



GRENFELL TOWER INQUIRY RT

Day 290

June 13, 2022

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Monday, 13 June 2022

1
2 (10.00 am)
3 SIR MARTIN MOORE—BICK: Good morning, everyone. Welcome to
4 today's hearing. Today we're going to hear further
5 evidence from Professor Bisby.
6 Yes, Mr Millett.
7 MR MILLETT: Yes, Mr Chairman, good morning. Good morning,
8 members of the panel.
9 I now call back, please, Professor Bisby.
10 PROFESSOR LUKE BISBY (affirmed)
11 SIR MARTIN MOORE—BICK: Thank you very much.
12 Now, please sit down and make yourself comfortable.
13 (Pause)
14 Yes, Mr Millett.
15 Questions from COUNSEL TO THE INQUIRY
16 MR MILLETT: Mr Chairman, thank you.
17 Professor, welcome back. We are going to hear your
18 evidence today in response to questions that I have for
19 you.
20 We will take scheduled breaks in the normal way, as
21 we have throughout the Inquiry with the witnesses.
22 Can I just ask you, please, one thing that I always
23 ask all witnesses, and that is to keep your voice up, to
24 speak slowly and clearly, so that the transcriber, who
25 sits over there to your right, can get down everything

1

1 you say on the transcript clearly.
2 A. Sure.
3 Q. Now, you've produced six reports for Phase 2 of the
4 Inquiry, three of which we referred to last week when
5 you gave your presentation, and those dealt with the
6 experimental work that you carried out. So that was
7 work package 1 and work package 2. Those were,
8 respectively, {LBYP100000002} and {LBYP200000001},
9 dated, respectively, 15 March 2020 and 15 December 2021.
10 I'll call each of those "work package 1 report" and
11 "work package 2 report".
12 Now, the third report that you produced to
13 the Inquiry when you gave evidence last week was your
14 materials testing report at {LBYP200000002} of
15 24 February 2019, updated on 1 June 2020, and that is,
16 as I think you told us, to be read in conjunction with
17 your final Phase 1 report, 21 October 2018, and that is
18 to be found at {LBYS0000001}.
19 In addition, you've produced to the Inquiry another
20 report, and that is at {LBYP200000001}. Can we please
21 have that up on the screen. Here on the screen now is
22 "Phase 2 — Regulatory Testing and the Path to Grenfell",
23 dated 10 November 2021, updated twice, 4 December 2021
24 and 1 June 2022, this year. We'll call that your "Path
25 to Grenfell" report.

2

1 If we can go, please, to page 12 of that report
2 {LBYP200000001/12}, you will see paragraph 1.16, under
3 the heading "Statements", and there again are the
4 familiar fourfold paragraphs setting out a number of
5 matters which cover the statement.
6 First, are these your statements in relation to this
7 report?
8 A. They are.
9 Q. Secondly, you can see a signature at the bottom, next to
10 the date of 10 November 2021; is that your signature?
11 A. Yes, it is.
12 Q. Have you read this report recently?
13 A. I have.
14 Q. Can you confirm that the facts and the factual matters
15 set out in it are true to the best of your knowledge and
16 belief?
17 A. Yes.
18 Q. And can you confirm that the opinions you give are your
19 honestly held professional opinions?
20 A. Yes.
21 Q. Is it true that you provided your expert opinion in this
22 report to the Inquiry in the same way as you would have
23 provided it to an English court?
24 A. That's correct, yes.
25 Q. Can we then turn to another report, which is

3

1 {LBYP200000003}. This is entitled "Phase 2 — BRE
2 Reconstruction Report", and there is a signature there
3 above the date, 10 May 2022. Is that your signature?
4 A. Yes, it is.
5 Q. Can we go, please, to page 4 {LBYP200000003/4}, where we
6 can see paragraph 1.1, and there again the fourfold
7 statements about the report and a signature at the
8 bottom, next to the date. Again, is that your
9 signature?
10 A. Yes, it is.
11 Q. Are these your statements about this report in
12 particular?
13 A. They are.
14 Q. Have you read this report recently?
15 A. I have.
16 Q. And can you confirm that the facts and the matters set
17 out in this report are true to the best of your
18 knowledge and belief?
19 A. Yes.
20 Q. Can you confirm also that the opinions that you give in
21 this report are your honestly held professional
22 opinions?
23 A. Yes.
24 Q. And, also, that you provided your expert opinion in this
25 report to the Inquiry in the same way as you would have

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1 done providing it to an English court?
 2 A. That's correct.
 3 Q. Right.
 4 Lastly, then, please, if we can turn to
 5 {LBYP20000004}, we can see a report entitled "Phase 2 —
 6 BR 135 Desktop Assessment Report", and there is
 7 a signature there above the date of 30 May 2022. Is
 8 that your signature?
 9 A. Yes.
 10 Q. Can we turn, please, to page 7 in that report
 11 {LBYP20000004/7}, paragraph 1.2. The four paragraphs we
 12 can see there again, above a signature, against the date
 13 30 May 2022. Is that your signature?
 14 A. Yes, it is.
 15 Q. Are these statements here statements that apply to this
 16 report?
 17 A. Yes.
 18 Q. And have you read this report recently?
 19 A. I have.
 20 Q. Can you confirm again that the facts and matters set out
 21 in this report are true to the best of your knowledge
 22 and belief?
 23 A. I can.
 24 Q. And can you confirm that the opinions that you give in
 25 it are your honestly held professional opinions?

5

1 A. Yes.
 2 Q. And is it true that you provided your expert opinion in
 3 this report in the same way as you would have provided
 4 it to an English court?
 5 A. That's correct.
 6 Q. Can you confirm, in relation to all of these opinions
 7 that I have shown you this morning, that your opinions
 8 and conclusions in them have not changed since they were
 9 produced to the Inquiry?
 10 A. That's correct.
 11 Q. Now, you've given evidence before, including in relation
 12 to your experience and your fields of expertise, and
 13 you've set those out in a CV that you provided in your
 14 final expert's report for Phase 1 at appendix E. I'll
 15 just push that up on the screen so that those who want
 16 to look at that can. It's at {LBYS0000001}. That's the
 17 final expert report, and if people want to see — well,
 18 perhaps we should go to your Path to Grenfell report at
 19 {LBYP20000001/10}. Here, at paragraph 39, under
 20 paragraph 1.4, you summarise what you've already told us
 21 in the previous report I put up on the screen, and that
 22 runs over to page 11. What I want to do is just
 23 summarise briefly with you what you say about yourself.
 24 First, is it correct you are currently professor of
 25 fire and structures within the school of engineering at

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1 Edinburgh University?
 2 A. That's correct.
 3 Q. And also, within the same school, the head of the
 4 research institute for research and environment.
 5 A. Infrastructure and environment, yes.
 6 Q. Infrastructure and environment.
 7 I think, formerly, you were Royal Academy of
 8 Engineering research chair.
 9 A. That's correct.
 10 Q. As well as Arup chair.
 11 A. They were linked.
 12 Q. They were linked.
 13 And in the UK, you are a chartered structural
 14 engineer.
 15 A. Correct.
 16 Q. And in Canada, a licensed professional engineer.
 17 A. That's right.
 18 Q. And, also, a fellow of the Institute of Fire Engineers.
 19 A. Yes.
 20 Q. Institute of Structural Engineers.
 21 A. Yes.
 22 Q. International Institute for FRP in Construction.
 23 A. Yes.
 24 Q. And, in Scotland, the Institute of Engineers.
 25 A. That is correct.

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1 Q. Institution of Engineers, yes.
 2 I think you have advised various industrial and
 3 research organisations in this country, as well as in
 4 the US, Canada, France, Switzerland and Germany;
 5 correct?
 6 A. Yes.
 7 Q. And that includes, or included, in relation to the
 8 development of design codes and guides internationally.
 9 A. That's right.
 10 Q. I think you are also currently co-editor-in-chief of the
 11 technical journal, Fire Safety Journal.
 12 A. Correct.
 13 Q. Is it right that your current fire safety and your
 14 structural fire engineering research is based on matters
 15 including building and infrastructure materials at
 16 elevated temperatures, fire—safe structural
 17 strengthening and rehabilitation materials, and fire
 18 performance of external cladding materials, products and
 19 systems?
 20 A. Correct.
 21 Q. I think you have published peer-reviewed articles in
 22 those areas, as well as in related areas, including
 23 sustainable building design and engineering education.
 24 A. Correct.
 25 Q. Is it also correct — confirm for me, please — that

8

1 you've got extensive experience of engineering research,
 2 consultancy and university teaching, as well as the
 3 promotion of public understanding of science and
 4 engineering?
 5 A. That's right.
 6 Q. Finally, I think it's right to say — well, let me ask
 7 you — you have received a number of awards for your
 8 commitment to high quality engineering research and for
 9 your dedication to the broader academic and research
 10 communities.
 11 A. Yes.
 12 Q. Let's then turn to your Phase 2 experimental work.
 13 Last week, we had the benefit of hearing from you,
 14 on 9 June, a presentation to the Inquiry on the
 15 experimental work that you carried out as set out in
 16 work packages 1 and 2; yes?
 17 A. Yes.
 18 Q. There was one matter which I think was an error which
 19 I just want to pick up with you before we go on to some
 20 questions about work package 1 and 2.
 21 Can we please go to the transcript from last
 22 Thursday where you gave your presentation. That is
 23 {Day289/179:16–24}. You are describing the experiments
 24 where you removed foil facers from the insulation
 25 products, and if we pick it up at line 16, you say:

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1 "Of course, we know that while there were exposed
 2 edges of insulation within the cladding system at
 3 Grenfell Tower, most of the insulation products, whether
 4 RS5000 or K15, had foil facers in place. In the case of
 5 the Kingspan product, again, the foil facer is
 6 perforated.
 7 "I therefore repeated the above experiments, but in
 8 each case I retained the foil on the front face of the
 9 insulation, including having foil on the front face of
 10 the combustible mineral wool insulation."
 11 Now, when you used the word "combustible" there,
 12 did you mean combustible mineral wool insulation?
 13 A. No. I mean, I almost certainly will have meant to say
 14 non-combustible mineral wool insulation, although, as
 15 I said during my evidence, any material that has a heat
 16 of combustion, strictly speaking, is not
 17 non-combustible. So the mineral wool is non-combustible
 18 from a regulatory perspective, but not necessarily from
 19 a physical perspective.
 20 Q. Yes, thank you.
 21 Now, I would like to turn, please, to
 22 work package 1. Can we go to {LBYWP100000002/5},
 23 paragraph 29. There you say this:
 24 "Under the most severe heating conditions used in my
 25 experiments, I observed short lived surface spread of

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1 flame over the polyester powder coating of samples of
 2 Reynobond PE ACM."

3 Are you able to say what the likelihood is that
 4 there was some surface spread of flame over the
 5 Reynobond PE ACM in the early stages of the
 6 Grenfell Tower fire?

7 A. That's a very difficult question to answer. The footage
 8 that we assembled at Phase 1 didn't show any obvious
 9 surface spread of flame over those panels in the early
 10 stages of the fire. As the fire grew, it's very hard to
 11 say where that spread of flame was occurring, whether it
 12 was a consequence of burning of the polyethylene core or
 13 a consequence of the powder coat. So, I mean, that's
 14 a very difficult question to answer.

15 The amount of energy that would be liberated by any
 16 burning of the surface coating would be very, very small
 17 in comparative terms, if you compare it to the amount of
 18 energy that can be liberated from the polyethylene core.
 19 So I wouldn't think — I think I intimated as such in my
 20 report — that that's a hugely significant observation.

21 Q. Then if we look at the heading below that, it says
 22 "Aluglaze Window Infill Panels". Let's look at
 23 paragraph 33 there, still on page 5. You say:
 24 "The Aluglaze window infill panels are comparatively
 25 easy to ignite, provided that even a small area of XPS

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1 foam is directly exposed to heating. This is due to the
 2 low thermal inertia of XPS foam. It is noteworthy that
 3 the low thermal inertia is also the reason that XPS foam
 4 is desirable as a thermal insulation in buildings."

