. Stopping there, the space you're referring to there, the 22 space referred to earlier on, the space between the two 23 wire barrels illustrated at the top of figure 2. 24 A. Yes. Yes, so I don't consider this a tight connection. 25 Now, what was your question exactly?</p> <p style="text-align: center;">Page 125</p>	<p>1 However, I would say that the slices that have large 2 voids, such as the centre one, are likely correlated 3 with the ribs. 4 Q. To some extent, can we draw any reassurance from the 5 fact if we're looking at the centre cross-sectional 6 slice, there's a green line, an arrow immediately above 7 it, if we follow the line up, does that reach a rib in 8 the lowest wire barrel? 9 A. It does. Now, I have to be careful here. I selected 10 a cross-section more or less in the middle of the wire 11 barrel, and then I drew a line from what I considered to 12 be the middle of the wire barrel down to this. I can't 13 say that that is aligned with a rib. 14 So even though I'm showing it like that, I did not 15 specifically say: yes, this came from that rib. 16 This cross-section came from more or less the centre 17 of the barrel, this cross-section came from the left 18 end, this cross-section came from the right end 19 (Indicates). 20 So when I drew this, I was not thinking of ribs; 21 I was just picking five cross-sections that would 22 broadly scan the entire length of the barrel. 23 Q. Understood. 24 Can I turn to the hypothesis on the initial fire 25 spread insofar as it concerned MJS/1.</p> <p style="text-align: center;">Page 127</p>
<p>1 Q. Well, the question is really: are there multiple points 2 illustrated by these cross-sectional slides where the 3 wires are tightly clamped? Is that a proposition you 4 would accept or not? 5 A. I would not use the words "tightly clamped". There are 6 locations where wire strands are in contact with each 7 other, and there are other locations where there are 8 void spaces. I would not consider this a tight clamp. 9 I would not consider any of these a tight clamp because 10 of the lack of the curvature portion of this barrel 11 projecting more into the strands, which you can compare 12 with the lower figure for 3A. 13 Q. Going back to the top of figure 2, looking at the wire 14 barrel itself, there appear to be, looking at the top 15 wire, two or possibly three ribs. Is that a correct 16 reading of that? 17 A. There are rib sections, yes. 18 Q. Are you able to say whether there is a correlation 19 between the location of the ribs and the location of the 20 voids illustrated in the cross-sectional slices below? 21 A. Well, considering that there are 80, 8-0, slices here 22 that the CT scan gave us, and there are voids in every 23 slice, you are going to have some slices in between 24 ribs, some slices under ribs, both of which have voids. 25 So I'd say there's no correlation there.</p> <p style="text-align: center;">Page 126</p>	<p>1 Is it a correct assumption that the scenario you've 2 set out in the addendum report is based upon the fire 3 starting within the relay compartment? 4 A. Of the fridge freezer, yes. 5 Q. If MJS/1 was located outside the relay compressor, how 6 did overheating in JDG/6B cause arcing on MJS/1? 7 A. Did you say the fused section of MJS/1 is located 8 outside the relay compartment? 9 Q. No, simply if MJS/1 was located -- I put it more 10 generally than that. 11 A. The important part is the fused section of MJS/1. 12 Again, I have concluded that MJS/1 was associated 13 with this fridge freezer and ran into the relay 14 compartment, but a certain part of that 10 centimetres 15 must have projected outside of the relay compartment, 16 heading towards the run capacitor. 17 Q. Can you help us with how the fire would have travelled 18 from within to without the compartment? 19 A. Before the short circuit or after -- 20 Q. Yes, before, first of all. 21 A. So you're placing -- I just want to get your premise. 22 You're assuming that the fused section is outside of the 23 relay compartment. 24 Q. If we assume it's within. 25 A. Well, then, the fire doesn't need to travel outside.</p> <p style="text-align: center;">Page 128</p>

1 **The fused section is within the relay compartment, and**
 2 **that's my opinion, that's my conclusion, and the line to**
 3 **neutral short circuit that gives you the arc damage to**
 4 **MJS offence is all within the relay compartment.**
 5 Q. In relation to the scenario you've postulated in the
 6 addendum report, are you able to identify which two
 7 wires touched each other in the short circuit that
 8 you've set out, illustrated in figure 7?
 9 **A. One of them had to be an energised wire. That would be**
 10 **JDG/6B or an extension – remember, we only have about**
 11 **7 centimetres of it and then it ends. So you think of**
 12 **the end of that 6B bridging across the run capacitor**
 13 **wires and causing a line to neutral short circuit.**
 14 Q. This may follow from a question I asked before lunch,
 15 but are you able to assist us with what you think came
 16 first: was it the short circuit or the overheating
 17 connector?
 18 **A. The overheating connector, in my opinion, was the first**
 19 **event that started burning the insulation on the wires**
 20 **that led to a short circuit.**
 21 Q. If that's so, would the full path of the current through
 22 that connector during normal operations operate at
 23 a maximum of 0.4 amps or thereabouts?
 24 **A. 0.4 amperes?**
 25 Q. Yes.

Page 129

1 **A. I don't know where you got that number. Maybe I don't**
 2 **understand the question. Repeat that.**
 3 Q. Yes, of course.
 4 If you say, which you do, that the overheating
 5 connector came first, do you accept that the full path
 6 of the current through that connector during normal
 7 operations would be at a maximum of 0.4 amps?
 8 **A. No.**
 9 Q. Can you give a reason why you don't accept that?
 10 **A. Well, we need to know what the compressor load is, and**
 11 **I have not calculated that, but I am assuming that it's**
 12 **more than that.**
 13 Q. Okay.
 14 Would you agree with the proposition that there were
 15 additional wires in the exemplar compressor relay
 16 compartment that you reviewed compared to the flat 16
 17 fridge freezer? By way of example, do you agree there
 18 was a jumper relay system in the exemplar but not in the
 19 flat 16 fridge freezer?
 20 **A. Okay, I think I understand your question, but if you**
 21 **could repeat that one more time.**
 22 Q. Of course.
 23 Do you agree with the proposition that there were
 24 additional wires in the exemplar compressor relay
 25 compartment compared to the flat 16 fridge freezer? By

Page 130

1 way of example, there was a jumper relay system in the
 2 exemplar but not in the flat 16 fridge freezer.
 3 **A. Yes, that's a possibility. The exemplar exact design**
 4 **and manufacture may have some differences, including, as**
 5 **you say, I observed some small jumper wires – it's in**
 6 **one of my figures in the report – within the relay**
 7 **compartment of the exemplar fridge freezer which may not**
 8 **be associated – they may not have those jumper wires**
 9 **within the subject fridge freezer.**
 10 Q. Would that difference have any material impact on the
 11 reasoning you set out in your addendum on the
 12 hypothetical fire initiation scenario?
 13 **A. No.**
 14 Q. Can you help us why not?
 15 **A. Because I am associating the short circuit with 6B, that**
 16 **has 23 strands and 14 strands in it, and that would've**
 17 **been energised when the compressor is on, and that's**
 18 **where the overheating crimp is, and that is what would**
 19 **have arced to the run capacitor wires.**
 20 Q. Are you able to say whether the length of the wires in
 21 the flat 16 fridge freezer were longer or shorter than
 22 the wiring in the exemplar?
 23 **A. We have to take the wires one at a time.**
 24 **Let's talk about the run capacitor wires. The run**
 25 **capacitor is not within the relay compartment. If**

Page 131

1 **you're behind the refrigerator, it's over to the left.**
 2 **The run capacitor, as I understand it, would be**
 3 **a separate component, not necessarily supplied by the**
 4 **compressor manufacturer. That would be what the company**
 5 **that manufactured the fridge freezer would be connecting**
 6 **within the relay compartment.**
 7 **I would assume that the run capacitor wires would be**
 8 **similar for an exemplar, whether it be an Embraco or**
 9 **Tecumseh.**
 10 Q. If they were shorter, for example, in the flat 16 fridge
 11 freezer, would that have any material impact on the
 12 reasoning you set out in the addendum?
 13 **A. No, but, again, they can't be shorter. They have to –**
 14 **I know where the run capacitor is, on the left end of**
 15 **the mounting plate for the compressor, it's off to the**
 16 **left if you're behind, and then these wires run from the**
 17 **run capacitor to the relay compartment. They have to be**
 18 **a similar length, whether it be a Tecumseh or an**
 19 **Embraco.**
 20 Q. Dr Glover, thank you. I now come on to my final topic,
 21 which I'll deal with briefly.
 22 Given your experience of electrical fires in the
 23 United States, can you help us with what protective
 24 measures are fixed at the back of domestic fridges so as
 25 to contain fire?

Page 132

1 **A. Yes. This is an area that I did not address in my**
 2 **report, but the one difference that I have seen is that**
 3 **in the United States, the back casing, the rear casing,**
 4 **of refrigerators are required by Underwriters Laboratory**
 5 **Standards to be manufactured of a metallic -- steel,**
 6 **let's say steel, not plastic, whereas here in the UK,**
 7 **and I think in Europe also, you are allowed to**
 8 **manufacture refrigerators with a back casing that is**
 9 **plastic.**

10 Q. Are you able, on the basis of your experience, to give
 11 us any assistance as to how effective the metal casing
 12 is in America to containing fires that start within
 13 a fridge?

14 **A. Just in a general view, again, you're starting to get**
 15 **outside of my area of expertise. I'm an electrical guy.**
 16 **But you can imagine a fire starting within**
 17 **a refrigerator, and with a steel backing -- now, that**
 18 **backing does not span the entire length of the**
 19 **refrigerator. There is an open space down below where**
 20 **the compressor is located, but that steel backing would**
 21 **help to contain an internal fire, keep it within the**
 22 **refrigerator for a longer time, and you have less**
 23 **combustible now. Instead of a plastic casing on the**
 24 **rear which is combustible contributing to the fire, you**
 25 **have a steel casing that is not, but that's just in**

Page 133

1 **layman's terms, again, because I'm not a cause and**
 2 **origin person.**

3 MR KINNIER: Dr Glover, I'm grateful for your assistance.
 4 Sir, may I ask for the usual 5 minutes or so just to
 5 see if there are any points which I ought to have
 6 covered?

7 SIR MARTIN MOORE-BICK: Yes.
 8 Well, we usually have a little break at this point.
 9 Counsel thinks he has run out of ammunition, but he
 10 needs to check that that's the case.
 11 We'll have just over a 5-minute break, and please
 12 don't talk to anyone, of course, about your evidence
 13 while you're out of the room.
 14 If you would like to go with the usher, we'll come
 15 back at 2.35.

16 THE WITNESS: Thank you, sir.
 17 SIR MARTIN MOORE-BICK: Thank you very much.
 18 Right, 2.35, please.
 19 MR KINNIER: Thank you, sir.
 20 (2.25 pm)
 21 (A short break)
 22 (2.35 pm)
 23 SIR MARTIN MOORE-BICK: Well, I haven't asked Mr Kinnier
 24 whether he has any more questions, but I would be
 25 surprised if he didn't have one or two, so shall we just

Page 134

1 see?
 2 Yes, Mr Kinnier.

3 MR KINNIER: Well, sir, there are two unique events which
 4 have happened today: one, we have finished before 5.00,
 5 and the second unique event is that there are no
 6 supplemental questions.

7 SIR MARTIN MOORE-BICK: No supplemental questions! That
 8 must be a first!

9 MR KINNIER: So it leaves me to simply say, Dr Glover, thank
 10 you very much for attending today to give evidence. It
 11 has been very helpful indeed.

12 SIR MARTIN MOORE-BICK: Dr Glover, can I thank you, please,
 13 on behalf of the inquiry as a whole. I found your
 14 evidence really interesting and very useful, and, if
 15 I may say so, very clearly put.
 16 Thank you for giving us the benefit of your
 17 expertise. We're very grateful to you.

18 THE WITNESS: My pleasure, sir.
 19 SIR MARTIN MOORE-BICK: Thank you very much indeed.
 20 So that's it. If you would like to go with the
 21 usher, she'll look after you.
 22 (The witness withdrew)

23 MR KINNIER: Sir, there are two final points before we rise
 24 today, the first one of which is to thank Mr Penfold,
 25 who has been the documents director for a significant

Page 135

1 chunk of the inquiry. This is his last day assisting
 2 today.
 3 If I may on behalf of the entire CTI team pass on
 4 our thanks to him. His patience has been exemplary,
 5 I think.

6 SIR MARTIN MOORE-BICK: I think we all owe him a great debt
 7 of gratitude. Thank you very much indeed.

8 MR PENFOLD: Thank you.

9 MR KINNIER: Sir, the final matter is that concludes the
 10 evidence today and we have Professor Nic Daeid at
 11 10 o'clock tomorrow.

12 SIR MARTIN MOORE-BICK: Good, thank you very much.
 13 Well, we all get an early afternoon, but I'm sure
 14 you can make good use of it. We'll break now and resume
 15 at 10 o'clock tomorrow with our next witness.
 16 Good. Thank you very much.
 17 (2.40 pm)
 18 (The hearing adjourned until Wednesday, 28 November 2018
 19 at 10.00 am)

I N D E X

22 DR J DUNCAN GLOVER (sworn)1
 Questions by MR KINNIER1

23
 24
 25

Page 136

A	102:5,8 103:19,21 104:8,8 105:2 106:21,23 113:25 114:1 116:15 120:11 124:23 128:2 129:6 131:11 132:12	American 110:22 110:23 Amherst 3:14 ammunition 134:9 amount 90:21 91:25 100:17 101:7,12 ampere 67:12 amperes 67:25 89:7 90:21 91:22 96:13 122:20,23 123:5 129:24 amplified 49:25 amplifies 17:8 amplify 16:6 30:9 30:21 45:16 51:17 59:1 72:25 77:18 100:3 110:1 115:22 116:1,24 amps 67:13 129:23 130:7 analyses 5:1 43:1 analysis 4:8 13:14 22:20 34:11,24 37:19 40:24 41:14 44:14 61:25 62:3 66:16 67:21 71:4 72:18 84:15 92:21 100:17 104:6 116:23 117:13 119:20 125:2 annotated 84:2 94:13,16 answer 92:6 101:5 114:7 119:15 120:2 124:19 answers 115:7 apartment 20:2 99:20 101:14 apologies 24:8 44:22 51:15 61:4 78:16 87:3,12 88:16 103:5 106:21 107:14 110:2 121:15	appear 81:1 82:19 126:14 appeared 100:11 appears 18:11,15 20:21 80:19 81:13 93:20 appendices 13:9 appendix 3:2 appliance 8:14 19:7 19:12 37:22 47:11 55:14 appliances 13:1 19:9 34:20 35:17 37:20 44:14 75:17 92:16 application 79:22 applied 71:17 79:21 111:10 apply 111:13 appreciate 87:16 approximate 52:19 52:23 approximately 23:12,24 24:2,17 24:18,21 25:16 27:2 57:15 66:7 79:11,13 115:9 120:3 122:21 April 27:18 52:15 104:11 arc 6:10,14,18 7:15 9:5,15,21 10:19 10:23,24,25 11:1 11:7 12:2,9,19,23 13:24,24 14:3,6 14:13,14,19 15:1 15:4,7,7,18,25 17:20,25 18:2 20:22 21:5,13,17 21:18,20,25 22:18 22:24 23:1,2,19 25:22 31:10 40:11 47:3 48:5,9 49:5 52:25 53:23 56:25 57:2 59:18 65:25	66:20 69:11 70:10 70:12 90:22 91:13 93:1,6,16 94:12 105:21 107:16,19 108:16,17,25 109:1,2 113:19,22 113:22 129:3 arc-damage 51:2 54:4 arc-damaged 15:15 27:25 41:18 42:9 46:6 48:9 52:1,17 57:4 59:21 64:15 65:7 70:1 92:24 104:1,10 105:3,9 106:5,9,18 108:7 108:20 119:24 120:8 arced 15:5 53:25 55:8 66:10,22 67:1 106:25 107:4 107:15 131:19 arcing 12:17 32:13 32:25 36:25 37:11 54:24 93:8 103:7 103:12 128:6 area 4:15,23 5:6,12 10:1,16,19,22 11:1 12:5,23 13:20 14:11 17:21 19:13 23:16,22 24:5,22 25:1,3 27:20,23 34:13 36:21 55:1 58:5 70:19 71:2 77:21 78:2 83:25 84:6 85:3 101:20 113:2 115:13,15 117:18 133:1,15 arisen 35:20 36:11 arrow 127:6 artefact 17:12 artifact 11:12 artwork 94:14 ascertain 122:13
A1-1 28:15,16 A1-3 30:5 A1-4 30:9 A2 25:7 A4-1 56:1 A4-3 57:17 A4-8 55:18 able 36:13 37:4,5 40:1 41:21 73:15 87:12 89:18 97:11 97:20 101:6,10,11 101:19 105:1 113:5 116:25 123:6 126:18 129:6,15 131:20 133:10 abnormal 7:10,21 9:14 12:18 20:21 21:6,14,16,22 22:1 36:7 39:21 40:11 48:6 59:18 64:6 69:11 70:12 108:10 absence 42:18,25 48:17 accept 51:25 97:4 126:4 130:5,9 accommodate 124:20 accompanied 84:12 acknowledge 98:8 activity 7:10 9:14 20:21 21:6,14,16 22:1 39:22 40:11 48:6 59:19 64:6 69:11 70:13 actual 43:9 111:24 addendum 2:2,11 2:15,20 4:14 5:6 55:7 71:25 72:2 72:13,18,21,22 77:6,9,14 83:19 88:2,17 94:2 97:24 100:19	addition 3:18 15:2 18:18 22:8 additional 17:1 86:5 123:15 130:15,24 address 133:1 adjacent 35:6 48:22 adjourned 136:18 adjournment 118:22 advance 77:10 adverted 15:17 24:15 65:21 76:23 97:25 advertising 44:17 Afeworki 47:25 50:19 53:3 99:17 affixed 24:5 76:1 76:10 78:15 119:16 afternoon 136:13 ago 53:10 55:5 agree 6:25 98:9 130:14,17,23 aim 36:2 air 9:7 12:20 84:22 84:22,23 99:1 ajar 100:25 alarmed 58:11 aligned 127:13 allow 35:11 123:10 allowed 133:7 alongside 78:5 alternative 34:24 alternatively 36:4 aluminium 9:10 America 133:12			