5 Given the conclusions that you have derived from
 6 your experiments in relation to the Aluglaze infill
 7 panels, are you able to reach any conclusions on the
 8 potential contribution of the ignition of the Aluglaze
 9 infill panels to the ignition of other elements of the
 10 façade?

11 A. Again, challenging to say definitively. I mean, the
 12 reason that comment is in there is because we have
 13 evidence from Phase 1, from memory, that suggests that
 14 the extract fans that were located within small pieces
 15 of infill panel, essentially the same product, in the
 16 kitchen windows of the flats, flat 6s, all the way up
 17 the building, those extract fans softened and fell out
 18 quite early on in the fire, and certainly the footage
 19 that we have from the fire of the kitchen window of
 20 flat 16 early in the fire suggests that the extract fan
 21 had fallen out and, you know, you can see a circular
 22 hole in that small panel of window infill panel
 23 material.

24 If the extract fan falls out of that infill panel,
 25 then around the circumference of the hole where the fan

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1 was sitting, you will have had exposed XPS foam
 2 insulation. That foam insulation is quite likely to
 3 have both softened and melted and dripped and ignited,
 4 and will have contributed to burning in that location
 5 and will have contributed to flaming that is likely to
 6 have impinged on the ACM.
 7 So that's quite a long-winded answer, but I think
 8 the answer is: it's certainly possible that ignition and
 9 burning of the XPS core of the window infill panel that
 10 was holding the extract fan will have contributed to
 11 some extent.
 12 Q. Are you able to quantify that contribution?
 13 A. No, not in any sort of meaningful way. You know,
 14 other — you have a fire in the kitchen that is quite
 15 a well developed fire and is venting flames out the
 16 window, and would have been regardless of the burning of
 17 the infill panel. So I would say some additional
 18 flaming, some additional energy release. Quantifying
 19 that, you know, whether we're talking 1% or 10% or 20%,
 20 I wouldn't be able to say with confidence.
 21 Q. Moving on to Celotex RS5000, if we go to page 6 of this
 22 same report {LBYWP100000002/6}, please, you say this at
 23 paragraph 45:
 24 "Furthermore, I have found that without [in italics]
 25 its aluminium facer Celotex RS5000 is comparatively very

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1 [in italics] easy to ignite. The PIR foam core of
 2 Celotex RS5000 has very low times to ignition — a direct
 3 consequence of its comparatively very low thermal
 4 inertia."
 5 If RS5000 had lost its aluminium facer, what is the
 6 likelihood, can you tell us, of the ignition of the PIR
 7 foam if it came into contact with downward flowing XPS?
 8 A. So you have downward flowing XPS and you have Celotex
 9 RS5000 without a foil?
 10 Q. Yes.
 11 A. Yes, I mean, I think it's going to ignite. Whether that
 12 ignition or the extent to which subsequent burning would
 13 be sustained is a more challenging question, but
 14 I think, you know, this PIR insulation without a foil
 15 facer, when it's exposed to a heat flux of, you know,
 16 more than something in the range of 25 to 30 kilowatts
 17 per square metre for any appreciable amount of time,
 18 ignites very quickly, as we saw in my work package 1
 19 experiment.
 20 Q. So do we take from that answer that the relevant heat
 21 flux to make XPS drip and flow would be enough to ignite
 22 unfaced RS5000?
 23 A. Again, it would depend on the duration, so it's not
 24 necessarily just the magnitude of the heat flux, but
 25 I think if you've got burning, dripping, flowing XPS,

14

1 then you probably have enough heating to ignite Celotex
 2 without a foil facer, yes.
 3 Q. What is the likelihood — this I think flows, as it
 4 were, from the last answer — of downward flowing
 5 flaming XPS coming into contact with non-faced RS5000 in
 6 the geometry at Grenfell?
 7 A. I don't think that that likelihood is very high, if I'm
 8 being honest. I would have to think quite hard about
 9 the configuration, which I don't have in front of me, of
 10 the — so the Aluglaze window infill panels at
 11 Grenfell Tower sat within a system of aluminium rails
 12 that made up the window assembly. So you essentially
 13 have an aluminium framing around those infill panels.
 14 So getting the XPS out of the window infill panels,
 15 notwithstanding my comments about the small panels that
 16 house the kitchen extract fans, you know, there has to
 17 be a route for the XPS to get out, if you like, of the
 18 aluminium framing.
 19 You've got two aluminium sheets. The XPS between
 20 the aluminium sheets would melt and start to flow and
 21 drip within the infill panel. As it gets to the bottom,
 22 it finds an aluminium frame. The extent to which it can
 23 come out of that frame will depend on a whole host of
 24 factors. Then, if it comes out of that frame, where it
 25 goes, I think you would have to look very closely at

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1 that interface between the aluminium framing and the
 2 cladding below the windows.
 3 From memory, I think I probably would consider that
 4 reasonably unlikely. I think it would more likely — if
 5 the ACM cladding were still in place, beneath the
 6 window, I think I would consider it more likely that
 7 that XPS, the melted, dripping XPS, would flow over the
 8 outside surface of the ACM, from memory.
 9 Q. And, therefore, not come into contact with RS5000,
 10 whether foil faced or not foil faced at that point?
 11 A. I mean, eventually, probably, yes, given that the ACM is
 12 probably going to ignite and burn quite vigorously and
 13 disappear, and eventually, yes, you're going to find
 14 some insulation there. Certainly below the windows, the
 15 way the Celotex insulation was cut and formed within the
 16 cladding cassettes below the windows, again, from
 17 memory, the top edges of the insulation panels, if you
 18 like, did not have foil facers on them. They were cut
 19 to an angle, so that you get a sort of down slope on the
 20 ACM panel below the window. So if the ACM were removed,
 21 then you do have exposed Celotex at that location
 22 beneath the window.
 23 But it becomes a question of, you know, whether
 24 we're in an upward fire spread mode or a downward mode
 25 or a lateral, horizontal kind of mode.

16

1 Q. If we turn, please, to page 7 of this same report
2 {LBYWP100000002/7} and go, please, to paragraph 49, you
3 say there:

4 "From my experiments to date, it appears that flat
5 samples of Celotex RS5000 tested in isolation do not
6 significantly spread flame horizontally [in italics] in
7 the absence of an applied external heat flux.
8 Additional experimentation is required to confirm this."

9 What additional experiments would be required to
10 confirm that, in your opinion?

11 A. I would want to do a lateral ignition and flame spread
12 type testing, both with and without the foil facer. So
13 it would be similar — you know, you could do something
14 similar to a BS 476—7 lateral flame spread test. Yes.

15 I mean, I have to say, based on our experiments,
16 what I expect you would see is that they would not
17 spread flame very enthusiastically at all. Yes.

18 Q. And in the fire at Grenfell, would the RS5000 have been
19 the subject of an applied external heat flux?

20 A. Can you repeat the question?

21 Q. Yes. Would the RS5000 have been the subject of
22 an applied external heat flux?

23 A. Again, it depends on whether we're talking about — it
24 depends on where the insulation is on the building,
25 obviously, but, I mean, yes, if you have a large

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1 external fire burning, then you have a large heat flux,
2 yes.

3 Q. Yes. And the source of that heat flux would have been
4 what, in your view?

5 A. Early in the fire it would have been burning
6 polyethylene from the ACM. I mean, very early in the
7 fire, as we're talking about the fire getting from the
8 kitchen out into the insulation — out into the cladding
9 system itself, that source of heat flux could have been
10 the kitchen fire itself. You know, I talked last week
11 about the potential route of fire spread through the
12 side of the window and, in that situation, the kitchen
13 fire would have provided the heat flux. As the fire
14 grows, you've got most of the heat release, as I said
15 last week, is probably coming from the polyethylene,
16 from the ACM. So, in an upward fire spread mode, you're
17 likely going to get the heat flux coming from that fire
18 plume. As the fire reaches the crown, starts to go
19 around the crown and you have dripping polyethylene down
20 the building, then it gets slightly more complicated, in
21 terms of where do you have polyethylene collecting,
22 pooling, generating pool fires, igniting other materials
23 et cetera. At that point it gets complicated, probably
24 beyond the point that I could say for sure, although in
25 every case, as I've said, my view is that the ACM PE and

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1 the burning of the polyethylene is what's contributing
2 the vast majority of that heat flux.

3 I should also say that, of course, as the fire
4 spread past flats in Grenfell Tower, either up, across
5 or down the tower, it typically ignited fires within the
6 flats, and those fires then burned as, you know,
7 typical, if you like, compartment fires,
8 ventilation—limited compartment fires, and you have fire
9 plumes coming out the window for extended durations of
10 time, given that the fire service couldn't do anything
11 about those fires. So then you have very significant
12 external heat flux coming from the fire plumes generated
13 by those fires over long periods of time.

14 Now, those heat fluxes and those exposures of the
15 cladding products are on timescales that are typically
16 much longer than those that would be relevant to the
17 external fire spread, and under those — I mean, it's
18 actually quite an important point, you know. After the
19 fire, when we went to look at Grenfell Tower after the
20 fire and we did, you know, a walk-around survey of the
21 entire external surface of the building, once the
22 scaffolding had been put around the tower, and we
23 examined the insulation, you know, the extent to which
24 the insulation boards had charred or been burned in the
25 fire. You know, the question is the charring of the

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1 insulation that you observe when you walk around the
2 fire (sic), you know, days, weeks, months after the fire
3 has been put out, to what extent is that charring
4 evidence of charring that will have occurred as the fire
5 was spreading, or to what extent is that charring that
6 will have occurred as a consequence of the fires burning
7 in the flats over long durations once the spreading had
8 essentially occurred in the ACM PE was long gone?

9 So that's quite a long-winded answer to your
10 question, but I think it's important to think quite hard
11 about the durations over which the materials and
12 products that constituted the external wall arrangement,
13 the durations over which their burning occurred, because
14 products that release a lot of energy very quickly are
15 much more hazardous from an external fire spread
16 perspective than products that might contain similar
17 amounts of energy but burn very, very slowly under
18 different circumstances, and that's a very important
19 distinction.

20 Q. Yes, thank you.

21 Sticking with page 7 {LBYWP100000002/7}, can we
22 look, please, at paragraph 51, where you say this:

23 "However, the ease of ignition of Celotex RS5000 may
24 be relevant as regards initial growth of the fire
25 outside the kitchen window of Flat 16, where — without

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1 protection from foil facer or aluminium tape at a cut
 2 edge — it could have been one of the first (or possibly
 3 the first) cladding materials ignited, thus promoting
 4 ignition of other materials that were present at that
 5 location (for instance the PE filler/core of the
 6 Reynobond PE ACM rainscreen cassettes)."
 7 Can you explain the mechanism by which the ignition
 8 of the RS5000 may have promoted the ignition of the
 9 PE filler or PE core of the Reynobond PE ACM?
 10 A. I mean, simply that if something ignites and starts to
 11 burn, then it's going to liberate energy. That energy
 12 is going to go somewhere, and if that energy goes, you
 13 know, into the ACM, so to speak, heats the ACM and
 14 starts to mobilise polyethylene, which can then ignite,
 15 then that would be the mechanism. The mechanism is
 16 simply that the burning of the insulation liberates
 17 energy that could then be used to heat the ACM and cause
 18 its burning.
 19 Q. And what about other elements of the façade?
 20 A. I mean, there were other things in the cavity. You had
 21 the uPVC window frames, which would have been adjacent
 22 to that location, which can burn. You will have had the
 23 EPDM rubber membrane around that location, which can
 24 also burn. You had, you know, spray foam, bits of
 25 timber, various other things in the cladding system at

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1 that location.
 2 So there's a variety of things that could burn in
 3 that location, which is one of the reasons why I say,
 4 you know, it's very hard to say with any certainty what
 5 was the first item ignited, and whether the first thing
 6 ignited would have continued burning in the absence of
 7 the other things is really difficult to unpick.
 8 Q. Are you able to quantify the amount of energy that the
 9 RS5000 would have allowed to be fed back to the other
 10 cladding components?
 11 A. I mean, as I sit here, you know, if we're talking
 12 specifically about the configuration that existed at
 13 Grenfell Tower, I think no is probably — I certainly
 14 wouldn't want to attempt it as I sit here.
 15 My work package 1 experiments do quantify the types
 16 of energy release or heat release that we would expect
 17 from the various insulation products, both with and
 18 without foil facers, under a range of heat flux
 19 conditions, and all of that work suggests that the
 20 energy contribution from the insulation products is
 21 quite small, and that's probably the best quantification
 22 I could give you, you know, comparatively quite small if
 23 you compare against something like the polyethylene from
 24 the ACM, once it starts burning.
 25 Q. Right. Now, you say "quite small"; do I take it from

22

1 that that you are not able to attribute a reasonably
 2 precise percentage?
 3 A. I mean, this is something that I've discussed within my
 4 team at Edinburgh a lot. One of the challenges is, of
 5 course, we've performed experiments where we have
 6 quantified a number of things under a range of
 7 conditions. None of those conditions are exactly what
 8 was at Grenfell Tower; they are all representative of
 9 the physics, but we can't say for sure what was
 10 happening at Grenfell Tower in the cladding. That's one
 11 of the challenges when you go from the lab to reality.
 12 I was discussing this point within my team quite
 13 recently, because I expected I'd be asked this question,
 14 and, you know, the best I can say is that I think the
 15 contribution from the insulation in that initial
 16 environment and even to the upward fire spread is
 17 probably less than 10% of the overall contribution.
 18 Something like that. I mean, it could be 2%, it could
 19 be 10%.
 20 Q. Before getting too hung up on figures, are you able to
 21 say — well, two things.
 22 First of all, flowing from that last answer, does
 23 the answer to the question I've just asked you depend on
 24 where in the building and at what point during the fire,
 25 treating it as a single entity, you are looking?

23

1 A. I think so, yes. Yes, I mean, the work that I've done
 2 to date has focused pretty heavily on the upward, you
 3 know, the fire going from a small fire to a big fire in
 4 an upward mode. How the fire goes from a small fire to
 5 a big fire in the lateral or the downward mode is more
 6 complicated, yes.
 7 Q. Just pinning that down a little bit further if I can.
 8 You used the expression "going from a smaller fire to
 9 a bigger fire". Doing the best you can with
 10 a particular point, whether in timing or in quantitative
 11 terms, maybe that's the point at which the fire becomes
 12 out of control of any reasonable FRS, if that's
 13 a possible bridge point, but at that point, what would
 14 have been, up to that point, the contribution, in
 15 percentage terms, if you can, of the RS5000?
 16 A. Up to the point that the fire is "out of control" and
 17 spreading quickly up the building?
 18 Q. Yes.
 19 A. Less than 10%.
 20 Q. Secondly, less than 10%; would you say that that was
 21 negligible, or would you say that it was small but still
 22 materially contributive?
 23 A. I mean, I guess, again, it depends what we mean by
 24 "contributive". I presume in your question that we're
 25 talking about the contribution of the insulation via its

24

1 combustion, rather than the contribution of the
 2 insulation by its presence, if you like .
 3 Q. Yes.
 4 A. Because, as I explained last week, when I gave my
 5 presentation, the fact that the insulation has a very
 6 low thermal inertia and is very insulating is critical ,
 7 absolutely critical . So if there had been no insulation
 8 there whatsoever, whether Kingspan or Celotex or mineral
 9 wool, the outcome may have been quite different;
 10 significantly different , more than 10% different. The
 11 fact that that insulating material is also contributing
 12 energy by its burning is what I'm referring to the 10%.
 13 Q. Yes.
 14 A. So that's probably quite an important distinction for me
 15 to make.
 16 Q. Thank you for that clarification .
 17 Let's turn to your report dealing with Kingspan K15,
 18 page 9 {LBYWP100000002/9}, please, paragraph 65. Same
 19 report, page 9, paragraph 65. You say there:
 20 "However, the ease of ignition of Kingspan K15 may
 21 be relevant as regards initial growth of the fire
 22 outside the kitchen window of Flat 16 (if it were
 23 present in this location) where — without protection
 24 from foil facer or aluminium tape at a cut edge — it
 25 could have been one of the first cladding materials

25

1 ignited, thus increasing the local heat flux and
 2 promoting ignition of other materials present (for
 3 instance the PE filler /core of the Reynobond PE ACM
 4 rainscreen cassettes)."
 5 Are you able to describe for us the mechanism by
 6 which the ignition of the K15, as you say, could have
 7 promoted the ignition of the PE core of the Reynobond PE
 8 ACM as well as the other elements of the façade?
 9 A. I mean, I would give the same answer I gave previously
 10 for Celotex effectively , yes.
 11 Q. When you say "could have been", would you give the same
 12 answer in response to the question of quantification?
 13 A. That's right, yes.
 14 Q. If we go to page 26 of this report {LBYWP100000002/26},
 15 please, you say this at paragraph 165 at the top of the
 16 screen:
 17 "Unlike polyethylene, both PIR and phenolic polymer
 18 foam are thermosetting polymers (i.e. they will char on
 19 heating rather than melting and dripping or flowing).
 20 As a consequence, it is the extent to which PIR and PF
 21 foam ignite and spread flame over their surface that is
 22 of primary interest , along with the extent to which they
 23 do, or do not, continue to contribute to heat release
 24 and flame spread over the timescales relevant to
 25 consideration of external fire spread during the

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1 Grenfell Tower fire."
 2 Given the absence of melting, dripping or flowing
 3 from PIR and phenolic polymer foams, what is the
 4 mechanism by which the PIR and phenolic foams contribute
 5 to the external fire spread?
 6 A. By insulating the cladding system and making sure that
 7 the heat is retained within the system and fed back to
 8 the ACM, which exacerbates the burning of the ACM, and
 9 by liberating some admittedly small amount of energy via
 10 their own combustion, potentially by spreading flame,
 11 although I think the flame spread characteristics are
 12 probably not that significant , particularly if you had
 13 a foil facer in place.
 14 Q. Yes.
 15 Now, if you then turn to page 27
 16 {LBYWP100000002/27}, at paragraph 169 you say, under the
 17 heading "Products and Materials under Investigation":
 18 "I decided, however, not to use the cladding
 19 products removed and retained from Grenfell Tower for my
 20 Phase 2 experimental programme. I made this decision
 21 because I felt that I would be unable to guarantee
 22 adequate control (by others) either of the chain of
 23 custody for these products or the specific origin of the
 24 various samples; nor could I be completely certain that
 25 the products had not been damaged in some way due to

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1 their installation on the Tower, their in-situ service
 2 experience, some exposure to heating during the fire, or
 3 mechanical damage during their removal."
 4 Do you consider that, as a consequence of that
 5 decision that you have described there, you would have
 6 been unable to take account of any alterations or
 7 modifications to the cladding products which resulted
 8 from the manner in which they were installed or the
 9 means by which they were affixed to the façade of the
 10 tower?
 11 A. I mean, none of the experiments that I've performed
 12 intended or even tried to simulate or reproduce those
 13 issues in any way that I would say is directly
 14 applicable to Grenfell Tower. We were much more
 15 interested in understanding the mechanisms by which the
 16 different behaviour — well, what the behaviours would
 17 be and then the mechanisms by which those behaviours
 18 would manifest in the products.
 19 So, no, I don't think I would agree with that
 20 statement.
 21 Q. Right. But focusing on the consequences of your
 22 decision not to use the cladding products removed and
 23 retained, did that materially or should that materially
 24 affect the conclusions?
 25 A. No.

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1 Q. So do we take it from that that you didn't think it was
2 necessary to take account of the exposure of the PE core
3 resulting from the installation of the product in
4 cassette form?

5 A. In the experiments that I performed, we did certain
6 things to the ACM panels, certainly in the work
7 package 2 experiments, that were intended to ask
8 questions that were relevant to whether or not the
9 panels were installed in a riveted form or a cassette
10 form. So, for instance, as I showed in my presentation,
11 we intentionally routed the rear face, the face of the
12 ACM panel that was facing in to the cavity, in our
13 work package 2 experiments because we recognised that
14 the opening up, the separation, the removal of the
15 inside aluminium face in a cassette configuration would
16 probably drastically affect the burning behaviour, and
17 that's certainly something that we observed.

18 We also performed — and I didn't present the
19 results of these experiments last week — some of the
20 experiments that are presented in my work package 2
21 report where we intentionally, if you like, overly
22 routed or overly riveted the ACM panels. So we
23 performed experiments where we looked at the time to
24 escalation, the manner of failure, heat release rates,
25 peak heat release, et cetera, where the ACM panel, in

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1 addition to being the baseline configuration that
2 I showed during my presentation last week, we added,
3 let's say, rivets to the ACM panel. So we intentionally
4 secured the inside face of aluminium to the ACM panel so
5 that we could see what the influence of that would be.
6 And we did that, actually, in a number of
7 configurations. So, you know, we riveted the entire
8 panel and observed what differences in behaviour
9 manifested in the experiments, or we riveted only the
10 top half of the panel and left the bottom half free to
11 open up. We did experiments where we intentionally
12 routed horizontal lines over the aluminium face on the
13 inside of the ACM panel to see what would happen if you
14 had more exposed lines of ACM core and smaller aluminium
15 inside surfaces that could mobilise in a different way,
16 and we did observe differences in behaviour.

17 So, you know, we've asked — in those experiments,
18 I asked a number of questions that I think are relevant
19 to understanding why the manner of fixing could matter,
20 and I think have pretty clearly demonstrated, at least
21 for myself, that the presence of rivets and routing can
22 be very important in terms of the timescales over which
23 things occur.

24 Q. Now, two things.

25 First, I think you're drawing a distinction, which

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1 I may have blurred accidentally in my answer, between
2 workmanship and in-use experience of the particular
3 panels at Grenfell. Just to be clear, that's what
4 you've excluded under 169 here; is that right?

5 A. What I've excluded under 169, if you like, is the
6 manufacturing and materiality of the products
7 themselves. So the concern that I'm trying to express
8 in 169 here is a concern that, given that there was
9 a very significant fire at Grenfell Tower and given that
10 that fire lasted for hours and hours, and given that
11 there was a lot of downward mobilisation of polyethylene
12 in that fire, you know, there were significant portions
13 of the building, of the cladding system at
14 Grenfell Tower, that looked relatively undamaged, let's
15 say. The Metropolitan Police Service took all of those
16 products, the undamaged products, and they put them in
17 a warehouse, and they used those products for
18 experiments so that they could understand, you know,
19 what products precisely had been used, what
20 classifications they would achieve, et cetera,
21 et cetera. The Metropolitan Police Service forensics
22 team, working with BRE, did a whole host of things to
23 try to understand those products.

24 When it came time for us to perform the experiments
25 related to my Phase 2 work at Edinburgh, the question

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1 was whether we should ask the Metropolitan Police
2 Service if we could have a substantial amount of
3 materials that they had stored that had come off the
4 tower, and whether we would be able to get from them
5 a suitable volume of products that would allow us to
6 undertake the work that we wanted to undertake,
7 recognising we were going to need quite a lot of each of
8 the products in order to perform, you know, the very
9 large number of experiments that we ended up performing.

10 So the two concerns were, one, maybe that much
11 product wasn't available via the MPS, given they needed
12 some of it for their purposes, and we certainly didn't
13 want to deprive the MPS of the product that they would
14 need in order to conduct, you know, criminal work
15 et cetera, and so if we're going to — so where do we
16 get the product from? And the answer is we get it from
17 the corporate CPs to the Inquiry, but, of course, if one
18 goes down that road, one has to be sure that what one is
19 given by the corporate CPs is fairly representative of
20 what was on the tower.

21 So that's what I'm expressing there. We recognise
22 that probably we're going to have to go to the corporate
23 CPs to get the products, and we wanted to have some
24 confidence that what we were being given, you know,
25 hadn't been fiddled in any way, let's put it that way.