asked 108:12 110:3 129:14 134:23	135:10	basic 6:25 7:16,19 9:16 23:5 25:5 35:24 42:14 60:24 62:6 72:15,20 76:7 106:3 107:11 123:21 124:5	bit 22:11 77:17 79:25 87:20	49:11,15
asking 24:8 60:24 103:5	automatically 20:8 20:14 31:1	basically 23:11 65:13,16 69:19 74:17 78:9 79:19 82:9 86:15 87:6 107:5 114:18 117:2	blistering 16:4,10 16:20,23,25	break 43:15,19 44:5 87:13,16 109:11 118:6,15 119:3 134:8,11,21 136:14
aspects 1:7	avoidance 2:5	basics 20:18	blow 8:4 41:7 67:15 77:17 79:24 92:3 92:14,16 94:11 107:13	breaker 8:3,4 19:22 20:8,13,15 29:2,5,11,12,13 29:14 30:11,22 31:7,16 32:15,16 33:8 34:15 35:25 36:6,22 37:2,6,8 37:13 40:16,21 41:8,12 45:21,24 46:2,3 57:25 59:14,15 66:25 67:19,22 68:5 70:21 89:8 92:1,4 92:7,17,19 96:11 103:16 106:6 107:20 108:11
assess 4:14	awaken 58:10	basis 18:11 133:10	blowing 67:20	breakers 19:2,18 28:8,23 29:1 30:24,25 31:9,18 31:25 32:3,6,9,20 34:12,19,25 35:2 35:20,23 36:12,15 37:9 41:6 46:1 59:9,11,13 94:25
assessment 2:1,6,10 2:15,19 5:17,22 6:9,21 9:19 21:2 23:10 25:10 108:15	awarded 3:18	bead 11:17,19 15:12,15 25:20,21 25:22	blown 19:7,10 40:20 41:11,13 49:16 51:6 54:12 67:7 68:3 105:7	bridging 129:12
assist 101:6,19 109:6 129:15	aware 62:8 100:8 100:13	beading 11:21	blows 92:5,20	brief 10:2 13:21 14:25 43:14
assistance 133:11 134:3	awoken 98:16	beads 14:11,18 15:5,5,7,8 17:4 52:17 108:25,25	blue 94:13 110:8,16 110:21	briefly 132:21
assistant 4:5	B	bear 92:21	blurry 24:3 80:14 81:14	brigade 31:8
assisting 136:1	b 45:6,9 69:23	bedroom 27:17 66:6,10,13,18,22 93:10 98:16,18,18 98:25	board 21:24 22:6 39:7,14,14,17,17 75:5 76:15 89:24 90:3,3	bring 28:9 44:24 49:22 121:9,11,12 122:7
associate 4:2,6 114:23	back 12:15 14:4 17:14 29:17 43:23 44:12 51:15 70:23 80:9,10 88:16 97:17 99:19 104:7 105:2,12 106:3 115:18,21 118:12 119:2 120:11 124:23 126:13 132:24 133:3,8 134:15	bedrooms 24:12	boards 21:23 62:22	brittle 48:17 49:4 49:10
associated 13:10 19:2 38:22 41:19 41:20 42:8,10 46:7 51:5 57:5 59:22 63:17 76:17 84:12 105:22 114:12,15 128:12 131:8	backing 133:17,18 133:20	beginning 16:21	bottom 9:20,22 30:20 50:2 51:19 62:16 73:5,19 78:24 80:9 98:7 115:24 116:1 120:14	brittle/not 48:13
Associates 4:8	bad 55:5 107:9	behalf 135:13 136:3	bought 53:10	broad 5:23,25
associating 131:15	bag 12:18	belief 2:12	bound 45:22	broadly 127:22
Association 3:25 10:6	bags 113:11,12 119:17	believe 15:3 37:14 42:21 67:24 106:13 112:23 113:20 114:14	box 8:14 12:13 19:2 19:5,19,21 20:10 28:17 54:15,19 117:11	
assume 12:2 128:24 132:7	balance 71:17 95:12	benefit 108:14 135:16	BPS/1 63:15,20,22 64:2 65:23,25	
assuming 14:12 86:7 107:24 108:3 128:22 130:11	barrel 78:3,9,11,14 78:15,16,18,20 79:10,10,13 81:2 81:17,22 82:5 83:8,10 86:24 123:23 124:9 125:11,17 126:10 126:14 127:8,11 127:12,17,22	Bermondsey 27:19	BPS/3 27:9 65:9,11 65:12,14,15	
assumption 128:1	barrels 78:5 80:7 84:2 125:23	best 2:11 39:12	BPS/4 27:9 104:4 113:2	
attach 42:24 43:8	base 65:15	better 28:24 29:4 79:25 82:22,25 83:10	BPS/5 69:24	
attached 54:7 73:13,19 74:16	based 34:11 71:20 128:2	beyond 20:22 21:17	bread 47:11,17,23 47:24 48:1,3,6,10 48:12,21,25 49:7	
attacked 96:4,8 98:3		big 16:9 23:21		
attacking 17:24 95:21		Bisby 5:1 19:15		
attending 1:22				

broken 49:5 117:12	105:12 111:11	cellphone 99:20	8:3,9,17,23 9:1	101:19 102:11,25
BS 3:12	114:5,18 115:17	cent 71:20	19:2,18,22 20:7	103:4,11,15,16
bucket 45:5	116:12 117:1	centigrade/Celsius	20:13,15 21:23	106:4,6,6,11
build-up 86:2,8	121:2,2,3,6,9,19	10:21	22:6 28:8,23 29:1	107:20,20,22,23
builds 102:18,19	121:23,25 122:5	centimetre 10:24	29:2,2,4,5,6,9,10	108:8,10 120:13
Bureau 27:19	128:16 129:12	11:3	29:11,12,14,18,21	120:17 121:16,22
52:16 53:6 104:12	131:19,24,25	centimetres 23:12	29:21,23 30:1,10	121:24 122:1,3
burned 70:11 87:1	132:2,7,14,17	24:2,17,18,24	30:11,22,24,25	128:19 129:3,7,13
103:3	capacitors 21:24	25:16 66:8 115:9	31:7,9,11,12,16	129:16,20 131:15
burning 99:2	64:8 90:12	115:15 116:6	31:18,25 32:2,5,9	circuit/over 31:2
129:19	capital 50:2 51:19	117:15,16,18,24	32:10,12,12,15,16	circuits 12:11 20:9
busbar 69:13,16,17	carbonaceous 96:6	117:25,25 120:3	32:16,18,24,24	31:15 33:10 46:4
69:23,24	careful 127:9	128:14 129:11	33:4,4,6,9,11,11	59:12,16,17 95:25
bypasses 91:3	carefully 113:16	central 77:9	33:11,13,13,17,23	clamp 124:2,7,9
122:3	carried 116:23	centre 110:13	33:24,25 34:12,15	126:8,9
	carries 8:25	114:10 127:2,5,16	34:15,19,25 35:2	clamped 125:9
C	carry 44:7 69:19	certain 11:20 34:20	35:8,8,10,15,20	126:3,5
C 87:10	84:19	71:20 77:7 113:10	35:22,25 36:6,8	clamping 125:15
calculated 130:11	carrying 7:23	113:11 128:14	36:12,15,16,17,18	class 20:24
calipers 26:21,25	case 13:11 21:18	certainly 38:20	36:19,21,21,22,25	clear 22:9 41:16
call 1:10 11:1,16	36:10 61:2 91:6	70:10 82:19	37:1,3,6,8,9,11	44:18 96:19 109:2
15:11 17:4,5 19:4	95:8 134:10	100:11,20 123:10	38:7,10 39:14,17	clearly 135:15
28:2,17 29:2,5	cases 92:3,19	123:16	39:23 40:16,16,21	close 14:3,6,6 16:17
74:22 84:19 95:1	casing 133:3,3,8,11	certainty 71:15,19	41:6,8,8,12,12	17:14 22:11 56:2
101:9,13 103:11	133:23,25	71:23	44:19,20,20,21,22	93:15,21 97:3
110:21 123:25,25	casts 5:11	change 82:21	45:12,19,20,21,22	103:1
called 9:12 17:2,3	catastrophic 39:24	changed 61:9	45:23,25 46:1,2,2	close-up 25:13 30:5
22:5 29:13 53:11	categories 38:24	chapter 10:7	46:3,5,7 55:2	closed 12:12,16
60:22 62:19 73:22	cause 7:6 8:3 14:13	characterise 88:10	57:20,21,24,25	99:4 100:6,12,24
78:2 107:7	33:6 37:14 62:1	characteristic	59:7,8,9,10,13,14	100:24 101:3
calling 99:22 111:6	85:19 90:22 92:1	10:15 11:7,10	59:14,15,16 63:17	closer 117:11
calliper 26:22 27:1	94:5,21 97:18	13:7,14,22 14:22	66:13,15,24,25	closest 48:25
calls 76:19	102:25 107:25	15:1 17:19	67:19,19,22 68:4	cloudy 99:11
camera 100:9	128:6 134:1	characteristics	68:5 69:6,9 70:2	clue 31:24 32:2
candle 108:2	caused 7:24 10:3	7:15 9:21 10:12	70:18,21,21 71:3	106:3
capable 7:12,13 9:9	15:7 22:3 32:2	11:6 15:18,18	75:20 87:25 88:6	coil 48:8
capacitor 22:2 39:8	34:15 40:15 57:24	108:16	88:11 89:3,8,8	collected 39:1
39:22,24,25 40:1	70:21 96:15 102:6	charge 61:1	90:9,10,11,13,19	73:11
60:23,23,25 61:1	107:13 108:2	chase 34:4	90:20,25,25 91:3	combustible
61:7,9,10,10,14	120:18	check 134:10	91:7,13,18 92:1,2	133:23,24
61:15,19,21 62:9	causes 103:6	chemical 99:2	92:4,7,17,19,25	combustibles 36:20
63:23 64:21 65:3	causing 7:12,13	chooses 90:4	93:18 94:3,12,14	36:24
65:19,20 90:7,12	103:4 129:13	chunk 136:1	94:16,20,24,25	come 11:20 12:25
90:15 91:5 93:2,3	ceiling 58:17,21	cigarette 108:2	95:2,10,23,24	19:17,20 22:17
93:4,12 104:3	59:5	circuit 7:20,21 8:3	96:2,3,7,11,14,15	23:9 28:7 35:16

38:10 43:23 55:10 76:5 78:22 82:4 89:21 102:2 106:8 111:19 113:20 118:12 132:20 134:14 comes 75:10 76:14 76:16 90:4 comfortable 1:15 87:19 comfortably 118:3 coming 76:3 82:3 94:7 95:8,9,10 99:10 119:2 common 92:15 Commonwealth 3:6 company 42:19 62:19 110:9,9,10 132:4 compare 32:21 67:18 82:14 126:11 compared 42:25 67:20 130:16,25 compartment 64:17,22,25 65:5 72:4 73:12,20,21 73:22,23 74:12,13 74:16,19,20 75:14 76:1 91:1 93:21 102:22 103:2 104:4 111:7,12,24 112:3,20 113:14 114:20,22 115:6 115:11,14,16 116:8,12 117:7,8 117:14 118:3 119:12 120:23 121:7,13 122:6 128:3,8,14,15,18 128:23 129:1,4 130:16,25 131:7 131:25 132:6,17 completely 64:12	completeness 49:14 68:14 component 22:4 34:14 40:19,24 43:3,5,8 51:3 53:24 64:3,5,12 70:20 106:13 132:3 components 5:24 7:1 8:1 21:24,25 22:8 27:10 38:20 39:6,15,20,20 40:3 57:1 62:6 63:16 76:5 112:2 113:12,13 119:13 119:16 composition 24:14 24:19 25:14 76:23 compress 62:14 compressed 74:1,4 compresses 74:6 compression 78:9 79:21 80:4 81:19 compressor 54:14 62:13,16,18,20 63:24,25 64:25 65:4 72:4 73:12 73:13,19,20,22,25 74:3,6,16,18,24 75:3,4,8,10,13,21 76:1,2,19,20 82:1 89:5,10,25 90:1,6 90:14,18 91:1,4 91:23 102:22 110:4,8,12,14,18 110:19,24 111:5,7 111:8,12,24 112:2 112:4,13,15,20 113:3,14,21 114:20,22 115:6 115:11,14 116:8 116:11 117:7,8 118:3 119:8,10,12 119:16,17 120:19 120:22 121:12	122:4,16,22,24 123:1,4 128:5 130:10,15,24 131:17 132:4,15 133:20 comprising 58:21 computer 4:3 77:20 79:5 concept 12:10 concern 64:4,11 83:14 concerned 55:20 73:1 127:25 concerning 50:14 concerns 82:23 conclude 49:11 56:15 71:5 102:4 107:21 concluded 23:1 55:7 65:2 66:9,21 71:9 78:21 104:1 104:24 114:17 115:10,12 128:12 concludes 136:9 concluding 94:20 105:21 107:3 conclusion 22:22 54:22 68:23 72:8 94:8 102:8 129:2 conclusions 31:23 47:21 52:9 63:8 70:15 71:22 102:5 condition 7:21 conditions 122:25 conducted 37:20 conduction 97:19 conductive 96:6,19 conductor 10:1,17 12:6 16:23 84:18 84:22 conductors 15:23 16:2 65:14 84:21 114:6 confirm 1:24 2:9 38:6 51:24 113:5	116:2 119:6 confirmed 71:2 115:8 confirming 1:19 42:16 45:22 59:10 connect 117:19 connected 32:19 33:25 35:15 55:2 56:22 66:24 71:3 76:11 107:22 117:17 connecting 132:5 connection 72:9 77:10 78:8,13 82:1,7,8 86:15 102:17,20 123:7 125:24 connector 72:3,8 76:8,9,11 77:22 77:23,25 78:2,2,7 80:21 81:25,25 82:6 84:1,2,6,8,10 85:5,8,13,16,19 86:14,22,24 104:25 114:8,11 114:12,15,24 115:3 123:12 124:3,8 125:16 129:17,18,22 130:5,6 connectors 6:17 64:24 65:1,2 74:22 75:25 112:8 112:25 117:5,6,7 124:18 connects 81:25 89:24 117:20,22 consequence 14:13 81:20 consequences 9:11 9:12 81:21 85:21 consider 23:23 27:13 28:14 33:19 34:4 63:6 100:20 125:24 126:8,9	consideration 48:18,18 considered 60:3 105:2 107:15 127:11 considering 120:25 126:21 consistency 64:18 consistent 48:10 52:2,24 64:16 65:8 70:2 93:12 104:2 105:11 121:1 consisting 24:16 77:2 consists 25:15 52:16 76:24 consumed 56:5 64:12 112:21 consumer 8:13 12:13,15,22 19:4 19:21 20:2,3,6 28:8,16 35:19 37:15,16 45:21 59:8 69:20 contact 11:25 81:6 81:9 82:5,9 83:25 84:5,12,16 85:3 85:14 86:4 126:6 contacts 36:17 contain 132:25 133:21 contained 114:19 116:4 containing 133:12 context 47:16 72:1 76:3 110:2 contextual 72:16 77:7 continuation 117:1 121:11 continue 87:14 continued 107:10 116:12 contrast 17:20
--	---	---	---	--