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1 Q. Right. But were you also seeking to eliminate error in
2 your own methodology by using products which had
3 actually been used as a result of —
4 A. Yes. I mean, it's very difficult to know with certainty
5 if any particular piece of cladding that we might obtain
6 from the MPS was actually undamaged or had not been
7 altered in some way, had not been heated in some way
8 during the fire, but that was much more about the
9 thermal history of the sample than it was about the
10 manufacturing or installation history of the sample.
11 Q. The second thing, just to draw out from what you have
12 just been telling us, is that there is a distinction
13 between non—use of the materials actually used at
14 Grenfell Tower, which you've covered at paragraph 169
15 and what you have just said about that, on the one hand,
16 and, as it were, pre—designed installation or fixing
17 methodologies, use of bolts or rivets on the one hand or
18 use of cassettes on the other, which were the subject of
19 analysis by your team.
20 A. That's right, but not insofar as we were attempting to
21 recreate the conditions at Grenfell Tower. We were
22 simply attempting to understand.
23 Q. Yes.
24 Can you tell us, I know it is in your reports and
25 your data, but can you summarise for us what you

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1 concluded as a result of the experiments done where
2 rivets were applied?
3 A. That the presence of rivets substantially — and
4 obviously with all sorts of caveats about how many
5 rivets and where and of what type, et cetera, et cetera.
6 But if one manages by any mechanism in one's
7 installation of ACM PE panels to prevent the aluminium
8 skins from opening up, either with rivets or with
9 framing or bracketing or, you know, I'm aware that over
10 the years, in standardised testing of ACM products,
11 sometimes little U—sections of metal were put round the
12 edge of panels to try to keep the faces together, that
13 will improve performance.
14 Now, in our experiments, what that tended to do was
15 to make it take longer for escalation to full
16 involvement of the ACM to occur, but you still do get,
17 eventually, full involvement of the ACM, and you still
18 do get approximately the same total amount of energy
19 release.
20 So the presence of rivets or the presence of any
21 mechanism that holds the aluminium skins together, what
22 it does is it prolongs the time until things go really
23 bad, until you get a lot of burning and you get this
24 rapid escalation. That's, for me, very relevant to
25 a number of questions and pieces of evidence that the

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1 Inquiry has heard. You know, the fact that riveted
2 systems are apparently able to achieve a class B result
3 in the Euro classification system when tested in an SBI,
4 but a cassette system does much worse. What's
5 interesting about that is that if you let an SBI test
6 run with a riveted system, my expectation is that
7 eventually you would see the same result. It's just
8 that, because of the timescales that are involved, you
9 don't necessarily push the panels to that point.
10 Again, within my team, my colleagues will hate that
11 I use this terminology, because we argued about it quite
12 a lot as we were doing the work, but I started referring
13 to these ACM products as "tipping point" products. So
14 there's a moment where things go from not so bad to
15 really bad, and if you pass that point, all bets are
16 off, and if you don't, then things can sometimes look
17 like they're not quite as bad as they might be a minute
18 later. That's one of the reasons these products are so
19 dangerous, is because they display this very volatile
20 behaviour.
21 Q. Yes, thank you.
22 Now, moving on to page 32 of your report
23 {LBYPWP100000002/32}, you explain there — in various
24 places, but let's pick it up at paragraph 184 — that
25 you are aware that the Celotex insulation boards used at

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1 Grenfell were, I think, typically produced on two
2 different production lines — this is paragraph 183 —
3 called the Hipchen and the Hennecke lines. At 184 you
4 say this:
5 "Celotex (via Linklaters LLP) have provided the
6 Inquiry with a detailed account of these differences.
7 I have not been able to quantify the possible
8 influences of these differences on the reaction of these
9 two thicknesses of Celotex RS5000 products to heating,
10 aside from a brief comparative evaluation of the
11 response of the RS5080 and RS5100 products supplied to
12 me — this comparison is presented in Section 8.7.3.
13 I do not, however, consider it likely that the temporal
14 variation in manufacturing inputs/processes is
15 significant."
16 What do you mean there by "temporal variation"?
17 A. Okay, yes, so I'm not a polymers chemist, nor am
18 I someone who manufactures polymer foams, but the base
19 chemistry of these products didn't change a whole lot.
20 It seemed to me, in reviewing that information, that
21 there were little tweaks and changes and decisions made
22 by the manufacturing operatives in terms of, you know,
23 a little component here, little component there,
24 probably based on things like the temperature in the
25 facility that day, potentially ambient relative humidity

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1 and things like that that might influence manufacturing.
2 I don't know. So, I mean, I would hesitate to put too
3 much stock in that.

4 If the Inquiry feels that the changes in, let's say,
5 chemical inputs to manufacturing process over time
6 warrant investigation in terms of the possible outcomes
7 for the resulting product, then I would probably insist
8 that the Inquiry ask a polymers manufacturing specialist
9 rather than me.

10 Q. But it's really the word "temporal" I was asking about.

11 A. Yes, "temporal", I just mean in time. You know, if you
12 look at the data that we were provided — again, from
13 memory, it was quite some time ago I looked at this —
14 there's little adjustments that are made to the
15 manufacturing process in time.

16 Q. Right.

17 A. And I felt that that was probably unlikely to
18 significantly alter the outcomes of what we would
19 observe if we took a piece of the product and tested it
20 in some way. You know, it's not going to vary
21 significantly any of the reaction to fire properties
22 that we looked at, in my view, you know, heat of
23 combustion, critical heat flux for ignition, those sorts
24 of things. I wouldn't expect to see differences.

25 Q. Yes, I see.

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1 If we go, then, to page 58 of your report
2 {LBYWP10000002/58}, please, let's look together at
3 paragraphs 328 and then 330 on that page, under the
4 heading "Effects of Melting and Dripping".

5 At 328 you say this:

6 "In my Phase 1 — Final Expert Report I have
7 identified that melting and dripping of burning PE
8 filler /core material from Reynobond PE ACM rainscreen
9 cladding cassettes played a critical role in both the
10 horizontal and downward fire spread experienced during
11 the Grenfell Tower fire. I have also identified that
12 XPS foam insulation that formed the core material within
13 the Aluglaze window infill panels may have been
14 a secondary source of melting and dripping thermoplastic
15 polymer."

16 Then at 330 you say:

17 "PIR and phenolic foam insulations, however, are
18 thermosetting polymers which will not melt."

19 Are you able to explain how your experiments in
20 work package 1 or work package 2 quantify or measure the
21 extent to which RS5000 or K15 may have contributed to
22 the downwards spread of flame?

23 A. I mean, in a direct way, the RS5000, in a direct way,
24 won't have contributed to the downward spread, in that
25 the RS5000 product itself isn't going to mobilise bits

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1 of itself downward, you know, you're not going to get
2 bits of burning PIR foam mobilising downward and
3 spreading flame by that mechanism. Obviously, the
4 extent to which those products insulate a cladding
5 cavity where you might have other things burning is
6 going to be relevant to the downward mechanism, in that,
7 you know, if you have more heating locally, more melting
8 of ACM, more mobilisation of PE, you're going to get
9 more downward.

10 So for the Celotex, you know, in terms of the
11 material that made up the core itself, no direct
12 involvement, although a contributory involvement to the
13 other mechanisms of downward, ie the melting of the
14 polyethylene.

15 With respect to the phenolic, I would say largely
16 the same thing, with the small caveat that we did
17 observe that the phenolic foam or the Kingspan product
18 did have a tendency to spall, to become mechanically
19 detached from the face of the insulation when we didn't
20 have a foil facer there, when there was no foil facer
21 there to keep that material in place. So you would
22 observe pieces of glowing phenolic foam that would
23 detach and drop downward. That is a possible
24 contribution to downward, although, again, you know,
25 you're not talking a huge volume of material. These

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1 pieces of material, in the absence of an applied
2 external heat flux, would go out very quickly. They
3 wouldn't continue to flame.

4 So it's not a huge issue, but it is a small
5 distinction between those two products that I think is
6 relevant.

7 Q. Right. Just to be clear, then, your findings were that
8 RS5000 would not produce burning, flaming debris of any
9 kind, but Kingspan K15 would?

10 A. Yes. I mean, although I would hesitate to say that
11 Kingspan K15 would develop, you know, a lot of burning,
12 flaming debris. I would say that we observed bits of
13 glowing phenolic foam that would detach from the face of
14 the sample and then drop downward, yes.

15 Q. So it's a qualitative difference, but you can't really
16 say much about the quantitative difference?

17 A. That's right, yes.

18 Q. Yes, I see.

19 Then if we go, please, to ... Well, let me just ask
20 you that: are you able to say or comment on the extent
21 to which melting PE may lead to the involvement of PIR
22 or phenolic foam into the fire through pooling?

23 A. Significantly, yes.

24 Q. Yes.

25 A. I mean, I think pooling of PE on surfaces within and

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1 outside the cladding was very significant at the
 2 Grenfell Tower fire.
 3 Q. Yes.
 4 Now, you showed us last week, very helpfully, your
 5 drip tray in the work package 2 experiments.
 6 A. Mm—hm.
 7 Q. And we saw that from the video in particular.
 8 Are you able to make any analysis or assessment for
 9 an experiment which was designed identically to your
 10 work package 2 experiments, but which replaced the drip
 11 tray you used there with an exposed edge of a sample of
 12 RS5000 or K15 or Rockwool?
 13 A. You mean if instead of having a steel drip tray, we have
 14 a piece of insulation there?
 15 Q. Yes. So molten, dripping, burning polyethylene falling
 16 on to unexposed(sic) RS5000 or K15 or Rockwool.
 17 A. No. I mean, I'm not able to say anything confidently
 18 about that. We certainly didn't do it. We certainly
 19 didn't try that to see what would happen.
 20 I suspect that, you know, in that scenario, you've
 21 got polyethylene dropping on to a very insulating
 22 surface, unless you've got mineral wool, where the
 23 polyethylene might actually, you know, wick into the
 24 fibres and, you know, I have absolutely no idea what
 25 would happen under those circumstances.

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1 But one of the things that's interesting about the
 2 drip tray that I didn't discuss last week is when we
 3 were developing the experimental programme, as
 4 I mentioned last week, the reason we had the drip tray
 5 was because if you don't control, if you like, the pool
 6 fire that you get, the burning polyethylene pool fire
 7 that you get once the polyethylene starts to mobilise
 8 downward, you get polyethylene going all over the place,
 9 and you get a pool fire that is very hard to control the
 10 consistency of from experiment to experiment. So the
 11 drip tray was created or was placed in the rig so as to
 12 make sure that the pool fire we got was the same every
 13 time, and we could ask other questions that were perhaps
 14 more interesting in a more controlled way.
 15 When we were doing our initial experiments to kind
 16 of finalise the procedure that we were going to use and
 17 the exact set-up, we ran experiments where we had the
 18 drip tray, but the drip tray wasn't — I didn't mention
 19 it again last week, but the drip tray, you have a steel
 20 ledge underneath the ACM. On top of the steel ledge,
 21 you have a drip tray. Between the drip tray and the
 22 steel ledge, we had a thin piece of ceramic paper, which
 23 is essentially an insulating ceramic paper a couple of
 24 millimetres thick. When we ran an experiment without
 25 the ceramic paper, it didn't escalate; when we ran

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1 an experiment with the ceramic paper, it did escalate.
 2 So we always used the ceramic paper.
 3 Now, if we had left the burner in longer, you know,
 4 various other questions we could have asked about the
 5 extent to which we needed an input of heat to make the
 6 experiments escalate, but that fact indicated that the
 7 extent to which the polyethylene in the pool fire was
 8 kept warm, was insulated, itself as a pool fire, was
 9 relevant. So if you have the pool fire developing on
 10 a highly insulating surface, then probably it's going to
 11 make matters slightly worse.
 12 Q. Yes, thank you.
 13 If we then go to paragraph 331 here, same page,
 14 page 58 {LBYWP100000002/58}, you say:
 15 "Melting and dripping of polymer filler /core
 16 materials can be expected to play significant roles in
 17 the responses—to—heating of both Reynobond PE ACM and
 18 Aluglaze window infill panels, since they will influence
 19 the extent to which the thermoplastic filler /core
 20 materials burn in—situ at the sample location, or rather
 21 in some other location once mobilised."
 22 Can you explain what you mean by "since they will
 23 influence the extent to which the thermoplastic
 24 filler /core materials burn in—situ at the sample
 25 location, or rather in some other location once

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1 mobilised"? What do you mean by that?
 2 A. I guess, in simple terms, I mean that it matters where
 3 the energy goes, or if the energy goes. So these
 4 materials, the polystyrene, the XPS and the
 5 polyethylene, are quite calorific materials. They have
 6 high heats of combustion. Where and when that energy
 7 that's essentially locked up in the material is released
 8 matters.
 9 So if you have a lot of mobilisation of the
 10 polyethylene, the polyethylene in the cladding is no
 11 longer where it started, and where it goes matters, you
 12 know. So, you know, if the polyethylene drips out of
 13 the cladding and into the atmosphere and falls through
 14 the sky and lands on the pavement at the base of the
 15 building, which we did see some of that, then the
 16 influence of that burning polyethylene on the cladding
 17 fire locally has been removed. If, however, the
 18 polyethylene drips and pools in the shelf at the bottom
 19 of a cladding cassette — you know, these cladding
 20 cassettes on the tower, certainly the spandrel panels,
 21 you have the face of the panel comes down, it comes in
 22 above the window, and then there's a little lip up on
 23 the back of that cladding. You've got essentially
 24 a perfect container for a pool fire of polyethylene
 25 sitting in your cladding. So every spandrel cassette at

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1 Grenfell Tower is essentially a drip tray for burning
 2 polyethylene.
 3 Q. On the inside —
 4 A. On the inside of the cassette within the cladding
 5 system, and that's —
 6 Q. And therefore looking at the foil facing of —
 7 A. Looking at the insulation, that's right.
 8 Q. — the insulation.
 9 A. So, you know, you have a very efficient system for
 10 creating the worst possible fire in those cladding
 11 cassettes. You have a physical means by which to
 12 locally collect pool fires of burning polyethylene
 13 within your cladding, so that that energy can be
 14 released locally in the worst possible way, for upwards
 15 spread. Yes.
 16 Q. Now, can we go to page 81 of this report
 17 {LBYWP100000002/81}, please, and go to paragraph 422.
 18 You have set out some graphs on that page under
 19 figure 32, measuring heat release rates for typical
 20 samples of ACM. At 442 you say this:
 21 "The heat release rates from these small samples are
 22 comparatively low. It is noteworthy that the
 23 measurement resolution of the HRR measurements made by
 24 the University of Edinburgh's Furniture Calorimeter is
 25 insufficient to provide high fidelity data for such low

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1 heat release rates. However this does not affect the
 2 conclusions drawn from these data."
 3 Then you go on to say ... yes, I think that's
 4 probably enough for my question.
 5 Is it your opinion that a feedback loop existed
 6 during the fire at Grenfell Tower?
 7 A. I mean, yes. I mean, there's always a feedback loop
 8 when a fire grows, yes.
 9 Q. Yes. Are you able to identify the elements of the
 10 façade which would have contributed to or created this
 11 feedback loop?
 12 A. Anything that had a heat of combustion will have
 13 contributed to some extent to that feedback loop.
 14 Q. Right. What would that include? Can you identify the
 15 elements?
 16 A. I mean, in order of decreasing relevance, let's —
 17 I mean, I can try to do that in order of decreasing
 18 relevance. I mean, the ACM PE, first and foremost. The
 19 insulation products, whether Celotex or Kingspan at any
 20 given location.
 21 Q. Yes.
 22 A. Then — all of it, really. Any timber that might have
 23 been there, uPVC window frames, window surround
 24 insulation, EPDM membrane, spray foam, you know,
 25 anything that could burn will have contributed to some

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1 extent. I mean, very minor in some cases, but yes.
 2 Q. If we go back to page 77 {LBYWP100000002/77} and look at
 3 paragraph 411 next, you say there as follows:
 4 "The heat release rate is central to evaluating fire
 5 hazard, since it determines the amount of energy
 6 released from a material that is available to be
 7 transferred back to the fuel via convection and
 8 radiation, thereby creating a positive feedback loop and
 9 possibly resulting in fire growth and/or spread."
 10 Now, the heat release rate that you have generated,
 11 does that come from all of the components or each one
 12 individually?
 13 A. I mean, the heat release rate that one measures when one
 14 observes a fire is going to represent, typically —
 15 you know, if you're measuring the way we did in the
 16 experiments in the lab at Edinburgh, what we're
 17 measuring is the total heat release rate that comes from
 18 everything that may be burning. So, yes, everything.
 19 Q. And when you say "via convection and radiation", are you
 20 describing there — I don't want to put words in your
 21 mouth — the effects of heating when a pool fire in
 22 a drip tray, so to speak, on the inside of the cassette
 23 on Grenfell Tower heats the insulation and creates
 24 rising heat — radiates, but creates rising heat?
 25 A. I mean, I think — which paragraph is that in again?

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1 Q. 411.
 2 A. I mean, yes, I think 411 could be read almost without
 3 "via convection and radiation". Those words are
 4 probably not necessary. The key idea in that paragraph
 5 is that when you have heat release, the heat release
 6 rate is telling you how much energy is being released
 7 per unit time, and the more energy you have, the more
 8 likely it is that that's going to feed back to the fuel
 9 and cause the fire to grow. The convection and
 10 radiation are just the specific heat transfer mechanisms
 11 by which that would occur.
 12 Q. Yes, I see.
 13 If we go on, then, to page 104 of this report
 14 {LBYWP100000002/104} and look at paragraph 606, you say
 15 there, three quarters of the way down your screen, after
 16 the reference to the "Video Bisby":
 17 "Based on the experiments performed on 100 mm x
 18 100 mm samples of Reynobond PE ACM and Aluglaze, I would
 19 estimate that the majority of the polymer mass lost from
 20 samples incorporating thermoplastic filler /core
 21 materials (i.e. 50% or more of the polymer mass lost in
 22 all such experiments to date) was due to mobilisation of
 23 these polymers downward (i.e. dripping or flowing)."
 24 What would have been the effect of the downward
 25 dripping or flowing of the polymer?

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1 A. Twofold. I mean, (1) it would have removed energy from
2 the local site of burning and taken that energy
3 somewhere else, where else depends where the polymer
4 goes; and (2), you know, in the conditions that we
5 observed, certainly for the ACM PE, that polymer is
6 burning whilst going where it goes, and so if it lands
7 somewhere else and it continues to burn, which it
8 appears to have done, then that's a pretty effective
9 downward fire spread mechanism.

10 I mean, that's one of the reasons why, at Phase 1,
11 I really focused in on the crown detail at
12 Grenfell Tower. The upward fire spread mechanism is,
13 you know, pretty straightforward. The lateral — the
14 horizontal fire spread mechanism at Grenfell Tower,
15 which is, you know, quite unusual in terms of things
16 we've observed in other cladding fires that involve
17 these products, I believe is a direct consequence of the
18 presence of the crown, and the fact that the crown
19 provided a mechanism by which the fire could go around
20 the building, and then the downward spread from the
21 crown is what effectively makes the fire goes sideways.
22 You know, the diagonal lines of burning that you saw on
23 Grenfell Tower in the fire, and those diagonal lines,
24 how they progressed around the building, are simply
25 a manifestation of the flowing of PE down from the top

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1 of the building, as opposed to, let's say, a classical
2 lateral fire spread mode across the horizontal surface
3 of the product.
4 Q. Yes, I follow.
5 Are you able to quantify the contribution to the
6 intensity or propagation rate of the fire of the
7 downward flowing or dripping polymer from Reynobond, or
8 perhaps also with the Aluglaze, XPS?
9 A. Am I able to quantify it?
10 Q. Yes.
11 A. No. I mean, not in any useful way, I don't think. You
12 know, quantify with respect to what? You know, I think
13 that is the mechanism by which the fire goes down and
14 around the building, I think. In the absence of
15 polyethylene, it simply doesn't occur. You just simply
16 wouldn't get the downward and then horizontal in the
17 absence of the polyethylene.
18 Q. If we go, please, to page 111 of this report
19 {LBYWP100000002/111}, paragraph 651, you say there:
20 "I felt it was important to satisfy myself,
21 experimentally, that the ignition and
22 physical/mechanical deformations of Celotex RS5000 PIR
23 and Kingspan K15 phenolic foam insulations were broadly
24 similar to the cases where they were exposed to heating
25 on a cut edge rather than on a flat face with the foil

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1 facer manually removed."

2 What was the importance of demonstrating the
3 ignition and physical/mechanical deformations of the
4 RS5000 and K15 that you describe in this paragraph?

5 A. I wanted to make sure that what I felt — so earlier —
6 this is the work package 1 experiments. So the
7 work package 1 experiments, as I discussed last week, we
8 did experiments with and without foil facers and we
9 observed how the insulation products behaved under those
10 circumstances. But those experiments were performed by
11 taking sheets of insulation and essentially peeling off
12 the aluminium facers, and so the surface of insulation
13 that was exposed in those experiments was the front face
14 of the foam panel with the aluminium removed.

15 Now, that is probably, but not definitively, the
16 same situation as you have at a cut edge of the polymer
17 foam, because of the way these products are
18 manufactured, because for the Celotex RS5080 product you
19 have, as I mentioned at Phase 1, in-depth glass fibre
20 meshes that are sort of in the insulation, in depth
21 within the foam, and also the aluminium foil facer is
22 somehow adhered to the foam in a way that, you know,
23 we've not interrogated in any way, so the peeling off
24 may leave some residue of something there.

25 So there's all sorts of reasons why — and, you

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1 know, I wasn't — and we know that the locations in
2 Grenfell Tower where we were concerned about the direct
3 exposure of the polymer foam cores of the insulation
4 products were situations where we had cut edges, not
5 where people had intentionally removed the facers by
6 peeling them off. So I just wanted to make sure that
7 there was no substantive difference in the behaviour
8 under those edge exposure conditions, both because they
9 were the ones that existed actually in the tower, at
10 Grenfell Tower, and because the peeling of the aluminium
11 could potentially result in some differences in
12 behaviour. But we didn't observe anything that
13 I thought was particularly different.