32:21 82:14	corner 50:3 51:19	covers 10:6	95:12 96:10,12,21	107:16,17,19
contributing	73:5 110:21 114:8	creates 86:3 103:14	122:13,19,24	108:15,16,17,24
133:24	120:14	creating 9:3	123:3,4 129:21	109:3 113:20,22
control 39:7,9,14	correct 2:8,22 3:8	crimp 72:9 77:10	130:6	113:22 129:3
39:16 62:22 74:23	3:14,17 4:17 5:9	78:13 79:20 80:3	current-carrying	damaged 9:25
75:5 76:15,15	5:18 10:14 17:24	80:4,20 81:18	57:1 69:19	12:20 13:20 14:7
89:24 90:3,3	20:12 22:21,24	82:6,16,18,22,23	currents 29:15	15:23 39:18 47:6
convenient 43:14	30:7,15 42:19	83:1 85:25 86:22	67:24	52:25 123:14
43:16 109:12	45:8 49:17 74:5	102:14 103:9	cursor 27:1	damages 31:10
118:5	78:7 81:4,13	104:25 117:5	curvature 83:10	dated 1:25 2:1,2
Conversely 40:8	110:18 116:3	120:18 123:20,23	126:10	day 48:25 56:6
cook 46:15,18,21	126:15 128:1	124:5,10 131:18	curved 125:17	136:1
cooker 5:8 35:5,6,7	correctly 20:1	crimped 78:7 79:21	cut 36:4	days 24:13 27:17
35:9,13 44:16,18	45:11	crimping 83:20	cutting 34:4	de-amplify 16:6
44:20,23 45:9,19	correlated 127:2	crimps 125:4	cycle 62:15	50:10 52:6 100:3
45:19,20,24 46:4	correlation 126:18	cross-section 14:24	Cyfan 42:20	de-energise 36:18
46:7,25 47:4,4,5,7	126:25	15:8,13 127:10,16	Cyfan/Cyfan-C	37:2
cooking 46:15,16	corresponding	127:17,18	42:16	de-energised 20:7
46:20,21	12:5,23	cross-sectional		33:10,12 95:25
cooling 74:7 75:6	corridor 98:10,16	78:25 79:7,16	D	de-energising
copper 9:10 10:1	98:19 99:4,6,9	125:10 126:2,20	D 3:2 136:21	36:22
10:17 11:15,16,17	100:1	127:5	Daoid 5:1 19:15	deal 47:12 49:21
11:19,21 13:12,13	corrosion 123:15	cross-sectioned	136:10	58:18 92:11
13:19,25 14:1,2,6	could've 46:15	15:6	damage 1:25 2:6,10	122:10 124:15
14:8,17 15:5,11	67:14 100:17	cross-sections 79:4	2:15,19 5:17,21	132:21
15:13,23 16:1,3	105:17 106:10	80:16 125:13	6:9,11,14,19,21	dealing 72:15 76:7
16:19,21,22,23	108:8	127:21	7:1,5,9,15 9:16,18	deals 69:6
17:6,12,14,25	Counsel 134:9	cross-wire 25:19	9:21 10:16,25	dealt 55:15 93:25
18:3 21:19 23:11	count 26:4,11	CT 6:3,16 26:22	11:4,8 12:2,5,9,23	debris 38:25
23:17 24:6,16,18	38:19 79:12	27:1 72:2 77:19	13:24,24 14:3,13	debt 136:6
25:12,15,20,21,22	counted 42:6	77:22 79:5,9	14:14,19 15:1,7,9	decides 75:5
26:25 52:16,17	counter 58:22	114:8,11 126:22	15:18,19,25 17:18	decision 87:17
84:18 85:1 108:25	counting 6:16	CTI 136:3	17:18,20,21,21	decrease 83:25
cord 28:2 48:10,13	18:12	current 7:22,24 8:2	18:2,19 19:12	84:5
49:8,16 50:17	counts 26:1	8:10,17,24 12:11	20:22 21:2,5,13	dedicated 35:8
51:3,6 52:3,12,21	couple 52:4	12:12,16,17,21	21:17,18,20,21,25	deduced 19:1
54:5,7,8 56:16	course 34:23 88:9	15:3 29:14 31:2	22:18,24 23:1,2	defect 37:15
57:3,8,18 58:3	93:19 114:22	56:20,21,23 69:20	23:10,19 25:9,23	defects 37:8,16
63:2,16 67:7	120:5 130:3,22	75:7,11,12,23	39:16 40:4,11	defined 74:3
68:21,24 89:22	134:12	81:7,23 82:1,3,6	46:24 47:3 48:5	definite 104:21
91:8 111:22	court 2:17	84:19,24 85:11,12	49:5 53:24 56:25	definitely 81:14
122:17	cover 2:24	85:14 86:16 89:4	57:2 59:18 65:25	114:21 115:5
cord/mains 48:7	covered 102:12	89:12,25 90:2,4,8	66:20 69:11 70:5	deformations
57:5	134:6	90:13,19 91:6,17	70:8,10,11,12	16:21
cords 52:22	covering 44:13	91:17,25 95:4,8,9	93:1 105:22	degree 3:12,15

71:14,19,23	diagram 93:15,18 94:14,15 121:24	16:25	dressed 99:20	67:21,25 92:1 104:2,14
degrees 9:9 10:21 87:10	diameter 17:2,15 18:15 26:4,20,23 26:24 27:8,11 52:2,19,24 76:25	diverted 8:17	drew 127:11,20	electric 12:10 31:16 61:23 122:13
delay 36:18	diameters 27:2	divided 91:17	dry 84:23	electrical 1:7 3:10 3:12,15,18,22 4:3 4:22 5:24 7:1,2,4 7:9,10,21,22,24 7:25 8:15,19 9:14 15:24 17:18 18:2 20:21 21:6,14,16 21:22,25 22:1,5,7 22:18,23 31:15 34:14 35:23 36:7 37:20,21,22 39:21 40:11 44:14,15 48:6 54:15 57:10 59:18 61:1,11 64:3,6 69:11 70:12,20 71:22 74:17 75:6,21 81:23 84:17,24 85:12 87:7 90:2 93:1 95:4 103:7 106:13 107:24 108:3,6,10 123:6 124:3 132:22 133:15
delivered 56:20,23	difference 15:17 61:25 62:1,21 111:15 124:16 131:10 133:2	divots 14:11,18	due 56:21 101:4 105:19	
demarcation 9:25 10:16 11:1,5 14:5 17:22 108:24	differences 17:17 60:18,21 61:5 62:8,10,11 63:1,5 111:9,18 131:4	document 10:5,6,8	Duncan 1:10,12,21 136:22	
density 97:22	different 26:21 38:23 62:22 87:9 90:8,24 99:1,1,13 110:5 111:2,20,25 113:12 124:10,20 124:21	documents 2:4,16 7:18 13:9,15 61:9 61:18 135:25	<hr/> E <hr/>	
department 4:4 100:25	differently 34:18	doing 97:21	E 136:21	
depending 26:24	difficulties 109:19	domestic 132:24	earlier 9:18 40:14 41:5 44:17 50:8 51:24 61:12 65:21 66:7 67:13,18 73:25 74:3 88:3 88:24 92:3 98:1 104:5 108:12 110:3 125:22	
deposits 97:7,18	dimensional 125:2	door 57:15 58:10 98:19,25 99:4,6,7 99:11 100:7,12 101:3	early 31:19,25 54:25 87:21 136:13	
describe 24:15 60:11 80:12 82:15 82:18 88:5 89:18	dimensions 25:1 26:12	doors 56:3,5,8	easier 6:22 21:8 24:9 28:12 30:4	
described 13:9 36:3 78:25	director 135:25	double-socket 69:13,24	easiest 23:8	
describing 88:25	disassembled 113:9	doubt 2:5 5:11	easily 84:19	
design 110:3 111:2 111:3 123:21 124:5,19,22 131:3	discharge 9:7 12:19	downstream 40:19	east 38:9 56:2,9 57:14 100:22	
designed 29:14 61:20	disconnect 75:22	Dr 1:10,12,14,22 2:24 6:22 15:16 16:8,24 17:16 19:17 21:7 22:10 22:16 28:12 30:19 35:16 37:19 38:1 38:2 43:18 44:7 44:12 45:15 47:16 50:12 52:8 56:10 56:12,14 58:12 60:2 63:11 72:13 72:22 80:24 82:15 83:16 87:12,24 89:15 96:18 103:17,22 109:14 110:11 113:25 115:23 116:2 118:4,10,24 119:2 132:20 134:3 135:9,12 136:22	easy 81:7	
designs 124:11	disconnected 31:15	draft 2:5	edge 5:7	
detail 87:4	discuss 4:11 5:15 6:10 41:5 58:15	draw 37:25 83:16 127:4	edition 15:3,4	
detect 29:15 36:15 36:16 95:6	discussing 104:6 119:3	drawing 13:19	education 71:21	
detector 58:11	discussion 19:18	drawn 50:4	effect 97:13 100:16 122:8	
determine 6:13 19:9 40:1	dispersive 6:4	draws 75:11	effective 133:11	
determined 18:2 21:20 23:18	dissipation 56:21		effectively 70:24 71:5	
determining 18:5	distance 11:3 13:23 97:16		effects 15:25 16:22	
device 7:23 8:15,25 19:12 20:3 21:23 33:24 36:1 56:24 60:22 61:1,22 62:14 64:5,10 123:10	distinction 103:8		efficiently 61:3	
device's 19:7	distinguish 101:17		efforts 54:3 104:19	
devices 19:13 32:19 35:14 56:18,22 69:18,19 71:2 74:23 75:25 84:21	distinguishable 15:25		eh-cult/overload 40:15	
	distortion 16:4,10		eight 10:8 46:10	
			either 8:18 40:9 53:25 54:25 59:11 62:17 64:21 65:3	
				electrical/electro... 40:18
				electrically 55:2 66:24
				electricity 8:12,13 9:6 10:7 29:16 31:5 74:18 75:18 84:22,23 103:13 103:13
				electrochemical 86:2
				electrolysis 86:3
				electron 6:4
				electronic 3:22 123:10
				electronically 71:3 96:6

element 31:23 41:14 43:2 58:15 65:10 77:9	entitled 10:5 Equally 101:11 escaped 100:17 101:7,12 especially 9:5 83:12 84:23 essential 22:22 70:15 78:12 essentially 55:10 68:22 72:14 82:14 84:8 95:21 established 4:15 19:14 58:5 estimate 122:22,23 123:4 Europe 133:7 evaluate 6:18 39:21 64:4,13 event 7:4 19:24 22:3 32:11,17 33:3,9,12 34:1 36:4,5,7 57:24 105:19 106:9 107:12 108:10 129:19 135:5 events 7:2 9:3 21:22 33:23 57:24 135:3 eventually 66:17 81:24 82:7 evidence 1:5,23 5:11,16 18:20,23 19:1 20:20,22,23 20:24 21:5,13,17 22:17,23 25:22 31:10 33:21,22 34:8,20 35:12 43:9,21 44:17 48:3,5 50:25 51:24 53:18 68:23 70:12 88:25 98:12 102:13 106:25 107:3,12 109:2 113:11 118:15 134:12 135:10,14	136:10 exact 131:3 exactly 125:25 examination 5:16 6:2 38:3 44:14 50:21 52:15 53:14 examine 40:2 46:17 79:7 81:11 examined 5:23 13:2 19:8 22:23 23:18 23:18 38:13,20,22 39:1 41:21 58:20 60:6,11,20 113:6 113:16 examining 6:13 18:18 22:7 example 21:23 22:2 28:1 35:5 38:24 39:22 47:7 60:21 61:24 84:22 130:17 131:1 132:10 examples 14:16 excerpted 10:8,11 exclude 107:16 excluded 106:8 excluding 55:11 106:18 Excuse 8:7 74:2 84:4 124:4 exemplar 42:1,3 60:12,14,20 61:5 61:12 62:1,4,18 62:24 93:3 110:4 110:7 111:2,16,20 130:15,18,24 131:2,3,7,22 132:8 exemplars 79:16 exemplary 136:4 exercise 82:14 exhaustive 10:13 exhibit 23:4 25:4 27:6 50:21 52:14 53:14,23 54:9,12	54:24 63:15 65:8 65:11 72:3,16,17 72:25 73:16 76:8 86:20 102:17 104:10 106:10,25 108:7 112:17 113:2 exhibits 5:18,20,21 5:23 6:13,19 11:21 18:18 22:23 22:25 23:2 26:2,5 26:12,19 27:9,25 31:10 38:13,16,22 40:12 41:18 42:3 42:6,9 46:6 48:9 52:1,25 57:4 58:21 59:17,19,21 59:22 63:13 64:15 65:7 70:1 73:4,8 73:11 104:1 105:3 106:5,19 114:3 existence 6:13 exited 98:3 116:11 expand 94:11 expect 92:13 93:1 112:12 expected 7:23 47:8 experience 71:21 108:19,20 132:22 133:10 experiments 97:21 expert 1:5 4:21 107:25 expertise 4:20 5:10 133:15 135:17 explain 11:13 13:6 84:15 89:13 92:12 92:20 102:10 121:14 explaining 14:14 explanation 7:16 10:2 12:1,8 13:21 14:25 25:6 74:15 explicit 98:15 99:12 99:25 108:22	explosions 10:7 13:10 16:13 Exponent 4:7,9 exposed 16:1 123:14 express 37:4 extend 121:25 extension 50:22 53:15 55:15,19,23 55:25 56:5,16,18 56:19,20,22 57:1 57:3,5,8,9,12,18 57:22 58:1 129:10 extent 19:11 34:18 34:24 79:15 121:15 127:4 extract 98:5 104:5 extracted 73:9 extractor 37:23 38:4,6,8,10,12,16 38:18,21,23,25 39:5,11 40:9,10 40:13,18,24,25 41:1,1,4,10,15,19 41:20,24 42:1,5,8 42:11,20 67:14,16 extruded 116:10 eye 81:1,12 82:20
F				
F 115:1				
facilities 66:19 77:20				
facing 112:20				
fact 2:7 11:5 68:2 80:15 91:12 127:5				
factor 43:11 66:2 67:9				
factors 53:1 90:16 91:15				
facts 2:9				
factual 72:15,20				
fail-safe 61:22 64:10				
failed 43:3				