14 So that work was really just confirmatory. I just
15 wanted to make absolutely sure we weren't missing
16 something.

17 Q. Yes, I see.

18 If we go on the same page, please, to 657 at the
19 bottom, you say:

20 "For Celotex RS5080, ignition occurs within one
21 second of heating exposure, and is followed by pyrolysis
22 of the thermosetting PIR foam with continued minimal
23 flaming. The overall response is sufficiently similar
24 in appearance to this products' response when tested in
25 a face-on heating condition (without a foil facer) that

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1 I do not consider additional characterisation of edge
 2 exposure to be warranted. I consider the face—on
 3 exposure data to be broadly applicable to edge—on
 4 exposure.”
 5 What is the significance to the intensity or
 6 propagation of the Grenfell Tower fire of the response
 7 of the RS5080 which you describe there?
 8 A. What those experiments showed was that, under pretty
 9 severe heating conditions, the behaviour of the PIR foam
 10 core within the Celotex product, when you actually
 11 exposed the cut edge, was broadly the same as it was
 12 when we exposed the samples with the aluminium facers
 13 removed. So all of the conclusions that I drew with
 14 respect to the no—foil RS5000 case in the work package 1
 15 work are relevant. So, you know, easy to ignite,
 16 charring, reductions of heat release rates, you know,
 17 eventual cracking, maybe a bit of ongoing combustion in
 18 the presence of an external heat flux but pretty low
 19 heat release rates. All those sorts of things were
 20 equally relevant to the side exposure.
 21 Q. Then, Mr Chairman, finally on this topic, before we have
 22 the break, if I may, page 116 {LBYWP100000002/116},
 23 please, paragraph 680, you say there:
 24 “Based on my experimental work, I have concluded
 25 that in most cases the majority of the PE filler/core

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1 material is likely to have mobilised downward (i.e.
 2 dripped) during heating. This is likely to have been
 3 accompanied by flaming of the downwardly mobile material
 4 and the formation of pool fires where it was able to
 5 collect on horizontal surfaces both within and outside
 6 the rainscreen cladding system.”
 7 Now, there, when you refer to “downwardly mobile
 8 material”, are you referring, just to be clear, to the
 9 burning, dripping, flowing polyethylene core material?
 10 A. Yes, absolutely.
 11 Q. Yes.
 12 What effect would that burning, dripping, flowing
 13 material have on the propagation of the fire?
 14 A. It's going to spread it. It's going to grow the fire,
 15 it's going to spread the fire.
 16 Q. And pooling?
 17 A. Yes, I mean, pooling of polyethylene means you're going
 18 to have a local pool fire burning with significant heat
 19 release. That energy is going to go somewhere. If it
 20 heats ACM or insulation, it's going to contribute to
 21 combustion of those products and you're going to have
 22 a bigger fire.
 23 Q. In relation to the horizontal edges, you have described
 24 already very helpfully this morning the return
 25 internally into the cavity of the cassette, with the lip

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1 that retains flowing, dripping, melting polyethylene.
 2 Are there any other horizontal areas within the cavity,
 3 other than that return?
 4 A. Yes. I mean, so that was with respect to the spandrel
 5 panels that I mentioned that. The column cassettes also
 6 have little returns on them, not quite as substantial as
 7 the spandrel cassettes, and indeed at Phase 1
 8 I presented some images and some video evidence where
 9 you can actually see polyethylene burning in the
 10 cladding system, kind of between the cracks of the
 11 column cassettes, I think on those horizontal surfaces,
 12 you have pooling polyethylene. You can see flaming in
 13 those locations, in cassettes that look otherwise
 14 intact.
 15 I mean, the other location — sort of, you know,
 16 ironically, given the purpose of cavity barriers — is
 17 on cavity barriers that will have been installed within
 18 the system. You know, these cavity barriers kind of
 19 protrude horizontally out into the cladding cavity.
 20 They're made of a mineral wool insulation, and you could
 21 have polyethylene falling on to the cavity barriers
 22 within the cladding system, pooling there, burning
 23 locally and making matters locally worse for the
 24 cladding system, certainly for an upward fire spread
 25 mode.

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1 Q. Yes, and that's internally. What about externally?
 2 Where would the horizontal surfaces be externally?
 3 A. I mean, you have windowsills and various other locations
 4 such as that. On the outside of Grenfell Tower, there
 5 weren't actually a whole lot of horizontal surfaces on
 6 the outside of the cladding, if you like. Even the
 7 windowsill areas were inclined downward as soon as you
 8 got outside the glazing. There was almost immediately
 9 a downward slope to the cladding cassette.
 10 MR MILLETT: Yes. Well, thank you very much, professor.
 11 Mr Chairman, is now a convenient moment for the
 12 morning break?
 13 SIR MARTIN MOORE—BICK: Yes, I think it is, thank you.
 14 Well, Professor Bisby, I think it is time we had our
 15 morning break, so we will stop there. We will resume,
 16 please, at 11.35. You know the drill: please don't talk
 17 to anyone about your evidence while you're out of the
 18 room.
 19 THE WITNESS: Certainly. Thank you.
 20 SIR MARTIN MOORE—BICK: Thank you very much. Would you go
 21 with the usher, please.
 22 (Pause)
 23 Thank you. 11.35.
 24 (11.19 am)
 25 (A short break)

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1 (11.38 am)
 2 SIR MARTIN MOORE—BICK: All right, Professor Bisby, are you
 3 ready to carry on?
 4 THE WITNESS: I am.
 5 SIR MARTIN MOORE—BICK: Yes, thank you.
 6 Yes, Mr Millett.
 7 MR MILLETT: Thank you very much, Mr Chairman.
 8 Professor, can we now turn to work package 2 and the
 9 report, which we will find at {LBYWP200000001}. There
 10 it is. We looked at it very briefly earlier. It is
 11 dated 15 December 2021.
 12 If we go, please, to page 5 {LBYWP200000001/5},
 13 paragraph 32, you say:
 14 "The combustibility of the insulation product used
 15 has been shown to be of secondary, or even tertiary,
 16 importance based on our experiments (when ACM PE
 17 rainscreens are used). The combustibility of the
 18 insulation played an obvious role only when large
 19 surfaces were unprotected by foil facers, and were thus
 20 able to support ignition and widespread surface flaming
 21 of the insulation."
 22 Does that mean that where foil facers were damaged
 23 or simply not present, such as on cut edges, the
 24 insulation did support ignition and widespread surface
 25 flaming?

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1 A. Yes, the data that would underpin that paragraph would
 2 be data where we looked at the amount of mass that was
 3 lost — sorry, maybe I'll step a couple of steps back.
 4 So, as I explained last week, when we performed
 5 these experiments, the ACM panel was mounted on a scale
 6 that sat on a load cell, and the insulation products
 7 were also mounted on a load cell so that we could
 8 measure the mass loss with time as the experiments
 9 progressed. That enabled us to — if you know how much
 10 mass is lost, and you know what the heat of combustion
 11 of the thing that's burning is, you can, in approximate
 12 terms, figure out approximately how much energy might
 13 have been liberated by that mass loss, if you like. So
 14 you can sort of figure out what the contribution of the
 15 different products is to the burning by using mass loss
 16 as a proxy measure of energy release, if you like.
 17 When we did that comparison and looked at the loss
 18 in mass up to the point of escalation to full
 19 involvement of the ACM, we found that the mass loss from
 20 the insulation was only significant when its foil facer
 21 was removed, and that in some cases the amount of energy
 22 that would have been liberated, using mass loss again as
 23 a proxy for energy release, would have been about the
 24 same as was released from the ACM.
 25 So that's where that comes from. I don't know if

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1 that clarifies the point — clarifies the question at
 2 all.
 3 Q. I was more interested really — but thank you for that
 4 clarification anyway — in the question of damage to
 5 foil facers.
 6 Let me try it slightly differently.
 7 Do you think that, once the exterior cladding is on
 8 fire, damage to the foil facing is inevitable?
 9 A. I mean, if the ACM PE is burning, then the foil facer is
 10 going to be damaged and removed at some stage, yes.
 11 I mean, we saw that in our experiments. Once you have
 12 a significant amount of burning from the ACM PE, the
 13 foil facer was typically removed. You know, it would
 14 bubble and fray and ultimately fall off, yes.
 15 Q. So taking it step by step, does that tell us that, at
 16 some point in the Grenfell Tower fire, the foil facer
 17 ceased to be protective against significant mass loss?
 18 A. Yes.
 19 Q. And therefore began to contribute to the total energy
 20 overall?
 21 A. That's right. I mean, the — yes, but, again, when that
 22 happens in the process of escalation is quite important.
 23 So, you know, at that point the ACM is already well
 24 away, let's say, and burning quite well.
 25 Q. Yes. And in answer to that question — you say it's

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1 an important question — when did it happen or does it
 2 happen in the escalation process?
 3 A. When is the foil facer lost?
 4 Q. Yes, at what (inaudible) point?
 5 A. The foil facers, again, from memory — without watching
 6 all the videos back, I wouldn't be able to say for sure,
 7 but from memory, it's in that region when the escalation
 8 occurs, either immediately preceding or as the
 9 escalation to full involvement of the PE occurs.
 10 Q. We may be able to trace this through a little bit more.
 11 Can we go to paragraph 49 on page 9, please, in this
 12 report {LBYWP200000001/9}. You say there:
 13 "The condition that leads to rapid and irreversible
 14 fire growth has been identified as the mechanical
 15 separation (or otherwise compromising) of the ACM's
 16 inner aluminium skin, which exposes a large area of
 17 polyethylene to the fire in the cavity. This results in
 18 a rapid increase in the energy release from the fire and
 19 promotes rapid fire growth."
 20 Is it the case that, once the exterior cladding has
 21 attained irreversible fire growth, which you describe
 22 here, that will in turn cause the insulation to burn as
 23 well, provided it's combustible, regardless of whether
 24 it's foil faced?
 25 A. Yes. I mean, I think in a fire — I mean, never say

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1 never, but I think in a fire of that intensity, if you
 2 had an ACM PE rainscreen burning adjacent to
 3 a foil-faced polymer foam insulation with a cavity, then
 4 that insulation is going to get involved in the fire,
 5 definitely, yes.
 6 Q. Then if we turn to page 63 {LBYPWP200000001/63},
 7 figure 17, we can see at the top of the page some
 8 photographs taken or selections of photographs taken
 9 from experiment 21, and you can see the line burner
 10 there as the method of ignition.
 11 Do your experiments in work packages 1 or 2 quantify
 12 or measure horizontal flame spread from a single point
 13 of origin, as was observed at Grenfell?
 14 A. No. No. I mean, I guess I might dispute horizontal
 15 flame spread from the point of origin as was observed at
 16 Grenfell, depending on what kind of horizontal mechanism
 17 we're talking about as well.
 18 Q. Fair enough.
 19 Given the small-scale nature, though, of the
 20 experiments in work package 2 and the absence of a whole
 21 system test, what conclusion, if any, can you reasonably
 22 draw regarding the contribution of the insulation to the
 23 spread and the intensity of the fire which did occur at
 24 Grenfell?
 25 A. Yes, I mean, that is a very important distinction, and

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1 something that it's important to be clear about is that
 2 these experiments were focused on growth of a fire from
 3 a small fire to a large fire in an upward fire spread
 4 mode. The consequent spread of the fire around and down
 5 the building is not addressed by these experiments. You
 6 know, it's very important to be clear on that. You
 7 know, one of the reasons why I laboured the point a bit
 8 in the first session this morning, you know, is to
 9 explain sort of what my view of the lateral and the
 10 downward is, associated with the burning of the
 11 polyethylene, rather than, you know, what we might call
 12 a classical horizontal or lateral fire spread over the
 13 surface of a product.
 14 Q. If we go to page 121 {LBYPWP200000001/121}, paragraph 644
 15 at the foot of the page, it says this, under the heading
 16 "Contribution of Insulation to Total Release of Energy":
 17 "The data presented in this figure are the total
 18 energy release that can be expected in cases where the
 19 cladding is allowed to burn without intervention until
 20 local burnout of the ACM (at which point the insulation
 21 also typically self-extinguishes, notwithstanding my
 22 previous comments regarding ongoing smouldering
 23 combustion of the Kingspan K15 insulation)."
 24 What is "local burnout" of the ACM?
 25 A. Yes. I mean, it's perhaps slightly imprecise words, but

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1 what I mean by that is essentially until the
 2 polyethylene is not burning anymore at the location of
 3 the fire that we're interested in. Yes.
 4 So basically the polyethylene — there's no evidence
 5 of any further burning of polyethylene.
 6 Q. Whether within the panel or anywhere else?
 7 A. Or in the drip tray, yes.
 8 Q. Right.
 9 In relation to the figures of contribution played by
 10 RS5000 and K15 of the total energy released until the
 11 end of the experiment, I think we probably need the
 12 figures for those.
 13 Can we go, first of all, to figure 33 on page 78
 14 {LBYPWP200000001/78}. Let's have that up first. You
 15 showed us this last week.
 16 Then, again, perhaps have it side by side, page 123
 17 {LBYPWP200000001/123}, paragraphs 655 and 656. You give
 18 figures there of 20% and 53%, up to, as maximums, likely
 19 maximums in a worst-case scenario, for Celotex RS5000
 20 and in 655 and K15 in 656.
 21 Just taking that data and those opinions together,
 22 is it right that these experiments were terminated at
 23 20 minutes?
 24 A. Yes.
 25 Q. Now, what would have been the impact on your conclusions

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1 about the fire at Grenfell Tower given that it went
 2 beyond 20 minutes?
 3 A. I mean, it's an interesting question. At the end of the
 4 20 — I mean, 20 minutes was chosen essentially
 5 arbitrarily, because in many of the experiments,
 6 anything that was interesting that was going to happen
 7 had happened or everything had gone out and there was no
 8 further combustion that we could observe from the rig
 9 beyond 20 minutes. So, you know, all the burning had
 10 ceased, if you like. I mean, how that relates to the
 11 fire at Grenfell Tower, as I mentioned earlier, at
 12 Grenfell Tower, as the fire spread around the building,
 13 it ignited compartment fires, which then burned within
 14 the compartments for much longer durations, and so you
 15 had further thermal exposure to whatever products might
 16 have been left on the cladding due to the fire plumes,
 17 so insulation in particular. So any insulation that
 18 would have been left, after the external fire had kind
 19 of spread away, gone away, the ACM was gone, that
 20 burning was able to continue because you had fire plumes
 21 coming out the windows as a consequence of the flats
 22 burning.
 23 Remind me of the question again, sorry.
 24 Q. Well, no, I can build on the answer, I think.
 25 A. Okay.