<p>failing 61:22</p> <p>failure 3:10 7:25,25 39:24</p> <p>failures 43:4</p> <p>fair 5:24 6:12 7:6 9:16 17:19,22 20:11 24:19 43:11 47:2 71:8 72:11 77:11 83:8 85:22 86:13 94:5 95:17 102:7 125:7</p> <p>fairly 16:8 97:2</p> <p>fall 72:14</p> <p>false 103:7</p> <p>familiarise 89:20</p> <p>fan 37:23 38:4,6,8 38:10,12,14,17,18 38:21,23,24 39:1 39:11 40:9,10,13 40:18,24,25 41:1 41:1,4,10,15,19 41:20,25 42:2,4,5 42:8,11,15,20 67:14,16</p> <p>fans 42:23</p> <p>far 72:6 110:17</p> <p>fast 33:20</p> <p>faster 92:17</p> <p>fault 8:6,8 9:2 33:24 37:14</p> <p>feature 29:20 47:2 81:16</p> <p>features 18:5,6 28:14 111:9</p> <p>fed 29:3</p> <p>feeds 41:4</p> <p>feet 51:10</p> <p>fellow 99:16</p> <p>FF175BG 68:13</p> <p>FF175BP 60:8,15 68:13</p> <p>figure 16:5,6,12 17:7,8 25:7 28:15 30:5,9 44:24 45:3 57:17 72:25 76:5</p>	<p>77:15 78:24 79:25</p> <p>80:9,10,10 82:12</p> <p>82:13,15,25 88:2</p> <p>88:13,18 89:13</p> <p>94:10,11 102:12</p> <p>104:10 110:1</p> <p>114:3 115:22,24</p> <p>116:16,24 120:12</p> <p>120:24 125:7,23</p> <p>126:12,13 129:8</p> <p>figures 28:16 55:18 83:17 84:3,9 116:18 131:6</p> <p>file 28:19</p> <p>files 6:23</p> <p>final 2:7 14:22 26:11 27:5 34:8 42:13,17 54:20 58:15 70:7 132:20 135:23 136:9</p> <p>finally 2:19 4:7 8:21 19:11 20:18 49:14 68:9 72:17</p> <p>find 27:14,22 32:2 52:8 75:15 93:1 113:19 123:17 125:3</p> <p>fine 14:4 108:23 109:16,17</p> <p>finished 135:4</p> <p>fire 3:24 4:14,19,24 7:6,12,13,14 9:15 10:5,6 13:10 15:9 15:19,24 16:1,13 17:20,24 19:13 21:20 24:13 27:17 27:23 28:22 31:8 31:8,25 32:1,3 34:13,14 35:4,13 35:23 36:9,13,23 37:10 39:4,10,13 39:16,18 40:4,5,9 40:17 42:2,17,18 45:18 46:2,15,20 47:6,9,22 48:4</p>	<p>49:1,5,6 50:6,16</p> <p>51:1 52:11 53:1,5</p> <p>53:20 54:1,17,23</p> <p>55:1,2,3,9 56:5,6</p> <p>56:7,15,19 57:11</p> <p>57:12,22 58:1,5,6</p> <p>58:7 59:4,14</p> <p>61:11,20,23 63:14</p> <p>63:22 64:1,13</p> <p>65:20,23 66:2,11</p> <p>66:17 67:3,15</p> <p>68:23 69:8 70:11</p> <p>70:18,19,20 71:2</p> <p>71:7,10 72:10</p> <p>73:23 87:1 96:4</p> <p>100:22,25 101:4,9</p> <p>102:7,21 103:9</p> <p>104:14,17 105:7</p> <p>105:20 106:4</p> <p>107:1,4,7,15,17</p> <p>107:24 108:2,3,4</p> <p>108:5,6,9,11,22</p> <p>112:22 122:10</p> <p>123:13,13,14</p> <p>127:24 128:2,17</p> <p>128:25 131:12</p> <p>132:25 133:16,21 133:24</p> <p>fire-damaged 15:11</p> <p>fire-heated 15:13 16:20,22</p> <p>fire-heating 17:1</p> <p>firefighter 100:9</p> <p>firefighting 54:3 104:18</p> <p>fires 4:21,22 42:22 43:5 64:7 71:22 132:22 133:12</p> <p>first 1:19,24 2:24 3:5 5:17 7:19 9:24 10:4,15 11:6 16:3 17:8 18:11 18:22 23:6 25:6 26:3,11,14 28:15</p>	<p>31:4 32:7,23,24</p> <p>33:3,23 34:16</p> <p>35:24 36:13 37:22</p> <p>37:24 38:2 41:11</p> <p>41:11,22 44:18</p> <p>46:8,9,10 47:17</p> <p>49:22 52:10 55:17</p> <p>55:19 57:24 63:19</p> <p>65:10 67:22 68:6</p> <p>72:14,19,19 75:4</p> <p>77:15 83:22 84:14</p> <p>84:15 88:20 92:18</p> <p>100:9,13 101:9,13</p> <p>106:3,18 114:4</p> <p>128:20 129:16,18</p> <p>130:5 135:8,24</p> <p>fit 118:2</p> <p>five 38:13,16 63:1,2 76:17 79:3,4,14 79:15 80:11,14 111:19,21 123:2 127:21</p> <p>fix 107:10</p> <p>fixed 63:17 69:6,9 69:13 70:4,8,10 132:24</p> <p>flat 4:24 5:9,19 18:23 19:25 24:11 27:24 28:5,17,22 29:3 30:1 31:15 33:13,14 39:5 40:16 41:19 42:2 42:2,4,5 45:19,21 47:23 50:18 52:13 57:17,21 59:6,8 60:19 61:16 62:20 69:10 73:14 93:4 96:2,3 98:8,13,19 99:5,10 100:10 102:7 105:3 106:10,10 110:6 110:25 111:4 113:3 119:9 130:16,19,25 131:2,21 132:10</p>	<p>flats 99:19</p> <p>flex 28:3 48:7 49:8 50:18 52:13 57:3 57:6 63:16 89:22 92:10</p> <p>flexible 48:13</p> <p>floor 27:16 47:18 99:19</p> <p>flow 8:13 12:12 29:16 61:4 75:19 81:7 82:6 90:2,13 96:21 113:5</p> <p>flowing 8:10 12:16 12:19 32:4 33:18 81:23 85:11 92:6 95:13 103:13</p> <p>flows 9:6 12:1,8,11 12:11,18 75:7 95:5 101:6 108:13 122:14</p> <p>fluorescent 58:17 58:23</p> <p>focused 66:5 104:25</p> <p>focusing 76:18</p> <p>follow 46:12 127:7 129:14</p> <p>following 18:5 39:4 40:8,12 45:18 47:22 50:16 52:11 59:4,5 63:21 69:8 69:12 71:11 100:2 106:12</p> <p>follows 31:4</p> <p>foodstuffs 47:6,8 51:7 53:21</p> <p>footage 100:9,11,13 100:16</p> <p>footnote 98:7 100:3</p> <p>force 78:9 81:19</p> <p>foremost 18:22</p> <p>forgive 22:10</p> <p>form 41:23</p> <p>formation 17:4</p> <p>formed 38:6 104:21</p>
--	---	--	---	--

former 18:23 77:24 98:13	63:15,15,21 64:2 64:9,17 65:13,14 66:3 67:6,10,17 68:3,5,21 70:16 71:6,9 72:5 73:10 73:13,16,18 88:1 91:9,19 92:10,14 93:10,11 100:23 104:6,11,15,16,18 104:22 105:5,13 105:18,19,23 106:2,14,15,20 107:6,11 110:6,25 111:16,17,20 113:3 116:9,14 119:9 122:14,18 122:20 128:4,13 130:17,19,25 131:2,7,9,21 132:5,11	100:23 104:6,21 105:13,17,23 106:14,15,20 110:5,25 111:3,16 111:16 113:3,3 116:9,14 119:8,11 122:14,18,20 128:4,13 130:17 130:19,25 131:2,7 131:9,21 132:5,10 133:13	G	113:25 115:23 116:2 118:4,10,24 119:2 132:20 134:3 135:9,12 136:22
forming 38:14			gap 9:4,7,12 97:8 97:16 101:24 102:23	Glover's 30:19 38:1 45:15 56:12 63:11 103:22
formula 85:10,12 91:17			gas 12:20	glowing 16:1 86:15 86:16 102:17,20 103:12
forward 22:13 33:20			general 17:23 21:15 71:8 86:13 95:17 108:18 111:13 133:14	glows 103:10
found 15:6 19:22 20:4 27:16,18,18 27:20,25 28:1,4 28:25 29:11 31:1 38:25 41:24 42:7 46:18,21 47:6,17 48:25 49:3 51:7 52:1,14 53:21 54:7 55:5,24,25 56:6 59:9 63:21 64:16,25 65:12,17 66:6 70:8 79:19 80:15 93:9,10 104:11 105:3,5 106:14,20 109:7 110:5 135:13	freezer's 52:3,21 54:5,6	fridge's 51:2	getting 22:11 70:9 82:7 99:20 118:8	go 3:3 6:24 9:23 10:23 11:11 20:19 23:6 30:3 35:14 40:7 43:24 44:2 45:14 50:10 51:15 54:20 55:7,17,18 55:18 65:22 67:21 68:1,19 69:5 70:24 77:14 80:9 80:10 84:11 89:13 89:14 93:11 97:17 106:3 109:23,24 115:21 118:9,16 124:23 134:14 135:20
four 45:7 46:10,17 50:24 53:17 56:17 58:21 79:4 80:11	freezers 62:13 64:8	fridges 132:24	give 1:22 10:2 13:21 14:25 25:5 35:5 64:18 91:16 91:21 97:11 101:11 122:20 130:9 133:10 135:10	goes 48:16 79:10 89:23 90:2,5 105:12
four-gang 50:22 53:15	friable 48:14,17 49:4	front 46:25 47:5 90:25 99:5,7,10 112:18 119:9	given 12:2,9 37:5 86:7 100:16 102:13 107:14 116:23 120:1 132:22	going 1:5 3:3 19:17 28:7 32:23 43:13 43:19 46:20 75:15 87:12,15,19,19 89:25 91:25 92:1 92:17,18 93:25 95:11 98:23 99:17 99:19 102:22 109:9 118:14 126:13,23
fourth 65:18	fridge 27:10 28:5 29:22,24,25 35:6 38:11 45:5 47:18 48:22,24 49:3,12 49:21 50:1,14,17 50:20,23,25 51:4 51:8,9,21 53:11 58:16 60:3,7,19 60:20,22 61:6,16 62:2,4,6,7,13,15 62:17,20,24,25 63:9,14,15,20 64:2,7,9,17 65:12 65:14 66:3 67:6 67:10,17 68:2,4 68:20 70:16 71:6 71:9 72:4 73:9,13 73:16,18 88:1 91:9,19 92:10,14 93:3,4,10,11	full 61:4 75:11 129:21 130:5	gives 30:5 73:15 129:3	good 1:3 16:16 44:10 80:3 82:16 82:18 83:1,3 84:18,21 85:1 94:11 118:20
fractions 91:15		fully 100:24	giving 135:16	
freezer 27:7,10,21 28:1,4,5 29:22,24 29:25 35:7 38:11 45:5 47:18 48:22 48:24 49:3,12 51:14,18,21,23 52:9,12,15,22 53:2,4,9,16,19,22 53:25 54:2,10,16 54:18,23 55:4,13 58:16 60:3,7,19 60:22 61:6,16 62:2,5,7,8,16,17 62:20,24,25 63:9		fundamental 12:10	globule 15:11,13 17:10,14	
		further 17:15 55:7 56:21 77:12 86:4 87:3 105:8 116:13 118:9	globules 17:5,6,9	
		furthest 80:25	Glover 1:10,12,14 1:21,22 2:24 6:22 15:16 16:8,24 17:16 19:17 21:7 22:10,16 28:12 35:16 37:19 38:2 43:18 44:7,12 47:16 50:12 52:8 56:10,14 58:12 60:2 72:13,22 80:24 82:15 83:16 87:12,24 89:15 96:18 103:17 109:14 110:11	
		fuse 8:4,14 12:13 19:2,5,6,19,21 20:10 28:17 37:2 40:20,25 41:4,7 41:10 49:9,15 51:5 53:12 54:12 55:5 67:6,12,15 67:16,18,20,21,23 68:2,6 92:2,2,5,9 92:14,20 105:7 107:9,13 116:2,4 116:6 122:18		
		fused 23:16,16,23 24:4,22 25:1,3 66:8 115:13,14 117:18 128:7,11 128:22 129:1		
		fuses 19:8 24:6 41:6 92:15		
		future 119:20		

136:12,14,16 grain 13:4 grateful 37:22 134:3 135:17 gratitude 136:7 great 136:6 greater 98:12 greatly 89:19 green 127:6 grips 78:10 ground 8:6,8,11,17 8:19 9:1 29:15 32:13,13,14,15,25 33:1,2,6 95:3,5,13 96:21,25 97:9,9 101:25 grounded 12:6 95:5 grounding 8:11,18 95:3 guess 97:16 guidance 35:22 108:14 guide 10:6,11 13:10 14:17 15:3,10 16:13 108:21 guy 133:15	headed 2:5 115:16 heading 30:22 70:17 71:2 128:16 hear 1:5 hearing 1:4 136:18 heat 19:12 49:5,6 56:20 85:16 86:6 101:4 103:14 heat/fire 46:24 heating 48:8 heavily 39:17 123:13 help 7:16 19:20 21:15 27:12 35:1 35:21,24 37:5,23 39:10 42:24 48:15 55:23 60:18 61:2 62:11 71:16 73:8 73:15 77:15 84:14 87:3 89:19 94:10 96:22 98:11 115:18 117:3 124:24 128:17 131:14 132:23 133:21 helped 18:20 helpful 35:3 62:5 66:16 75:1 115:23 135:11 helps 109:12 high 8:2 10:20 14:23 15:8,14 16:22 81:9 85:7 95:9 high-current 8:6,8 9:1 higher 7:22 8:24 76:15 85:2,5,14 86:5 123:1 history 43:4,5,5,6 hoard 39:9 hobs 46:18 hold 3:12,15 holes 97:6 hook 121:13	hope 19:25 36:6,8 112:12 hopefully 112:16 hot 9:8 86:15 Hotpoint 60:8 68:13 hour 43:14,19 87:15 housing 112:3,4 hundred 67:25 hundreds 89:7 hypotheses 33:18 hypothesis 32:22 77:9 88:6,10 119:24 120:6 127:24 hypothetical 72:10 120:1 131:12	103:6 illustrate 122:3 124:25 illustrated 35:18 88:12 113:6 114:3 117:11 120:13 125:23 126:2,20 129:8 illustrates 83:5 illustrations 11:21 illustrative 10:13 imagine 17:24 48:20 133:16 imaging 100:9 immediately 36:20 127:6 impact 131:10 132:11 implausible 54:17 58:7 implicated 71:6,7 importance 20:11 important 11:7 17:19 31:24 43:4 47:1 81:5 128:11 inadvertently 104:17 inches 57:15 118:1 118:2 incidents 42:25 43:7 65:18 include 27:10 52:23 123:22 includes 27:7 including 6:3 39:7 49:8 51:10 131:4 increase 84:12,25 102:19 increases 85:20 86:4 index 111:3,16 indicate 7:5,9 indicated 50:7 indicates 11:14 23:25 24:3 29:6	78:3 79:24 80:13 90:1 94:17 112:24 114:14,24 116:7 117:15,19,21 121:4,7,11 122:2 122:7 125:19 127:19 indicating 71:17 indication 31:11 79:20 80:2 81:18 individual 35:17 80:21 information 27:13 initial 4:24 127:24 initially 54:6 104:15 initiates 39:13 initiation 31:19 32:1 54:25 72:10 122:10 131:12 injera 48:1 inner 101:21 inquiry 2:21 4:16 108:4 135:13 136:1 inserted 50:23 53:17 inside 27:18,20 52:14 78:10 80:20 86:24 120:19,22 insofar 127:25 inspected 5:18,20 inspection 104:12 inspections 27:19 installations 86:12 102:21 103:3 instance 42:18 instantaneous 101:23 Institute 3:16,22 instructed 1:6 insufficiently 37:7 insulating 87:6 insulation 7:25 8:1 9:6 12:21 70:11
<hr/> H <hr/> H 51:19,21 half 78:24 80:9 halfway 103:25 hall 101:8,13 hallway 100:18 happen 10:17 33:12 108:9 happened 78:21 135:4 happens 11:17 16:25 happy 109:9 hard 112:24 harness 62:23,25 76:13,16 91:10 111:19 headdress 110:23		<hr/> I <hr/> idea 73:15 97:11 101:11 identical 124:18 125:5 identifiable 9:15 12:5,23 identification 4:23 5:12 identified 9:20 50:2 51:18 68:20 73:1 79:3 80:11 106:12 identify 17:9 18:4 23:22 28:13 44:23 77:25 89:3,16 107:2 108:15,17 110:7 119:21 129:6 identifying 16:10 34:19 35:1 61:5 101:9 ignite 36:20 37:1 ignites 103:10,14 igniting 86:18 102:21 ignition 86:12,18		

86:17,18,19,20,23 86:23,25 87:4,7 103:14 129:19 insulations 87:2 intact 19:7,10 49:8 54:17,19 68:3,7 intact/not 49:16 51:6 54:12 67:7 intact/undamaged 51:10 interested 27:22 interesting 19:24 23:15 135:14 internal 14:23 22:3 39:23 48:7 51:3 52:4 53:24 56:25 64:2,21 65:4 71:9 76:14 88:7,11 91:10 104:3 109:7 123:22 133:21 internally 50:11 51:16 52:7 interrupt 110:11 interrupted 61:4 intervals 79:11 intervene 109:8 interview 31:5 investigating 71:21 investigations 108:22 113:10 investigator 31:8 investigators 4:16 19:14 42:7 56:6 58:6 73:23 108:4 invite 23:20 88:19 involve 32:12,14,25 33:6 involved 9:5 32:25 36:19 64:8 95:4 involves 8:9 13:7 involving 8:17 33:14 65:19,20 68:12 inwards 125:18 isolator 40:19,20	41:3,3 issue 2:24 35:19 issues 6:16 101:1 item 14:4 items 10:4,11 35:3 37:21 39:1 42:3 44:15 50:6 59:5 69:12 113:11 <hr/> J J 1:12 136:22 jacket 63:3 111:22 JDG/1 22:25 25:4,6 25:21 26:18 27:3 27:17 31:11 41:18 41:23 42:10 46:6 48:9 52:2,14,18 52:25 53:23,25 54:24 55:8 57:4 64:15 65:7 70:1 104:2,10,13,14,15 104:21 105:4,5,8 105:15 106:7,8,19 106:25 107:3,15 113:23 JDG/6 73:11,24 74:21 JDG/6A 113:1 114:7,10 JDG/6B 72:3 76:18 76:21 77:22 78:21 84:10 93:8 102:17 102:24 105:1 106:19 113:1 128:6 129:10 JDG/6C 114:10,21 115:3 JDG/6F 114:13 JDGM0000003_... 15:21 JDGR0000001_0... 44:24 JDGR0000001_0... 30:19 JDGR0000001_0...	26:9 JDGR0000001_0... 21:4 JDGR0000006_0... 115:21 JDGR0000016_0... 28:10 JDGR0000019_0... 72:21 job 37:9 John 1:21 jumper 64:21 104:3 130:18 131:1,5,8 jumping 51:15 106:21 junction 54:15,19 juncture 87:16 89:10 June 24:13 57:17 <hr/> K Kcbede 31:4 Kebede 19:25 20:5 28:21 31:14,20 45:1 47:24 50:5 50:19 53:3,8 55:4 58:8 66:15 95:16 96:8,16 99:15 100:4,21 101:3,8 101:13 105:6 107:9 Kebede's 45:3 51:17 52:6 107:5 keep 78:13 87:12 87:19 133:21 keeping 87:19 keeps 78:10 kept 78:18 key 3:4 31:23 40:24 41:14 43:2 kind 24:3 103:11 Kinfu 98:12 99:17 99:25 Kinfu's 98:5,9,14	Kingdom 91:20 Kinnier 1:8,9,13,17 1:18 16:24 22:16 43:13,17 44:11,12 87:23 93:24 109:12,19 118:4,9 118:25 119:1 124:13 134:3,19 134:23 135:2,3,9 135:23 136:9,22 kitchen 5:7,7 29:3 29:20 30:1 32:10 32:11,19 33:4,5 33:15,25 35:6,9 37:23 38:9 40:16 44:15 47:18 50:6 55:3 56:2,4,8 57:16,25 58:10,11 58:18,22 59:6 63:18 66:25 69:7 69:25 70:2 95:24 98:3 99:7,9 100:7 100:11,18,22,23 101:2,8,12 107:23 108:8 111:3 Klixon 75:15,16,19 75:22 88:23,24 89:6,11 90:5,14 91:3,24 112:8,23 122:3 know 37:4 43:8 46:11 64:9 105:6 125:3 130:1,10 132:14 knowing 96:5 knowledge 2:11 <hr/> L label 54:14,18 110:16,19,20 labelled 113:12 labels 110:13,19 laboratory 15:6 26:21 113:9 133:4 lack 126:10	lady 66:11 large 29:22,24 45:5 47:18 58:16 60:3 60:7,19 61:6 62:2 63:9,20 64:2 66:2 67:9 70:16 71:6,9 72:4 73:9,16 90:18 91:25 93:20 104:6,21 106:14 110:5 127:1 largely 51:9 54:16 54:19 larger 17:21 80:18 91:14 law 91:21 lay 39:11 47:1 66:1 66:4 67:11 80:25 81:12 82:19 104:20 layman's 11:13 13:7 134:1 layout 111:15 layperson 67:8 lead 32:3 50:22 53:15 55:15,19,23 55:25 56:6,16,18 56:19,20,22 57:1 57:3,8,9,12,18,22 58:1 81:10 86:12 lead's 57:5 leading 86:5 leads 9:15 83:20 85:6 leaning 22:13 leave 34:2 35:19 108:4 leaves 95:4 135:9 leaving 68:6 101:14 led 56:15 72:9 96:21 129:20 left 28:20 29:12 63:25 80:19,24 81:12 82:17 83:4 101:3 106:9 107:18 108:6
---	--	--	--	---

110:20 111:6	listed 108:23	longest 114:5	losses 85:6,16	manufacturer's
112:4,20 114:25	listening 88:5	look 1:6 9:19 11:9	102:19	110:20
115:14 116:13	listing 108:16	11:20 12:25 13:8	lost 94:18	manufactures
119:10,14,23	lit 108:2	13:16 14:5 21:8	lot 59:15 79:19	42:20
120:6 127:17	literature 108:21	21:24,25 22:5	low 84:19	manufacturing
132:1,14,16	little 74:25 79:25	35:7 39:3,19 43:2	lower 85:3 114:8	14:8
left-hand 45:4 50:3	134:8	43:4,10,24 45:4	116:13 126:12	marked 73:11
51:19 73:5,5,9	live 8:10,13 12:13	47:5 49:2 64:5	lowest 127:8	MARTIN 1:3,11
79:9,12 80:25	32:13,25 76:19	76:5 79:18 96:23	luminous 9:7 12:19	1:14,17 16:16
82:18 110:17	97:1	104:9 108:23	103:13	22:10,15 43:16,18
116:25 121:17	living 56:3,4,8	113:18 114:7	lunch 87:20 118:11	44:1,7,10 87:18
leftwards 30:13	57:14,16,19,20,23	115:18 117:15	129:14	93:13,19,23 109:8
legal 43:6 68:11	58:2,4,8	121:5 124:19	lying 27:16	109:11,13,17
length 23:12,15,24	LLC 3:10	125:1,2,13 135:21		118:7,10,14,19,24
24:17,19,23 25:16	Indesit 68:12	looked 13:22 15:1,4	M	124:12 134:7,17
66:8 115:8 120:3	load 8:24 12:14	18:19,22 19:1,6,8	m 27:8,11	134:23 135:7,12
127:22 131:20	56:20,21 75:11	19:11 26:17 33:21	m'tad 47:12,25	135:19 136:6,12
132:18 133:18	122:16,19,24	33:22 42:1,3,4,5	machine 78:8	Massachusetts 3:7
let's 90:11 97:5	123:4 130:10	60:6 61:13 62:5	magnitude 89:4,12	3:13,14,16
117:13 122:20	localised 10:22	62:18 64:24 66:6	main 19:19 20:2,5	match 18:6
131:24 133:6	12:3 17:25 18:1	70:25 83:11	20:6 21:18 28:2	material 48:17
letter 50:2 51:19	108:24	100:21 104:5	28:20,24 30:5,25	61:25 62:3,12
level 87:3	Localized 11:25	112:18 113:15	31:5,14,17,20	63:6 87:4,7 96:6
life 3:21	Locally 13:4	looking 6:17 10:15	41:9 49:8 66:15	131:10 132:11
light 58:17,23	located 38:8 41:1	13:18 17:17 24:14	69:25 70:2 89:22	matter 1:7 22:7
99:10	47:4 50:6 54:16	25:14 33:2,10	95:17 96:8,17	102:23 103:2
lighting 59:7,12,17	55:1 58:4 62:16	34:24,25 35:2	99:21	136:9
lights 99:9	104:15 115:11,13	41:17 46:23 65:6	mains 50:18 52:12	matters 2:9,20
likelihood 105:21	116:8 119:25	67:8 70:7 76:23	57:3 63:16 92:10	46:12 72:15,20
limit 89:11 90:19	120:8,18,22 128:5	77:8 80:24 82:22	maintains 17:15	76:7 92:12
91:6	128:7,9 133:20	95:25 96:18	majority 91:12	maximum 129:23
limited 14:11 89:5	locating 109:19	101:18 105:8,15	maker 47:12,17,23	130:7
90:23 91:23,24	location 10:24 18:6	108:20 109:4	47:24 48:1,3,6,10	MCB 31:12 33:6
limiting 90:16	48:22 104:13	110:16 112:22	48:12,21,25 49:7	89:8
91:14	126:19,19	113:13 119:11,11	49:11,15	MCL-06 69:14
limits 5:10	locations 21:19	119:14 120:24	making 101:9	mean 20:13 23:16
line 11:1 14:4 17:22	27:25 121:13	122:12 124:10	manually 31:3,9	68:3 71:16 111:5
33:23 71:13 95:1	126:6,7	125:6,9,11,15,16	manufacture 131:4	meaningful 123:11
97:24 103:4	logo 110:8,9,16,21	125:18 126:13,14	133:8	123:17
108:24 127:6,7,11	110:22	127:5	manufactured 14:1	means 15:24 20:15
129:2,13	London 27:20	looks 15:12 39:11	14:2 60:9,15	46:16 66:23 84:25
lines 13:19 14:2,7	long 40:23 53:11	47:1 66:1	61:13,17,20 62:19	101:2 121:16
lingo 20:15	101:20	loose 78:19 79:20	62:21 132:5 133:5	measure 119:19
lire 31:20	longer 86:25	81:18,18 86:14	manufacturer	123:6,11
list 10:12 11:11	131:21 133:22	loss 85:8,13,15 86:5	42:15 132:4	measured 26:4,20

26:23	111:18 124:16	MJD/64 59:20,23	109:15	neutral 8:16 12:6
measurement	MET00009047	MJS 129:4	motor 38:24 60:22	12:15 33:1,24
123:18	112:11	MJS/1 22:25 23:4,5	60:25 61:6,14,21	39:12 88:7,12
measures 132:24	MET00009077	23:6,10 24:10,14	74:18 75:4,8,10	91:2 93:5,15
measuring 18:15	119:5	26:17 27:3,16	75:18,21 82:2,7	94:17,25 95:2,11
27:2	metal 11:2 12:7	31:10 41:18,23	89:5,11 90:6,7,12	97:2 102:25 103:4
meat 6:24	69:18 95:5 133:11	42:9 46:6 48:9	90:12,15 105:12	129:3,13
mechanical 70:4	metallic 8:11,19	52:1,25 57:4	123:2	never 48:1,1 113:8
mechanism 101:18	12:24 32:14 95:3	59:21 64:15 65:7	motors 75:8	new 47:11 88:5
122:12	133:5	66:6,9,21 70:1	mounted 63:24	NFPA 10:6,11
medium 27:7 51:21	metals 9:3,9	92:24 93:9,12	mounting 63:24	13:10 14:17 15:3
51:23 52:12,14,21	meter 123:11	104:1 105:3,11,22	132:15	15:10 16:13
52:22 53:4,9,16	method 18:14	106:1,7,13 107:16	move 77:5 82:17	108:21
53:18,22,25 54:2	microphone 16:15	107:20 108:7	109:4	Nic 5:1 19:15
54:5,6,10,16,18	22:11	109:3,5 113:23	moved 28:25	136:10
54:22 104:14,16	microphones 16:16	115:7,8,10,13,19	104:17	nice 80:3 82:8
104:17 106:2	microscopic 24:4	116:7,25 117:10	moving 30:13 67:5	night 28:22 40:17
107:6,11	microscopy 6:4,6	117:18,22 119:3	114:10	46:20 66:10 106:4
medium-sized	middle 78:5 83:4	119:24 120:8,24	multiple 125:8	Nikon 26:22 77:20
27:20 28:1,4	110:12 127:10,12	120:25 121:19	126:1	nine 9:20 10:4,12
51:14,18 52:3,9	milliamperes 96:12	127:25 128:5,6,7		53:9 55:5 108:16
53:2 104:11 105:5	97:17,19	128:9,11,12	<hr/> N <hr/>	108:23
105:19	milligrams 97:20	MJS/6 38:24 40:14	N 136:21	ninth 9:21 10:9
melt 9:3 11:15,18	millimetres 24:21	mm 52:19	name 1:19,21 75:15	14:22
16:2 90:22	24:23,24 25:2	model 60:15 61:12	110:23	No.1 45:19,22
melted 11:2 17:6,12	27:3 76:25	111:10 124:20	narrows 125:19	No.7 31:12 34:15
21:19 23:17 24:6	milliseconds 102:1	125:3,5	National 3:24 10:5	55:2 57:21,25
melting 9:9 10:25	mind 1:19 16:9	models 111:14	native 110:22,23	89:8
13:11 16:2	43:22 70:14 99:24	moisture 123:15	nature 14:14	No.7-Kitchen 46:3
member 3:21,24	minded 69:15	moment 106:22	near 57:19 58:22	59:15 69:9 70:18
memo 5:22 6:9 21:2	Mindful 5:10	109:20	99:5,9 100:23	70:21 71:3
23:10 25:10	miniature 89:8	months 67:2	106:14 121:19,22	No.8 57:21
108:15	minutes 134:4	MOORE-BICK	nearby 86:12	non-electrical 4:19
memorandum 2:1	missing 39:6,15,20	1:3,11,14,17	necessarily 98:9	4:21 7:2,5 17:18
2:6,10,15,19 4:14	39:20 40:3 57:7,8	16:16 22:10,15	132:3	17:20 46:16 108:1
5:5,18 6:8,21 9:19	58:3,3 63:23 64:3	43:16,18 44:1,7	necessary 87:20	108:5
13:2 15:20 22:20	64:4,11 65:3	44:10 87:18 93:13	97:12 110:2	non-uniform 39:16
memory 50:5 83:21	112:21	93:19,23 109:8,11	necking 17:3	40:4
99:12 107:8	MIT 3:19	109:13,17 118:7	need 20:19 70:23	normal 8:12,24
mention 65:18	MJD/33 50:21	118:10,14,19,24	81:5 97:14 101:20	29:15 89:12 90:8
79:23	53:14	124:12 134:7,17	109:11 119:24	99:1 122:19,24
mentioned 10:19	MJD/34 54:9,12	134:23 135:7,12	124:15 128:25	123:3 129:22
13:23 29:19 66:5	MJD/38 27:7	135:19 136:6,12	130:10	130:6
67:13 92:3 93:9	MJD/49 59:20,22	mop 45:4	needs 134:10	normally 7:23 8:2
107:25 108:21	MJD/63 59:20,23	morning 1:3	net 95:12	8:12 12:12 13:8