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1 Q. What was the basis of the assumption, as you say in the
2 last answer, that anything interesting that was going to
3 happen had happened within the first 20 minutes?

4 A. Ah, right, yes. So, yes, I've remembered now where
5 I was going with my answer.
6 So in the case of experiments that involve the
7 Celotex product, from memory, you know, by 20 minutes,
8 everything had gone out. There was no further
9 combustion that was observable at all.

10 In the case of some of the experiments with the
11 Kingspan product, there was, as I mentioned last week,
12 some ongoing smouldering of the insulation that occurred
13 and, actually, in some cases that continued up to
14 20 minutes, and at 20 minutes we just sort of called it
15 and said, "Okay, we're just going to stop at 20 minutes
16 now". If we had let it run, whether that smouldering or
17 the extent to which that smouldering would have
18 continued beyond the end of the 20 minutes is anyone's
19 guess. You know, the intensity of smouldering tended to
20 decrease with time, so one imagines that eventually it
21 would stop, but we don't know.

22 I mean, one of the things that was interesting about
23 the experiments involving the Kingspan product, the K15
24 product, was that, you know, long after the ACM had
25 burned away and there was little evidence of any ongoing

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1 burning of the polyethylene, you still see this
2 smouldering combustion ongoing, and eventually what
3 actually happened is you get smouldering combustion
4 essentially eats its way all the way to the back of the
5 100-millimetre thick Kingspan product, and you actually
6 have smouldering combustion kind of coming out of the
7 back of the insulation panel in our rig. That was
8 something we didn't observe for the Celotex.

9 Q. Right. On Grenfell Tower itself, if that had happened,
10 where would that heat have gone?

11 A. At Grenfell Tower, the insulation was butted up against
12 the concrete of the building.

13 Q. I see.

14 A. So it would have gone, you know, to the concrete or
15 would have been — it would have been slightly
16 different, because the smouldering combustion depends on
17 the availability of oxygen and the extent to which
18 energy is retained within the insulation.

19 I mean, to sort of highlight that point, one of the
20 things that we observed that was interesting with
21 respect to the smouldering was that the Kingspan
22 products, when tested with the foil facer, seemed to
23 smoulder better, if you like, than when they were tested
24 without the foil facer, and that's because some of the
25 foil facer inevitably remains in place after some

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1 combustion and pyrolysis of the underlying polymer has
2 started, and that foil facer, kind of
3 counterintuitively, once you have some smouldering in
4 the foam behind the foil facer, the foil facer actually
5 keeps heat in the smouldering foam and makes the
6 smouldering worse. So, in that respect, having the foil
7 facer on the K15 product actually made the subsequent
8 smouldering continue for longer than in the case where
9 it wasn't there.

10 Q. I see.

11 A. So it's sort of a counterintuitive result.

12 Q. Well, it may or may not be counterintuitive, but would
13 this be right: that it actually has a double effect; the
14 presence of a foil facer protects the integrity and the
15 combustion of the K15 for longer, but once there's
16 combustion, but the foil facer remains in place in
17 parts, it lasts longer?

18 A. Yes, the foil keeps energy out, but it also keeps energy
19 in.

20 Q. Yes, that's an even better way of putting the duality.

21 Now, as you've said, you used a 20-minute cut-off
22 period. Just standing back and answering the question
23 in very general terms, as we have seen, I think,
24 throughout the Inquiry, the testing regime has tests
25 which have termination times. In general, what are

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1 those termination times based on? What assumptions are
2 made generally about a particular termination time?

3 A. I mean, typically our experiments were terminated or we
4 chose to terminate experiments when we felt we'd
5 observed what was interesting to observe —

6 Q. Right.

7 A. — in simple terms. So it is essentially arbitrary.

8 But we would not — I mean, I would never, as someone
9 who is interested in the way the world works, terminate
10 an experiment if I feel I still have something to learn
11 from it. I mean, that's one of the really important
12 things — I presume we'll talk later about the testing
13 regime and testing regimes associated with cladding
14 products, but, you know, that's one of the kind of key
15 messages for me overarching relevant to the question of
16 rivets versus cassettes and my comments about the SBI
17 experiment.

18 If you test an ACM PE product in an SBI and you test
19 it riveted and it achieves some level of performance and
20 you stop the test, and you test a cassette and it
21 achieves some level of performance and you stop the
22 test, you're missing information when you stop that
23 test, particularly on the riveted system. You're
24 missing the escalation, you're missing the shock and
25 alarm of what these systems and products can do when

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1 they are pushed too far, and that is a problem with fire
2 resistance testing, with standardised compliance
3 testing, is because these tests are run for 20 minutes,
4 that means that people can manipulate their products to
5 make it through the allotted time, without you observing
6 maybe something that you might like to observe if you
7 really wanted to understand what was going to happen.

8 So in our experiments — that's a very long-winded
9 way, with apologies, of answering your question, but
10 I do think it's an important insight, is that if you
11 want to understand how a product burns, then you should
12 let it burn until you can't burn anything anymore, and
13 that's the criterion that we used.

14 Q. Thank you, that's helpful.

15 Now, looking at Grenfell itself, as we know, the
16 fire there spread from immediately outside flat 16 to
17 the crown in the 20-minute period.

18 Taking all the evidence into account that you've
19 seen, is it your view — and tell me if this is not the
20 case — that the contribution of the insulation products
21 to the total energy released by the ACM PE cladding
22 occurred after the local burnout of the fire of the ACM
23 PE?

24 A. I mean, interesting distinction in words here.

25 I would — again, I think the words that I've used in

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1 the report are imprecise. Local — I mean, I've used
2 those words without defining what I mean by local
3 burnout of the ACM. What I would mean by that is until
4 there's no polyethylene burning anymore, but I think
5 perhaps the more relevant question or the better way of
6 phrasing that would be to say until local burnout of the
7 cladding, of the cladding system, because in some cases
8 you did have ongoing combustion of the insulation beyond
9 the point in time when there was no obvious burning of
10 the PE.

11 You know, it's quite hard, when performing these
12 experiments, to identify with absolute precision when
13 there's no more PE burning. You know, I think in the
14 experiment that I showed last week, I think it was
15 experiment 21, I think, where I showed the full
16 progression of the experiment, highlighted some of the
17 key moments, and I think the moment that we observed the
18 last burning of PE in that was around 18 minutes of the
19 20 minutes. Whether that is a consistent 18 minutes or
20 whether sometimes it's 8 minutes and sometimes it's
21 26 minutes, I would have to go back and look at the data
22 to know for sure.

23 I don't think it's a hugely significant point
24 because, at the end of the day, we're interested in how
25 much energy is liberated by the cladding system, and

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1 we're also interested in the timescales over which that
2 liberation of energy occurs.

3 Q. When you say "cladding system" in that answer, do you
4 mean the ACM or do you mean —

5 A. I mean the external wall arrangement.

6 Q. The build-up?

7 A. Yes.

8 Q. I see.

9 Can you just help me, is it the case that energy
10 released by the insulation products as part of that
11 external wall build-up, after local burnout, if you
12 like, of the PE ACM, was not relevant to the nature and
13 speed of the spread of the fire at Grenfell?

14 A. Sorry, could you ask that again?

15 Q. Yes. Well, let me try it differently.

16 What was the contribution of the insulation at
17 Grenfell Tower after local burnout of the PE?

18 A. I mean, I would say pretty minor. I mean, for the
19 Celotex product, it stopped burning — once the PE was
20 gone, the Celotex wasn't really burning anymore. For
21 the Kingspan product, the burning that was ongoing was
22 much less severe, you know, smouldering and a little bit
23 of flaming. So, yes, I think not very significant would
24 be — I mean, I'd struggle to put a percentage on it,
25 but not very significant, yes.

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1 Q. Now, if we go, please, to page 127 {LBYPWP200000001/127},
2 I'll show you the paragraph, it's paragraph 685, but you
3 say there that the experiments showed that the
4 arrangements using non-combustible mineral wool
5 insulation grew to full involvement of the ACM more
6 rapidly than for the foil-faced combustible insulation
7 products.

8 Now, in light of that conclusion, are you able to
9 tell us whether the theoretical percentage contributions
10 to total energy release attributable to different types
11 of insulation products provides any kind of reliable
12 indication of the relative contributions of those
13 insulation products to the speed and extent of flame
14 spread?

15 A. With apologies, could you give me the first part of that
16 question again?

17 Q. Yes. Given the conclusion that you've set out in 685,
18 which is that non-combustible mineral wool insulation
19 grows to full involvement of the ACM more rapidly than
20 the foil-faced combustible insulation, given that
21 conclusion, are you able to tell us whether the
22 theoretical percentage contributions to total energy
23 release provided by each individual insulation product
24 provides any kind of reliable indication of those
25 contributions to the overall speed and extent of flame

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1 spread where you have a PE—cored ACM system?
 2 A. I think what it tells us, as I said last week, is that
 3 that contribution in comparative terms is relatively
 4 minor, if it exists at all. I mean, obviously the
 5 insulation materials are pyrolysing, they are liberating
 6 flammable pyrolysis products. Those products, in the
 7 present of heat and oxygen, are going to burn, so there
 8 is a contribution. You cannot — I mean, it would be
 9 very hard to argue that there is no contribution. That
 10 contribution is probably comparatively minor.

11 But the other thing that — you know, it's important
 12 not to oversimplify the — I understand the question,
 13 but it's important not to oversimplify the complexity of
 14 the heat transfer environment within the cavity and the
 15 complexity of the interactions between the ACM and
 16 whatever is facing the ACM, whether it's foil—faced
 17 combustible or non—combustible or without the foil
 18 insulation.

19 That's really nicely shown, and this was the biggest
 20 sort of head—scratcher, if you like, for us when we
 21 performed these experiments, when you — I have to be
 22 careful to make sure I get this right. When we tested
 23 the system with mineral wool insulation and we added the
 24 foil, the escalation occurred more quickly. When we
 25 tested with the combustible insulation products and we

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1 added the foil, the escalation occurred less quickly.
 2 That's because the extent to which the insulation
 3 products can liberate energy, the extent to which the
 4 surfaces of those products heat, the extent to which the
 5 surfaces of those products reflect or re—radiate energy,
 6 and the extent to which the surfaces of those products
 7 can be heated by convective rather than radiation,
 8 rather than radiative heating, you know, the balance of
 9 all of those factors changes for each of those products.
 10 So saying for sure, "Oh, it must have been the energy
 11 liberated by combustion" is actually a very difficult
 12 thing to do.

13 So it's not — I mean, what I want to say is it's
 14 not that simple. It's actually very, very complicated.
 15 But I do think it's fair to say that the contribution,
 16 as I said last week, to the total energy release of the
 17 cladding system, the external wall arrangement, during
 18 the course of the 20—minute duration of our
 19 experiments — it's shown here on the graph that's on
 20 the screen. Given the combustible insulation, so the
 21 three leftmost sets of data, are not that dissimilar
 22 from the mineral wool data, the contribution from
 23 burning is comparatively minor when you compare with
 24 some of the other factors. The insulation, for
 25 instance.