122:15 Northeastern 4:4 Nos 59:7,9,16 notches 14:18 note 9:14 53:6 68:14 94:3 noted 27:6,9 96:18 notice 37:8 November 1:1 2:2 60:16 72:1 136:18 Nuaire 42:14,19 number 11:11,24 12:4 13:6,18 18:12 35:9 41:22 60:15,21 62:23 65:23 66:13,21 69:6 91:7 106:7 106:11 112:25 120:25 122:21 130:1 numbering 109:25 numbers 67:24 124:20 125:3	69:12 79:6 99:13 100:22 131:5 obvious 16:8 48:16 78:17 obviously 85:1 108:9 occasionally 8:21 occupant 19:25 occupants 18:23 98:8 99:18 occur 7:1 40:17,21 93:16 occurred 18:3 19:24 33:16 34:1 54:25 101:19 occurs 36:9 37:11 37:11 October 1:25 2:1 60:9,10 61:17 104:24 offence 129:4 ohm 91:8,9,11,14 91:15,16,21,22 Ohm's 91:21 Ohms 91:18 oil 46:16 okay 8:9 21:9 23:6 25:7,12 26:17 27:21 30:2 32:9 34:7 56:3 66:13 71:20 74:11,15 76:6 79:9 84:17 88:22 89:13 93:5 94:9 97:4 98:22 101:16 102:14 104:24 106:4 112:9 113:8 116:1 117:13 120:7 121:1,2,7 122:8 125:11 130:13,20 old-fashioned 23:21 once 23:18 43:19 75:18 94:9 98:18 101:23 102:19	105:1 106:1 107:18 ones 46:11 63:6 80:19 open 36:17 100:21 101:3 133:19 opened 98:18,25 operate 8:4 20:8 92:4,18 95:1 129:22 operated 20:5 31:1 31:3 37:6 operates 20:13 92:17 96:11 operating 67:18 operation 30:22 74:24 76:4 89:12 operations 129:22 130:7 opinion 34:2 46:19 54:9,21 55:8 58:7 83:2 96:14 108:1 108:7 114:21 116:7 117:17 118:2 123:16 125:16 129:2,18 opinions 2:20 opportunity 37:2 opposed 15:9,11 17:14 21:20 98:12 opposing 12:6,6 108:25 optical 6:6 optimistically 116:19 option 32:17,23 options 7:8 34:3 order 32:15 89:6 101:21 124:20 orientate 44:25 60:5 88:4 102:5 origin 4:14,23 5:6 5:12 18:4,6 19:14 27:23 32:3 34:13 34:14,21 35:1,4	35:13 39:4,10 40:5,9 45:19 47:23 50:17 52:11 53:2 54:17 55:2 56:15 58:5 59:5 61:25 62:3 63:22 64:1 65:23 66:2 67:10,14 68:24 69:9 70:18,19,20 71:2,7,10 107:25 134:2 original 17:15 originally 38:14 origins 4:19 63:14 ought 134:5 outer 63:3 111:22 outlined 14:14 73:25 85:21 94:4 outset 22:21 74:13 88:5 outside 4:19 13:19 25:18 58:5 86:24 99:18 104:16 128:5,8,15,22,25 133:15 oven 47:7,10 overcurrent 8:22 8:22 37:12 45:23 56:23 59:11 overheated 72:9 120:18 overheating 78:20 81:10 82:9,10 85:7 86:11 102:6 102:11,14 103:6,9 122:12 128:6 129:16,18 130:4 131:18 overheats 103:10 overleaf 9:22 overload 36:8 75:12,14,19,20,23 88:23,24 89:6,11 90:5,17 91:4,24 122:4	owe 136:6 oxide 86:1 102:18 oxides 85:24 86:3 oxidisation 85:19 85:20
P				
				P0 61:10,10,14 65:19 P2 61:10,19 64:9 65:20 page 3:1 4:18 9:20 9:22 10:9 14:21 14:22 21:3 26:8 26:13 27:5 28:11 30:3,20 32:4 34:9 34:10 45:15 47:14 49:23 50:10 51:16 52:7 55:17 56:12 58:25 63:10,12 65:14 68:18 70:14 71:12 72:24 77:14 83:18,20 88:2,16 88:17 89:2,14 92:7 94:1,2,4 97:23,25 98:7 102:4 103:22 104:8 106:22,24 109:7,24 114:1 116:16 120:12 124:23 125:6 pages 4:25 47:13 53:12 58:19 107:8 pan 39:5 48:1 panel 56:4,7 panels 57:15 58:10 pans 46:21 paper 54:14,18 paragraph 16:11 26:8,11,13 27:5 34:9 47:21 54:20 83:19,21 84:11 85:18 88:17 89:2 92:7 94:2 97:25 103:24 104:9
O				
o 56:17 o'clock 43:13 87:13 87:21 118:17,20 136:11,15 object 6:12 objects 6:18 obscured 45:6 observation 39:4 42:17 47:2 65:6 66:4 67:11 81:4 83:8 104:23 observations 40:8 45:17,18 46:9,10 47:22 50:13,16 52:11 54:21 56:14 59:3,4 63:21 65:22 68:20 69:8 observe 22:4 observed 11:2 40:12 59:19 65:25				

106:24 part 7:5 14:8 38:6 38:14 41:23 44:13 62:15 72:19 76:13 76:14 77:5,23 103:18 104:21 106:1 119:24 120:8 128:11,14 partially 45:6 participate 120:17 particles 95:21 96:4,5,9,15,19,20 97:12,15 98:2 101:24 particular 6:24 19:12,22 20:24 28:25 40:14 44:13 47:15 63:11 76:4 83:19 88:2 110:8 119:4 125:6 particularly 13:16 27:23 66:5 109:5 parts 72:14 pass 84:24 86:16 136:3 passes 12:14 path 8:11,12,18,19 12:16,18,24 29:16 32:14 33:1 90:8,8 91:3,23 95:3,13 97:9 120:13 121:16,22 129:21 130:5 paths 12:12 patience 136:4 pattern 19:11 Paul 14:21 16:6 17:8 26:9 28:9,10 30:8,17,18,21 37:25 44:23 45:14 47:14 49:22,25 50:10 51:15 52:6 55:18 56:11 58:25 59:1 63:10 68:18 70:14 72:20,24	77:18 80:10 82:12 89:14 97:23 100:2 103:21 106:22 109:6,22 112:10 113:24 115:21 116:1,15,22,23 Pause 83:23 88:21 109:21 116:20 penetrate 101:21 Penfold 135:24 136:8 penultimate 26:8 26:10,14,15 29:8 55:14 people 74:12 perception 98:15 perfect 37:9 performed 77:19 period 4:8 person 1:6 31:9 134:2 personnel 31:8 pertinent 28:14 29:20 PhD 3:18 phenomena 15:2 phenomenon 85:18 photo 24:20 73:6 109:6,20 113:8 116:15 119:4 photograph 23:7 28:9 30:4 77:25 110:13 112:10,11 112:13 113:7,24 119:6 photographs 14:16 28:13,24 30:17 56:11 photos 11:20 24:4 28:18,18 29:4 56:1 112:14 115:18 phrase 71:14,16 physical 5:16 18:19 93:16	pick 3:4 16:17 95:6 picking 99:20 127:21 pictures 125:7 piece 107:19 pieces 35:12 place 36:14 43:14 109:12 120:24 121:19 placed 98:11 placing 128:21 plan 45:1 51:17 52:6 plastic 51:10 54:15 54:19 73:21 111:7 112:21 133:6,9,23 plate 63:24 95:6 132:15 please 44:3 59:1 80:11 118:20 134:11,18 135:12 pleasure 87:14 135:18 plough 6:23 plug 19:7 49:9,15 51:5 54:6,10,10 56:17 57:8 58:4 69:21 92:9,14 96:24,24 97:7 117:6 plugged 29:22,24 29:25 47:25 48:4 48:21,23 49:12 50:20 51:1 53:4 53:19 54:23 56:18 57:10,13,22 58:2 69:21 97:6 plugs 50:23 53:16 111:8 plus 124:16 pm 118:21,23 134:20,22 136:17 point 6:25 11:25 12:25 21:4 24:9 33:18,20 34:2	35:17,20 42:13,14 46:14 61:23 65:18 67:12 68:19 83:5 92:11,11 97:25 98:11 100:2 103:25 107:14,22 116:11 118:5,11 124:25 134:8 pointing 23:21 66:2 67:9 points 3:4 22:19 72:16 77:7 83:16 125:8 126:1 134:5 135:23 poor 72:9 77:10 82:9 83:20 84:22 porosity 14:23 15:8 15:14 porous 15:9 portion 33:14 57:7 58:3 97:9 125:17 126:10 posit 72:10 posited 92:24 100:19 101:22 position 19:23 20:4 20:14 29:1,10,12 30:6,12,14 31:1,3 45:22 46:19 50:1 positions 59:10 possibilities 7:8 34:3 66:23 67:4 101:5 104:13 possibility 6:18 40:4 43:3 46:14 85:23 86:1 100:20 102:20 106:1 107:16 123:15 131:3 possible 18:6 32:5 36:24 63:14 67:22 103:23 116:17 123:9 possibly 8:3 47:10 126:15	post-fire 50:21 53:14 112:12 123:6 postulated 129:5 postulating 93:14 potentially 65:20 power 28:2 31:16 38:12 39:8 48:6 48:10,12 49:7,15 50:17 51:3,5 52:3 52:12,21 54:5,7 56:16 57:2,5,7,18 58:3 63:15 67:6 68:21,24 75:22 76:20 85:6,8,13 85:15,15 86:5 89:21,22,23 91:8 102:19 122:17 pre-predict 37:10 preamble 71:13 preceding 16:11 precise 25:1 73:15 precisely 73:1 96:20 premise 128:21 preoccupied 99:16 prepared 71:25 present 113:10 119:15 presented 113:17 preserve 107:11 president 3:9 pressing 107:14 pressure 78:8 presumably 85:20 101:6 pretty 91:18 prevent 36:2,13 82:8 prevention 35:23 previous 42:18,25 65:18 94:4 115:7 120:1 previously 12:2 14:15 26:17
---	---	--	---	---

primary 6:18 9:12 46:12	projecting 81:17 83:11 125:17,18 126:11	82:12 94:10 103:21 109:6 112:10,10 113:11 113:24 115:5 128:9 135:15	range 6:3,7 22:12 67:23 122:23 123:5	recalling 99:25 recalls 43:6 68:11
principal 3:9 4:7 6:12,15 11:7 22:19 46:8,11 62:11 63:6	prolonged 86:11 prong 96:25 97:1,2 97:2	putting 34:18 105:8 PVC 87:8 PVC-type 87:6	ranging 67:24 rapidly 102:1 118:8 ratings 87:9 RCCB 29:5,13 30:13 32:10,15 33:2,8,10,16 46:3 59:15 94:5,21,25 95:6,8,11,16,25 96:11,14 97:10 101:25	received 42:15 receiver 96:21 97:8 101:25,25 receivers 69:14 97:3,16
printed 21:23 22:6 39:14,17	prongs 97:4,7 pronouncing 20:1 properly 79:21	Q	RCD-protected 46:4 59:16	recognisable 11:10 recollection 98:9
prior 43:7 50:6 54:1 55:3,8 64:7 67:1 105:19 106:9 106:25 107:12	proposition 108:18 126:3 130:14,23	qualifications 2:25 3:1	reach 127:7	record 1:20 31:7 89:17
probabilities 71:18	protected 40:25 61:11,19 67:16 70:4	quantify 97:14,21	reached 102:8	recording 99:13
probability 71:11	Protection 3:24 10:5	quantifying 101:10	reaction 86:2	records 61:8
probable 34:13 35:4,13 54:24 70:19 71:10,23,24 95:20 98:2 102:6 115:12	protective 132:23 protects 8:1	quantity 97:11	read 68:22 83:21 88:19 98:14,21 104:7	recovered 24:10,12 24:13 72:3 73:17 73:24
probably 23:8 28:12 30:4 37:24 48:15 71:6 79:24 115:23	provide 32:2 34:20 74:18 75:6 81:7 85:10 124:24	query 83:7	reader 39:11 47:1 66:1 104:20	rectangular 39:7
problem 8:16 61:21 75:21 78:19 86:8 90:23 105:6,6 107:6,10	provided 1:24 2:14 2:16 53:6 60:14 72:1	question 21:15 23:5 26:1 27:14 29:17 35:25 36:11 44:18 48:16 60:2,25 74:9 78:17 84:8 84:14 94:18 97:22 100:14 103:5 108:12 110:3 113:19 114:4 116:17 117:10 120:1,4 123:12 125:25 126:1 129:14 130:2,20	readily 11:9	red 28:20 30:7 31:5 94:12,13,13 96:8 96:17 99:21 120:14
proceed 77:11	proximity 36:25 86:17 93:16,22 97:3 103:1	questioning 77:5	reading 80:24 126:16	reduce 81:8
proceedings/claims 68:11	PTC 75:2,7,11 112:7,24	questions 1:13 72:13,17 93:25 103:18,20 114:2 118:12 134:24 135:6,7 136:22	really 77:6 94:19 97:24 105:9 126:1 135:14	refer 7:17 8:21 16:11 20:20 56:1 70:23 88:23 119:4
process 14:8 65:2 71:5 86:7 88:12 89:15 96:22 114:17	pull 121:9	quickly 37:1,7,7 40:21 41:7	rear 46:25 62:16 73:18,18 112:19 116:13 133:3,24	reference 21:4 23:8 26:9 109:22 124:14
produce 97:13 105:2	puncture 22:3 punctured 22:2 punctures 39:25	quite 16:16 49:3,4 68:5 84:19 92:12 96:15 99:12 105:10 118:2,8	reason 36:12 37:16 64:18 65:21 66:12 83:3 130:9	referred 5:21 24:23 40:14 61:6 88:3 88:24 125:22
produced 45:1	pure 16:2	quote 98:5 103:25	reasonable 71:14 71:19,22	referring 20:23 21:16 26:13 80:6 85:9 125:21
professional 3:6	purpose 4:12,13 5:5 35:25 37:24 76:12 78:12 124:7	R	reasoning 77:8 94:7,19 103:20 131:11 132:12	refresh 83:21
professor 4:3,5,6 77:24 136:10	purposes 13:2 29:21 38:14 78:4 119:23	race 92:18 ran 128:13	reasons 41:9 66:11 66:21 68:24	refrigerant 62:14 74:1,4,6
Professors 5:1 19:15	push 26:25 put 30:17 56:11		reassurance 127:4 recall 93:8 99:8	refrigeration 62:15 refrigerator 61:2 75:5 76:14,16 89:23 112:19 132:1 133:17,19 133:22
progress 58:9				refrigerators 75:16 133:4,8
projected 115:15 128:15				

regard 34:8 48:18	132:17	41:5 42:15 45:15	resume 136:14	134:18
regarding 63:9	relays 74:22 75:2	45:16 47:13 49:19	retained 4:16	right-hand 29:8
103:20 114:2	75:13,16,25 112:7	49:23 51:16 53:7	retrieved 5:19	30:10 73:2 79:10
region 90:20	released 9:2	55:16,20 56:12,13	return 8:15 12:14	79:12 117:11
registered 3:5	relevance 62:4	58:19 60:4 63:8	12:21,24 56:12	120:14
rehash 110:3	relevant 2:21 12:25	63:11 67:18 70:14	77:24 103:21	ring 69:25 70:2
rehearse 71:4	13:14 19:6,18,22	71:12 72:2 92:21	113:24 116:15	rings 45:7
related 38:16,18	27:13 43:11,12	103:22,22 104:25	119:4	rise 135:23
40:12 69:12	44:15 48:18 62:2	128:2 129:6 131:6	returns 90:6	role 35:22 77:24
relating 38:21	relied 4:25 6:2,7	133:2	review 65:13	102:2
72:15,18	45:2 50:7	reported 42:22	reviewed 63:13	room 43:22 56:3,4
relation 4:23 9:1	relocated 54:1	55:4 68:10	72:2 79:17 108:20	56:8 57:14,16,19
19:21 20:18 34:21	rely 25:23 46:9,12	reports 65:19	130:16	57:20,23 58:2,4,8
35:20 37:23 38:3	107:3	representatives	reviewing 61:8	66:12 99:3 134:13
41:24 50:13 52:1	remain 31:22 34:16	68:12	rib 126:17 127:7,13	roommates 99:17
52:9 68:20 70:15	40:22 48:13 49:18	required 133:4	127:15	rough 122:21
72:13,16 77:6	51:11 54:16 55:6	researchers 15:4	ribs 123:25 126:15	roughly 43:19
129:5	58:12 59:24 68:15	residents 98:13	126:19,24,24	110:12
relationship 70:17	remained 104:14	residual 29:14	127:3,20	round 11:12,16,19
92:23 102:10	remaining 23:2	resistance 81:8,9	right 1:17 2:3,7,14	15:12 17:6,12
relatively 82:25	33:14	84:13,16,18,20,25	3:5,21 4:13,20 5:2	56:17
Relativity 109:24	remains 42:4 54:4	85:3,6,7,11,14,15	5:4 6:2,8 7:9	rule 35:3,12
relay 64:17,22,25	55:10 57:2 60:7	85:20 86:4,5	11:22 14:12 16:12	ruled 35:15 41:9
65:4 72:4 73:12	62:24 64:16,24	90:19 91:12	18:3,9,13,19,24	ruling 34:20
73:22 74:12,13,16	69:3,13,23 74:21	102:18 123:7,11	19:3 22:13 24:21	run 41:2 60:22,25
74:19 75:3,3,7,11	119:8,12 125:3	resolidification	24:25 25:14 26:3	61:3,6,14,21
75:12,13,14,14,19	remember 24:10	13:5,12,16	26:12 28:23 29:5	63:23 64:8,21
75:20,22 76:1	38:18 42:9 55:24	resolidified 11:2	29:20 30:6,11,25	65:3,19,20 74:18
88:23,24,25 89:6	99:16 100:23	13:13 17:13 24:6	38:4,13 44:1,3,7	87:21 90:7,12,15
89:11 90:6,14,17	121:6 124:14	25:21	44:19 45:2 47:19	91:5 93:2,2,4,5,12
91:1,3,4,24 93:21	129:10	resolidify 11:19	50:3 51:20,25	104:2 105:12
102:22 103:1	remnants 13:1 54:9	respect 6:20 13:6	55:21 56:7 58:20	111:11 114:5,18
104:3 111:7,12,24	remove 30:8 45:14	14:10 25:5 26:2	58:23 60:6,11,16	115:17 116:12
112:2,7,8,13,20	69:17 75:22	77:6 83:17 100:4	64:23 69:1 72:6	121:1,2,3,6,9,19
112:23 113:14,21	repeat 34:22 88:8	103:19	72:22 73:2,10	121:22,25 122:2,5
114:20,22 115:6	120:4 130:2,21	responders 100:10	74:1 76:7,25 77:3	128:16 129:12
115:11,14,16	replicates 70:24	response 66:4	79:1,3 80:2,24	131:19,24,24
116:5,8,12 117:6	report 1:25 2:6,10	67:11 104:23	82:17 86:11,21	132:2,7,14,16,17
117:8,14 118:3	2:14,19 3:1,2 4:12	responses 105:25	87:22 88:5,10	134:9
119:12 120:19,22	4:13,18,25 5:5	rest 94:14 116:10	95:15,22 101:10	running 122:6,14
121:6 122:4,6	7:17 8:21 13:15	result 7:2,6,14 10:3	112:13,17 114:8	123:3
128:3,5,8,13,15	18:12 20:19,25	11:16 14:18 31:2	114:21 115:5,23	runs 111:12
128:23 129:1,4	21:1,3 25:9,11	49:5 77:19 89:3	117:17,22 118:7	rust 123:16
130:15,18,24	26:7,8 27:6 30:19	92:13 95:20	118:10,17 120:15	
131:1,6,25 132:6	34:2,9 38:1,15	resulting 77:22	124:5 127:18	

S

safely 75:22	21:3 26:7 27:6,9	49:4 52:17 105:16	shape 11:12 125:16	shown 16:4 24:20
safety 36:1	30:18,20 31:13	114:23	shaped 39:7	24:25 57:17 93:14
sake 68:14	37:25 39:8,16,18	segregated 63:13	sharp 9:25 10:15	110:4 113:16
save 22:13	45:15 47:12 49:18	selected 127:9	11:1,5 17:22	121:16
saw 48:2 93:2	50:12,24 52:19	senior 3:21	she'll 43:24 135:21	shows 23:13 67:21
98:22 99:5 105:1	53:13,17 54:11,13	sense 90:17 98:17	shock 61:12,23	77:16 104:10
109:2 113:8	55:16,20 58:18	sensed 98:20,20	shocked 99:8	112:16 119:7
119:17	59:1 60:3 63:11	sentence 40:23	short 7:19,21 8:9	shut 90:17
saying 24:21 95:15	63:13 66:8 68:18	100:4	8:16,23 9:1 11:3	side 6:15 28:20
107:18 116:3	70:23,25 71:13	separate 2:4 23:14	13:23 31:2,11	29:8 30:10 38:9
121:20	76:9 92:20 116:2	24:17 33:23 47:11	32:12,24 33:4	45:4 56:2,9 69:25
says 98:16 104:9	116:4,6 128:7,11	63:4 102:2 109:4	36:7,16,16,19,21	73:2,5,9 79:12,13
116:19	128:22 129:1	112:11 119:17	36:25 37:11 39:23	80:2,25 82:18
scale 23:13,13	sections 80:15	132:3	40:15 43:18 44:5	110:17 116:25
115:25 117:16	121:5 126:17	separated 54:8,10	45:23 59:10 68:4	119:10 121:17
119:19	see 11:21 12:22	56:4,8 57:16	72:8 75:20 87:25	sides 46:25 47:5
scan 6:16 72:2	14:3,7 15:21 16:8	September 77:21	88:6,11 89:3 90:9	significant 66:1
77:19,22 78:6	16:14,19,20,22	sequence 30:23	90:10,11,13,19,20	67:9 135:25
79:5,9 126:22	17:4,7,10,13	32:8,21 34:4	90:24,25 91:2,13	significantly 111:5
127:22	21:10 23:10 25:17	sequences 32:5	92:25 94:3,12,16	similar 15:12 17:5
scanner 26:22	25:20 30:9,13	sequencing 34:12	94:20,24 95:2,10	112:1 124:19,22
scanning 6:3	31:12 37:16 39:14	series 103:12	101:19 102:11,25	125:1,4 132:8,18
scans 6:3 114:9,11	39:15 42:19 43:6	serious 80:19	103:4,11,15 114:7	Similarly 69:5
scenario 48:20	45:4 49:7 50:24	serrations 123:22	118:22 120:13,17	simple 18:12 91:18
72:11 92:13,24,25	52:19 53:13,17	123:25 124:5,7	121:5,16,22 122:1	103:5
94:4,20 100:19	54:11,13 64:5	serve 76:12 89:11	122:3 128:19	simply 43:11 92:16
101:22 102:3	69:18 71:13 73:4	served 29:19 44:20	129:3,7,13,16,20	114:25 115:24
122:10 128:1	78:1 79:24 81:16	45:11 65:3 66:13	131:15 134:21	128:9 135:9
129:5 131:12	83:9,11 87:19	serviced 44:18	short-circuit 56:23	simultaneously
scope 4:19	90:2 91:2 93:20	set 2:9,20,25 4:18	shorted 90:15	32:11,16
screen 6:22 16:9	94:12 95:8,12	4:24 5:17 6:7	shorter 131:21	single 96:25
21:7,8 23:9,21	98:24 99:7,8	13:15 26:10 27:1	132:10,13	single-socket 69:23
24:9,20,25 116:18	111:10 112:24	27:12 32:4 42:13	shorting 32:13	sir 1:3,9,11,14,16
second 29:11 30:10	124:12 125:9	42:14 43:1 45:17	shot 30:5	1:17,18 2:18 3:11
31:7 32:23 33:8	134:5 135:1	47:21 49:18 50:12	should've 108:12	3:20,23 5:13
33:12,15 34:1	seeing 74:21	53:1 56:14 59:2	shoulder 16:9	16:12,16,18 18:17
62:21 66:6,10,18	seen 5:10 37:5 84:9	65:22 68:15,25	show 14:17 15:8	21:11 22:10,14,15
66:22 75:12,14	133:2	72:18 77:8 78:24	23:7 24:4 28:15	43:13,16,18,25
77:5 81:12 100:4	sees 95:12	79:15 102:11	28:16 41:6 81:13	44:1,7,9,10 51:12
135:5	segment 18:3,4	128:2 129:8	114:9,11 116:18	55:22 58:24 59:25
secondly 8:6 72:16	23:11,14 24:18,22	131:11 132:12	showed 22:23	68:17 69:2 72:7
74:12	52:18 65:8,17	sets 38:2 70:15	50:23 53:16	77:4 80:8 87:17
section 3:1 4:18,25	66:7 114:16	setting 20:18	showing 79:14 90:8	87:18,23 88:14
6:8,20,25 9:18	segments 23:14	severe 8:23	90:11,24,25 122:1	89:1 93:13,19,23
15:20,21 20:19	24:16 25:15,18	severed 57:18	127:14	102:9 109:8,10,11

109:13,17 118:5,7 118:10,13,14,18 118:19,24 119:1 120:16 124:12 134:4,7,16,17,19 134:23 135:3,7,12 135:18,19,23 136:6,9,12 sit 1:14 118:24 site 25:22 sits 110:12 sitting 109:14 six 123:2 size 13:4 111:24 124:21 sized 27:7 52:12,15 52:21,22 53:4,9 53:16,18,22,25 54:2,5,6,16,18,22 104:15,16 sketch 45:1 49:23 50:4 51:17 52:6 sleeping 58:9 66:11 slice 81:12 83:4 126:23 127:6 slices 78:25 79:7,14 79:15,16 81:11 125:10 126:20,21 126:23,24 127:1 slide 80:25 slides 126:2 sliding 56:3 57:15 58:9 slightly 62:22 111:20 SLW/111 65:8,16 small 10:22 14:11 29:15 49:21 50:1 50:14,17,20,23,25 51:2,4,7,9,21 73:20 74:15 76:9 90:21 91:7,9,10 91:15 96:9,12 97:16 111:9 131:5 smell 98:17,25 99:2	99:2,3 smelled 98:20 smoke 58:11 95:21 95:21 96:4,4,5,5,9 96:9,14,18,19,20 96:20 97:6,7,12 97:12,15,18,22 98:2,2,10,15,18 98:20 99:5,5,14 100:1,17 101:7,12 101:20,23 smooth 11:12 smouldering 108:2 snapshot 20:9 so-called 61:10,14 61:19 75:2 81:8 socket 38:11 48:4 48:23,24 51:1 53:19 57:10,13,13 57:19,20,23 58:2 69:17,18,20 95:22 96:7,15,23,24 97:3,5,6,15 98:4 101:21,24 socket/switch/spur 70:5 sockets 29:3,19 32:18,19 33:5,13 33:13 50:24 53:17 56:17 57:21 95:23 96:2,3 sold 42:20 soldered 65:9 somewhat 34:18 80:14 81:14 soot 96:5,15 97:15 97:18 101:23 sorry 20:25 29:23 88:8 110:11 sort 22:12 37:15 sorts 9:4 87:8 sought 36:12 source 31:16 42:16 sources 18:20 south-east 5:6	space 79:23 80:1,1 80:2,6,6 93:20 125:18,21,22,22 133:19 spaces 79:19 83:9 83:13 84:25 126:8 spade 81:25 span 133:18 speak 12:18 63:2 special 29:13 specially 5:21 specific 36:2 43:1 72:17 103:20 107:8 114:2 specifically 127:15 spectroscopy 6:5 speed 75:10,18 spend 74:25 split 116:17 spread 17:21 127:25 spur 38:10 40:10 69:25 square 85:13 stage 18:11,15 76:7 80:22,23 89:18 stages 31:20 55:1 standard 71:18 91:20 Standards 133:5 stands/wire 70:3 start 63:19 75:3,7 117:9 118:16 122:17 133:12 started 4:5 46:16 75:9 129:19 starting 6:25 22:21 23:4 36:13 72:19 79:9 128:3 133:14 133:16 starts 83:20 88:18 103:9 108:11 123:1,2 state 31:6 50:19 53:3 106:24	stated 31:4 statement 53:8 98:6,14,17,22 107:5 statements 31:6 states 47:24,25 53:8 100:6 132:23 133:3 staying 34:9 85:18 97:22 125:6 steel 9:10 133:5,6 133:17,20,25 stenographer 89:16,19 stenographer's 78:4 step 18:4 29:17 stop 60:24 78:12 80:5,22 87:20 109:12 112:16 118:10 stopped 53:9,11 55:4 Stopping 23:20 31:22 48:15 64:1 81:11 100:8 107:2 125:21 stores 61:1 straightforward 10:18 108:17 strand 26:1,4,11 27:8,11 52:19,23 65:1 76:24 93:8 114:6 strand-count 52:2 stranded 11:18 13:25 23:25 24:16 24:18 25:15 52:16 stranding 51:25 52:24 strands 6:16 11:17 18:7,12,16 24:1 26:19 27:8,11,15 27:24 41:22 42:6 42:8,10 52:5,18	52:23 64:20 65:17 77:2,3 78:10 80:21,21 81:6,8 81:15,17,24 82:3 82:4 83:12 84:1,6 85:4,4,24,25 93:5 93:7,7 105:10,14 114:9,12,16 115:2 115:4 117:21 120:25 121:1 124:2,8,17,17,21 126:6,11 131:16 131:16 stripped 86:23 strongly 54:22 subject 61:16 62:2 62:7,20,25 64:9 65:13 93:4,10 110:25 131:9 subparagraph 21:12 41:17 42:13 67:5 68:9 70:9 subparagraphs 43:1 68:25 subsection 63:20 69:5 71:1 subsequent 104:18 substantive 103:24 successful 36:22 suffer 23:2 suffered 23:1 sufficient 9:3 31:12 37:12 45:24 59:11 89:7 90:22 106:6 107:19 sufficiently 37:7 93:15 suggest 87:18 suggestion 105:25 suggests 104:20 suite 125:7 suits 43:6 109:18 summarised 17:17 22:20 summary 5:25 7:7
---	--	---	---	---

9:16 17:23 20:11 24:19 38:2 45:17 50:13 52:8 55:17 59:2 71:8 72:11 77:11 85:22 86:13 94:5 95:18 102:7 superficial 46:24 supplemental 135:6,7 supplied 35:8,9 45:20 57:20 59:7 132:3 supplies 38:12 89:22 supply 28:2,3 38:9 39:8 47:4 48:7,7 48:10,12 49:8,8 49:16 50:17,18 51:3,6 52:12,13 52:21 54:5,7 56:16 57:3,3,5,6,7 57:18 58:3 63:16 63:16 67:7 68:21 68:24 89:21,22,22 91:8 92:10 122:17 supplying 91:19 support 39:10 40:9 45:18 47:22 50:16 52:11 53:1,6 54:22 56:15 59:4 64:1 65:23 68:23 69:8 supported 63:21 supports 39:4 suppose 90:12 97:5 113:19 sure 100:6 109:13 136:13 surface 12:7 16:4 16:20,23 82:5 surprised 134:25 survived 47:8 suspect 86:17 sustained 107:17 switch 19:19 20:2,5	20:6 28:20,20,21 28:24 30:5 31:1,5 31:14,17,21 40:19 40:20 41:3,3 66:16 90:18 95:17 96:8,17 99:21 switched 61:18 switches 40:10 46:17 75:11 switching 74:23 75:25 sworn 1:12 136:22 system 130:18 131:1 <hr/> T <hr/> take 11:5 29:17 36:15 43:16,19 55:15 80:22 82:12 89:15,18 94:7 96:13 108:19 115:24 116:15 117:13 131:23 taken 5:4 10:4 14:17 16:12 57:17 79:5 100:9 113:13 takes 36:17 talk 15:10 28:12 32:7,22 43:21 44:16 90:11 118:14 131:24 134:12 talked 51:22 62:9 talking 13:12 75:24 84:17 90:10 122:19 tapered 80:1 tapers 80:1 taps 38:11 taste 99:3 tasted 98:21 team 136:3 technical 7:17 92:12 technically 69:15	technician 53:12 107:7,8 technologies 6:3,7 Technology 3:16 Tecumseh 62:19 110:10,22,23 111:10 132:9,18 tell 108:4 119:18 temperature 9:11 16:2 87:8 temperatures 9:8 10:20,21 tend 13:13 tenured 4:2,6 term 84:17 terms 5:23 6:16 7:17 10:18 11:13 13:7 55:11 93:16 134:1 testing 122:13 thank 1:9,11,14,16 1:18,22 2:23 4:10 5:14 8:5,20 14:9 14:20 15:16 16:18 16:24 17:16 19:16 20:17 22:9,14,15 22:16 23:3 24:8 25:25 27:4 28:6 30:16 32:21 37:18 41:16 42:12 43:17 43:25 44:1,3,9 45:11 46:22 49:13 49:24 51:13 55:13 56:10 58:14 60:1 68:8 69:22 76:22 77:18 82:11 83:15 85:17 87:11,23,24 88:15 92:22 93:23 93:24 94:23 103:17 105:24 113:4 116:21,22 116:24 118:4,13 118:18,19,20 119:1,2 123:19 132:20 134:16,17	134:19 135:9,12 135:16,19,24 136:7,8,12,16 thanks 136:4 thereabouts 25:2 115:9 129:23 thermal 100:8 thing 21:18 things 35:12 39:19 99:24 108:23 109:2 119:19 think 11:22 17:8 21:8 22:10 26:10 36:3 37:6 43:2 50:1 51:24 58:20 74:4 83:3,5 89:9 89:19 91:16,20 95:15 96:23 97:14 102:12 104:5 109:19 112:3,12 115:10,22 116:3,4 117:3 120:14 124:12 129:11,15 130:20 133:7 136:5,6 thinking 20:24 109:14 127:20 thinks 134:9 thinning 17:2,3,13 third 25:19 31:10 65:6 70:7 71:13 83:4,19 88:17 97:24,24 105:16 106:24 114:13 thirteen-ampere 92:9 thousands 9:8 10:20 75:16 three 2:4 46:8,10 48:12 49:9 63:5 63:14 72:14 79:4 97:7 98:20 99:13 105:9 126:15 threshold 96:12 ties 14:4	tight 26:25 78:16 78:18 80:3 82:8 125:24 126:8,9 tightly 78:15 125:9 126:3,5 time 4:8 32:20 34:1 36:15,17,18 46:1 48:4 51:1 53:5,19 54:1,23 55:3,9 56:19 57:10,12,21 58:1,9 59:13 61:18 66:20 67:1 67:2,20 74:25 75:6 76:20 86:9 96:16 100:21 101:8 102:18,23 103:2 104:13,16 104:24 107:1,10 109:18 116:18 130:21 131:23 133:22 timed 31:9 times 67:19 85:14 123:2 timing 30:22 34:11 41:5 today 1:5,23 66:7 135:4,10,24 136:2 136:10 today's 1:4 told 53:12 107:9 tomography 77:20 79:5 tomorrow 136:11 136:15 tool 26:22 27:1 78:8 top 14:21 15:21 30:4 45:4 46:15 46:15,18,21,21 51:22 63:12 77:23 104:9 110:16 115:22 125:7,23 126:13,14 topic 4:11 5:15
--	---	---	--	---

6:10 22:17 28:7 87:25 102:2 109:4 132:20 total 79:8 touched 129:7 traces 53:21 track 94:18 tracking 12:20 22:6 trade 75:15 training 71:21 travel 128:25 travelled 128:17 tried 48:20 123:17 trigger 101:22 triggering 100:18 Tring 26:23 77:20 77:21 trip 8:3 31:12 32:3 32:15 33:2,7,9 34:15,19,25 35:3 36:7,9 37:12 40:17 45:24 46:1 57:25 59:11,13 66:14,15 67:23 70:22 89:7 92:2,5 92:8,19 94:5,21 95:1,2,7,13 96:14 96:16 97:10 103:16 106:6 107:20 tripped 20:10,12 20:16 31:17,18,19 31:25 32:9,11,20 33:23 34:12 41:11 67:1 68:6 95:16 95:23 106:4,11 108:8 tripped' 31:2 tripping 32:5 trips 33:17 102:1 108:10 true 2:11 trunking 70:5 try 119:20 123:11 trying 6:22 86:16	101:18 122:2 124:13 Tuesday 1:1 turn 6:20 7:15 14:21 15:19 22:19 25:4 26:1,7 28:10 30:18 37:19 47:14 51:14 52:7 58:25 60:2 63:8,10 68:18 71:12,25 72:21,24 83:18 87:25 88:1,16 92:23 94:1 97:23 102:4 103:18 104:7 106:22 113:25 114:2 120:11 127:24 turned 9:18 20:2,5 20:10 28:21 31:4 31:6,14,17,20 66:15 75:4 95:16 turning 23:4 27:5 47:11 64:14 70:14 71:1 99:21 123:20 turns 20:6 96:8,16 two 7:8,8 22:22,25 23:11,17,25 24:5 24:7,16 25:17 26:12,18,21,23 27:24,25 28:25 29:1 30:24 31:9 31:25 32:4,5,9 33:10,18,22 34:3 34:3,12 42:9 57:24 64:16,25 65:19 66:23 67:4 69:14 74:22 75:2 75:13,25 76:10,13 76:17,24 78:1,4 79:4 80:7 81:16 89:21 90:16 95:25 98:8,13 99:15 104:12 105:2,11 105:13,15 106:5,7 110:13,18 112:7	121:9,10,12,13,24 122:5 124:10 125:22 126:15 129:6 134:25 135:3,23 Tying 115:7 type 39:18 41:24 types 22:1 typical 87:9 typically 87:6 91:13 <hr/> U UK 133:6 undamaged 9:25 10:16 108:25 undergone 71:4 underneath 103:24 underside 51:9 understand 10:12 74:13 84:14 89:10 93:13 96:22 101:18 122:9 124:3 130:2,20 132:2 understanding 26:3 35:22 38:13 51:25 61:8 62:6 76:8 86:11 94:19 94:22 123:20 understood 40:6 60:8 95:14 111:1 117:23 119:22 121:20 127:23 Underwriters 133:4 unique 135:3,5 unit 8:14 12:13,15 12:22 19:4,21 20:3,3,6 28:8,17 35:19 37:15,17 45:21 59:8 69:20 110:12 United 91:20 132:23 133:3	University 3:13 4:4 unknown 57:9 unplugged 53:10 unprotected 61:14 unrelated 46:4 54:1 55:3,9 57:23 59:17 67:2 107:1 upper 110:20 use 50:20 53:4 71:11,14 86:7 126:5 136:14 useful 34:20 35:16 35:21 37:25 39:3 48:17 76:3,22 77:14 89:9 135:14 usher 43:24 118:16 134:14 135:21 usual 134:4 usually 7:24 134:8 utilised 61:2 utility 31:16 <hr/> V vacated 20:1 28:22 66:17,18 100:1 vacating 99:21 valiantly 89:16 value 95:10 variability 26:24 variety 5:23 various 6:23 13:1 19:9 28:23 37:20 39:1 50:5 66:11 68:19 76:4 113:13 114:3 verifying 46:19 Veritas 27:19 52:16 53:6 104:12 versions 2:7 versus 41:6 vicinity 10:23 56:7 view 31:22 34:16 37:4 40:22 49:18 51:11 55:6,10 58:12 59:24 61:23	68:16 69:3 94:3 95:15,18 119:9 133:14 viewed 14:23 views 36:11 38:3 68:15 violent 36:3,4,20 visible 13:19 14:2 87:1 89:17 visualising 112:18 vividly 35:18 void 79:19 83:9,13 84:24 126:8 voids 80:12,13,14 80:15 81:1,13,15 81:20,21 82:19,20 83:6 84:23 85:2,5 85:23,24,25 86:1 86:16 103:12,14 105:1,1 126:20,22 126:24 127:2 voltage 91:17,20 volts 91:19,21,22 <hr/> W wait 37:10 wake 99:18 waking 99:16 wall 57:14 want 20:20 37:19 44:16 67:12 82:8 83:5,16 97:20 107:9 128:21 wanted 109:13 122:7 warning 110:19 wasn't 80:3 106:14 waves 13:5,13,17 way 2:16 11:3 20:7 23:21 24:1 27:18 39:21 42:1 66:9 67:14 72:1 80:20 81:7 83:10 89:25 93:7 96:11 101:4 110:7 130:17
--	--	--	---	---

131:1	33:1 40:18 51:3	75:24 76:4,10,13	worked 4:6	0.18mm 52:24
ways 26:21,23	52:16,18 53:24	76:17,19,21,24	working 53:9,11	0.4 129:23,24 130:7
98:20 99:13	64:21,21 65:4,8	78:1,13,17 81:1,3	55:4	<hr/>
we'll 11:21 22:19	65:16 66:7 70:5	81:13,20,22 83:6	workings 101:21	1
43:23 55:10 76:3	72:3,8 74:21	83:7 86:18,19,22	world 75:17	1 9:25 14:4 32:8,17
87:19 118:10,16	75:24 76:8,9,10	86:25 89:21 90:15	worry 16:15 38:20	34:13 35:9 39:6
122:17 134:11,14	78:3,9,10 79:22	90:22 93:4,8,11	worse 86:8	40:11 43:1 44:20
136:14	80:7,21 81:2,6,15	93:21 102:25	would've 2:16 20:4	44:21,22 45:12,20
we're 13:11 19:17	81:17,22,24 82:3	103:3,15 105:9,11	41:11,11 48:21,23	45:20 47:24 50:19
43:19 66:5 76:18	82:4,4 83:7,12	105:13,15 108:20	51:22 73:20 86:20	52:14 53:3 54:21
82:22 91:18	84:1,2,6 85:3,4,25	111:19,21,21	105:22 107:19	54:25 56:17 59:7
106:21 107:18	86:12,17 87:2,4	112:8,25 113:2,6	117:11,16 131:16	63:14,23 65:23,25
108:6 109:19	88:7,7,12,12	113:20 114:15,18	wouldn't 17:25	68:25 69:11 72:25
110:16 112:18,20	89:23 90:5 91:2,2	114:19 117:1,12	94:21 123:17,25	87:13,21 91:16,22
119:14 122:19	93:6,14,15 94:17	117:20 120:17	WPL000003234	92:20 104:14
125:11,15 127:5	94:17,25,25 95:3	121:2,10,12,25,25	109:7,22	114:3 116:16,24
135:17	95:5,11,11 97:1	122:5 125:8 126:3	wrong 22:21 116:3	136:22,22
we've 32:9 43:13	102:21,24,25	129:7,13,19	<hr/>	1-3 67:13
71:4 84:9 97:25	104:2,3 105:9,16	130:15,24 131:5,8	X	1.00 118:21
111:6	106:12 109:1	131:19,20,23,24	X 136:21	1.1 4:18 6:8
Wednesday 136:18	112:8 114:5,9,11	132:7,16	X-ray 6:4	1.3 3:1
weight 42:24 43:9	114:12,13,16,23	wiring 5:24 13:1	<hr/>	1.5 24:2,24 116:6
98:12	114:24 115:1,3	38:21 40:10 41:20	Y	117:18,25
welcome 1:3 44:12	117:14,16,19,21	41:24 46:7 48:7	year 1:25 2:2,2	10 23:12 47:12
went 62:7 99:4	117:22 118:2	48:11 55:14 58:15	72:1	54:12 66:8 106:22
105:2 115:18	119:3,14 120:6,25	58:17,21 59:19,22	years 4:9 53:10	115:9 122:20,23
weren't 41:23	121:1,3 123:20	62:23,24 63:17	55:5 67:2 105:7	123:5 128:14
Whilst 108:14	124:2,7,9,17,21	69:6,9,13 70:4,8	105:19 107:6	136:11,15
Whirlpool 60:14	125:11,23 126:6	70:10 76:13,16	yellow 23:13 53:12	10-centimetre
61:9,18,18 68:10	126:13,15 127:8	91:7,10 95:24	107:7	23:15,24
68:12 94:14	127:10,12 129:9	111:15,18 131:22	<hr/>	10.00 1:2 136:19
wide 67:23 125:19	wires 8:1 13:25	withdrew 135:22	Z	10.3 20:19 21:3,10
width 25:3	14:1,2,5,6,8,18	withstand 87:8	zero 56:20	47:21 49:18
winding 75:7	17:2,2 21:19 22:8	witness 1:16 18:22	zigzag 120:14	10/11 24:17
window 5:7 38:8,25	23:11,17,25 24:5	43:25 44:9 53:8	121:17	100 67:25 71:20
41:2 58:22	24:7 25:12,18	98:5 109:10,16	zip-locked 113:11	1085°C/1984°F
wire 6:16,17 8:10	26:20 27:7,10,14	118:13,18 134:16	<hr/>	16:3
8:10,11,13,16,18	27:23 28:3,4 38:9	135:18,22 136:15	0	11 32:4 34:9 43:13
9:6 11:15,17,18	41:2,22 42:6,7	witnesses 99:15	0 95:12	54:14,21
12:13,15,24 16:19	47:3 48:12 49:2,4	wonder 87:15	0.03 96:13	11.00 44:4
17:14,15,25 18:3	49:9 52:4,23	wooden 56:3,7	0.03-millimetre	11.10 43:23 44:3,6
18:6 23:14,14,15	62:23 63:1,2,3,4	word 20:12 71:11	79:11	11.7 37:25 39:3
24:1,16,18 25:15	64:16,20 65:1,3	86:8	0.16 27:2,8,11	113,000 42:21
25:18,19 26:18,20	65:12,16 69:24	words 88:18 126:5	52:19,24	12 23:2 60:3 88:16
26:23 32:13,25	70:2 74:17,17,20	work 22:12	0.17 76:25	89:2 92:7
			0.18 27:3,8,11	

12.10 63:11 70:25	1977 4:2	24-strand 28:4	59:21 98:7 100:3	7
12.10.1 63:20 68:15	1990 4:2,9	114:24	4.31 52:20	7 13:18,19 29:2,4,6
12.10.2 68:18		24-stranded 26:20	4.4 26:7	29:12,18,21 30:1
12.10.3 69:5	2	240 91:21,22,22	4th 99:19	30:11 32:10,12,16
12.9 27:9	2 4:25 11:11,12	27 1:1 24:13 27:17		32:18,24 33:4,6,9
13 42:2,4 58:18	32:21 34:4,14	52:15 55:18 56:12	5	33:11,11,17,23,25
67:12 88:2 89:14	40:15 44:24 46:1	104:11	5 9:20 13:4 24:18	35:10,15 38:7,10
94:1 120:12	48:3 50:21 52:21	28 136:18	48:12 51:5 53:21	40:16 41:8,12
13-amp 67:23 68:2	53:8 55:3 56:1,25	29 109:24	57:12 72:24 114:1	44:19,20 51:9
92:13	59:7,9,13 63:15		116:16 122:23	53:13 54:4 58:1
13-ampere 67:17	64:14,15 66:13	3	123:5 134:4	59:16 63:17 66:24
67:20 68:6 92:2	67:5,6 68:25 70:1	3 4:18 11:24,25	5-minute 134:11	67:19 69:6 70:3,3
92:15,20 122:18	77:15 80:10,10	21:4,5,12,13	5.00 135:4	76:5 83:18 88:2
13.5 59:1	82:12,25 83:17	24:23 25:2 41:17	5.5 45:15,16	88:13,18 89:13
14 4:9 5:18,21 6:19	84:3,9 104:15	41:18 43:1 46:6	50 65:14	91:7 92:2 94:10
24:13 57:17 77:2	118:17,20 125:7	48:5 50:25 53:14	57 103:22	94:11 95:23,24,25
93:7 97:23 98:7	125:23 126:13	57:4 59:7,9,18		102:12 106:4,7,11
124:16 131:16	2.00 118:23	63:16 65:7 67:13	6	107:20,22,23
15 1:25 2:1 24:21	2.1 6:20 9:18	68:9,10 69:24	6 4:25 13:5,6,8	108:8 115:15
24:24 102:4	2.2 15:20	70:4,9 82:13,15	14:22 46:14 49:15	117:15,16,24
104:24	2.25 134:20	83:17 84:3,9	50:24 51:7 53:23	120:3,12,24 129:8
15.1 70:23	2.35 134:15,18,22	103:18 118:2	55:16,20 57:20	129:11
16 2:2 4:24 5:9,19	2.40 136:17	3-amp 41:6 67:6,15	77:14 104:10	7.3 50:12
18:23 19:25 24:11	20 26:8,13	3-ampere 41:4,10	124:23	77 70:14 71:12
27:24 28:5,17,22	2004 3:9	67:15	6.1 53:17	7th 30:25
29:3 30:1 31:15	2006 60:16 61:13	3-pin 96:24	61 63:10	
39:5 40:16 41:19	2008 60:9,10 61:17	3-pronged 96:24	63 58:19	8
42:2,5 45:19,21	2013 42:21	3.2 118:1	64 58:19,25	8 4:25 14:10,11
47:23 50:18 52:13	2017 24:13 57:17	3.4 30:18,20	6A 59:11 82:22	16:5,6 29:9,10
57:17 59:6,8	105:7,20	30 50:10 96:12	114:4 117:5,20	33:11,13,13 46:23
60:19 61:16 62:20	2018 1:1 52:15	97:17,19	124:10,15,17	46:24 49:23 51:16
69:10 71:13 72:1	77:21 104:12	32-A 89:7	6B 72:16 73:1,16	54:6 58:7 59:16
73:14 93:4 98:8	136:18	32-amp 41:7,12	76:8,24 82:22	66:13,15 96:1,2,3
98:13,19 100:10	23 45:15 77:2 93:7	67:19,22 68:5	83:11 86:20 102:3	96:7,15 110:1
102:7 105:3	109:7 124:17	92:1,7,16	102:6,11 112:17	115:15
106:10 110:6,25	131:16	32-ampere 92:4	119:18,21 122:14	8-0 79:13 126:21
111:4 113:3 119:9	230/240 91:19	32A 31:12 45:24	123:7 124:10,15	8.2 27:6
130:16,19,25	24 24:1 26:19 27:7	33 52:7	124:16 125:8	8.5 117:25
131:2,21 132:10	27:10,14,24 42:8	37 47:13 124:17	129:12 131:15	80 79:13,18 80:15
16.1 70:17	42:10 52:5,18,23	39 21:3 47:13,14	6C 113:1 114:4	126:21
16.2 71:1	64:20 65:1,17	3A 40:20 126:12	117:1,5,12,13,19	
17th 15:4	93:5,8 105:10,14		119:14,18,21,23	9
18 57:15	114:6,9,12,16	4	119:25 120:3,6,9	9 14:23 17:8 54:9
1968 3:17	115:2,4 117:21	4 3:1 12:4,5 25:16	6F 114:5 117:1,12	54:11,13 104:8
1971 3:19	120:25 124:17	31:13 42:13 48:9	6th 30:25	115:15
		51:2 53:18 57:7		

<p>90 87:10 911 99:22 921 108:21 999 99:23,24 101:9 101:13</p>				
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