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1 Q. Now, if we go back to page 123 {LBYWP200000001/123}, we
 2 saw this earlier, and looked at paragraphs 655 and 656.
 3 There they are.

4 Is it right that the percentage contributions to
 5 total heat release that you set out there in relation to
 6 each of those products, RS5000 and K15, are calculated
 7 by expressing the heat released by the insulating
 8 product at the end of the experiment at an assumed 100%
 9 combustion efficiency, which is divided, I think, by the
 10 experimentally measured heat release by the ACM and the
 11 insulant at the point of local burnout, which is
 12 earlier?

13 A. I have to scroll up in the report to see — because
 14 we've made a number of comparisons in terms of — some
 15 of those comparisons are based on the mass loss measured
 16 during the experiment, some are based on the total mass
 17 measured at the end of the experiment. I think in this
 18 situation we're talking about the total mass loss from
 19 the insulation products.

20 So to back up a bit, before we ran the experiments,
 21 we measure the mass of the sheet of insulation that goes
 22 into the rig. So we weigh it. At the end of the
 23 experiment, we take that sheet of insulation off the rig
 24 and we weigh it again. The difference is the mass lost.

25 Q. Yes.

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1 A. If you take that mass loss and you multiply it by the
 2 heat of combustion, you get the maximum conceivable
 3 amount of energy that will have been released by that
 4 product, and that maximum conceivable assumes that the
 5 combustion is 100% efficient. I think that is the basis
 6 upon which these numbers given here in these specific
 7 paragraphs are calculated, yes.

8 Q. Let me try to help you.

9 If you go back a page, please, to page 122
 10 {LBYWP200000001/122}, on the right—hand side of the
 11 screen, you can see what the observations are that are
 12 the basis of figure 33 and the methodology you adopted
 13 there, just to remind you of what it was, and —

14 A. Yes, so that would be based on the full 20 minutes.

15 Q. Yes. So the question is: is it the case that your
 16 calculations do not compare like for like for two
 17 reasons, but the first is that they mix different
 18 timescales? One is you're measuring total mass loss
 19 over the full period of the test, but you're also
 20 measuring heat release by the ACM up to the point of
 21 local burnout, which is earlier on.

22 A. We did do the two different things, yes, but I think
 23 here we're just presenting the 20—minute mass loss as
 24 a maximum conceivable value.

25 Q. Right.

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1 A. Yes.
 2 Q. Let me ask you slightly differently .
 3 Is there any material flaw in the assumptions where
 4 you are measuring heat release up to the point of
 5 burnout in relation to the ACM, but up to the end of the
 6 experiment through the mass loss in relation to the
 7 insulating products?
 8 A. Okay, I think I see what's happening here.
 9 So I think that figure 33 is presenting the area
 10 underneath the heat release curve, if you like, for the
 11 experiments.
 12 Q. Yes.
 13 A. Whereas the numbers that we're discussing are based on
 14 the total mass loss from start to finish, and the
 15 question is which of those is the fairer comparison,
 16 I think is the question.
 17 Q. Well —
 18 A. And the answer is that the total heat release in
 19 figure 33 is the fair question.
 20 When you take the mass of the insulation at the
 21 start of the experiment, you run your experiment, and
 22 then you take the mass at the end of the experiment, and
 23 you assume that all of that mass resulted in liberation
 24 of energy, you are, if you like, being unfair to the
 25 insulation product, because it's not the case that all

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1 of the mass turns into energy. Right? It is the case
 2 that the conditions in which that combustion is
 3 occurring are not those that would exist within a bomb
 4 calorimeter, which is where you get the heat of
 5 combustion from, where you have, you know, 100% oxygen
 6 and you have the most efficient possible combustion
 7 environment.
 8 Now, how much less efficient the combustion
 9 environment in the cladding experiments that we ran is
 10 as compared to the bomb calorimeter, I can't say. But
 11 I do feel that I've been quite clear in the way I've
 12 presented those data to caveat it by saying, "These are
 13 the maximum possible values we could ever expect". So
 14 this is sort of the worst-case scenario. If we assume
 15 that all mass turns into energy, this is as bad as it
 16 could possibly be. In reality, it's going to be
 17 somewhat less than that.
 18 Q. Are you able to tell us whether the amount of mass lost
 19 between ACM burnout and the end of the experiment was
 20 material, was significant?
 21 A. I mean, potentially, but only insofar as those are the
 22 words that I've used. With respect to what happens on
 23 a building, which is why we've done this, then, as I sit
 24 here, I think probably in my report, if I had the
 25 opportunity to amend the report, I would simply change

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1 the words from "until local burnout of the ACM" to read
 2 "until local burnout of the cladding" —
 3 Q. Right.
 4 A. — and then it would be fine.
 5 Q. I see. So the answer is no, I think, there is no
 6 material —
 7 A. In terms of the out — in terms of my conclusions, no.
 8 Q. Right.
 9 Same question in relation to different combustion
 10 efficiencies as between the ACM PE on the one hand and
 11 each of these insulation products on the other. Are you
 12 not comparing like with like because you're mixing
 13 different combustion efficiencies?
 14 A. Yes, probably, yes.
 15 Q. Does that have an effect or impact on your conclusions?
 16 A. No, because I don't think that my conclusions are based
 17 on calculations that assume 100% combustion efficiency.
 18 No, I don't think so.
 19 Q. Is it the case that if, instead, you did compare like
 20 for like by comparing the heat release contribution from
 21 the insulation using experimental combustion efficiency
 22 measurements at the same points in time, namely at peak
 23 HRR, peak heat release, that the percentage contribution
 24 in respect of the total heat release from the insulation
 25 components would be lower than you've said?

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1 A. It's entirely possible. I'm not sure that that's
 2 a relevant question. I mean, we're not interested
 3 necessarily in just what happens up to peak heat
 4 release. We're interested in how much energy is
 5 liberated at that location, period. I mean, you
 6 know ... so it's not simply a question of what happens
 7 until we get to the peak. It's a question of what
 8 happens throughout the full duration of burning.
 9 So, yes, I think the answer is yes, it's possible
 10 that the contribution of the insulation up to that point
 11 might be less as a percentage, rather than the number
 12 I've given, but I just don't necessarily accept that
 13 that's an important question.
 14 Q. Now, if we go to page 36 of your report here
 15 {LBYWP200000001/36}, paragraph 239, you identify the
 16 mineral wool insulation, and you say in the second
 17 sentence:
 18 "The specific product chosen was a Rockwool duct
 19 insulation/lagging product marketed under the tradename
 20 Ductslab."
 21 I think it's right that that was classified as
 22 Euro A1 and non-combustible under the national
 23 classification system; yes?
 24 A. Yes.
 25 Q. As far as you are aware, is that a foil-faced insulant?

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1 A. Yes.
 2 Q. And marketed in the UK as a rainscreen insulation
 3 product; yes?
 4 A. I don't know if it's marketed as a rainscreen insulation
 5 product. Yes. I mean, I wouldn't — it doesn't really
 6 matter to me how it's marketed. What I'm interested in
 7 is what it is. I'm interested that it's
 8 a non-combustible mineral wool with a foil facer.
 9 Q. Right.
 10 Now, I want just to ask you one or two questions
 11 about 8414.
 12 We will come to the topic in more detail later, but
 13 in relation to the tests done under 8414-1 and carried
 14 out by the government following the Grenfell Tower fire,
 15 is it right to say that the nature and rate of flame
 16 spread on cladding systems incorporating foil-faced PIR
 17 and unfaced mineral fibre insulation behind PE-cored ACM
 18 have been found to be comparable at large scale and at
 19 intermediate scale?
 20 A. Could you run that past me again, with apologies?
 21 Q. Yes. Is it right to say, given the tests done under
 22 BS 8414 by the government after the Grenfell Tower fire
 23 in 2017, that the nature and the rate of flame spread on
 24 cladding systems incorporating foil-faced PIR and
 25 unfaced mineral fibre insulation, both in each case

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1 together with a PE-cored ACM rainscreen, have been found
 2 to be comparable?
 3 A. I mean, nature and rate, I might — I mean, I don't know
 4 that we necessarily learn that much about the nature and
 5 rate from a BS 8414 test, which would be the basis upon
 6 which that question is posed, you know, referring to the
 7 post-Grenfell DCLG tests, I presume.
 8 Q. Yes.
 9 A. It is the case that, in those tests, the system with
 10 mineral wool — that the test with mineral wool was
 11 terminated at a similar time to the tests with polymer
 12 foam insulation. But I think, from memory, in those
 13 experiments, that the mineral wool was used without
 14 a foil facer and the polymer foam insulations had foil
 15 facers, so there's a mild distinction there.
 16 Q. Right.
 17 Is it right to say the same thing, that the nature
 18 and rate of flame spread on cladding systems
 19 incorporating foil-faced PIR and foil-faced phenolic and
 20 unfaced mineral fibre insulation, in all cases with
 21 PE-cored ACM rainscreen, have been found to be
 22 comparable in modelling?
 23 A. I mean, I'm aware that some modelling work has been
 24 performed, sponsored I believe by Kingspan. The
 25 veracity of that modelling and the extent to which that

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1 modelling has been validated I think is a question that
 2 I've not looked at in very much detail. I'm aware that
 3 the work has been done and I'm aware that the
 4 conclusions of that work have been to suggest that there
 5 isn't a major difference.
 6 I mean, Professor Torero, in his report, has
 7 commented on that in some detail, and I think those
 8 would be very appropriate questions to ask him.
 9 Q. Right.
 10 Now, having regard to all the available evidence you
 11 have seen, including your own experiments, are you able
 12 to provide us with an opinion about whether the nature
 13 and speed of the spread of the fire at Grenfell Tower
 14 would have been materially different had unfaced mineral
 15 fibre insulation been used as the insulating product
 16 behind the PE ACM rainscreen cladding instead of RS5000
 17 and K15?
 18 A. I can only base an answer to that question on the
 19 evidence that I have from the experiments that I've
 20 performed and, as I said earlier today, my view is that
 21 the combustibility of the polymer foam insulations,
 22 which is effectively what this question is asking me,
 23 will have played a role that was probably something less
 24 than 10% of the contribution to the escalation and
 25 spread of that fire in an upward fire spread mode.

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1 Beyond that, it's very difficult for me to say one way
 2 or another. Yes.
 3 Q. Thank you very much.
 4 Now, I'd like to turn next to a different topic and
 5 a different report: your Path to Grenfell report of
 6 10 November 2021. Let's have that back up, please.
 7 That is at {LBYP200000001}.
 8 I just want to turn to page 4 in that
 9 {LBYP200000001/4} and run through the table of contents
 10 with you, where you set out the structure of your
 11 report. We can see there that it is divided into three
 12 parts, each with references, and an appendix A.
 13 Now, part I is "The Purpose of Testing"; yes?
 14 You've set out there three categories of tests,
 15 explaining the differences between them and giving
 16 examples of fire safety tests in each category; yes?
 17 A. Yes.
 18 Q. So category 1: unrepresentative tests, category 2: model
 19 tests, and category 3: technological proof tests.
 20 Then part II, foot of the screen, "The Path to
 21 Grenfell", and that's drawing together the various
 22 narrative threads relating directly to fire safety
 23 testing, research and investigation, as well as Building
 24 Regulations and the various pieces of associated
 25 statutory and industry guidance; yes?

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1 A. Yes.
 2 Q. Just on that, is it right that you begin that part of
 3 your report with an overview of the development of the
 4 building regulatory environment in England and Wales,
 5 starting in 1919, describing the deployment of
 6 particular fire safety tests within those regulations
 7 and the relevant guidance?
 8 A. That's right.
 9 Q. Yes. You also, I think, address a number of historic UK
 10 cladding fires on high-rise buildings, offering,
 11 I think, analysis not only of the fire events
 12 themselves, but subsequent investigations into those
 13 fires, such as Knowsley and Garnock?
 14 A. To the extent that I was able to, yes.
 15 Q. Yes.
 16 Is it right that you also offer analyses of patterns
 17 of risk and vulnerabilities in fire safety which existed
 18 at the time of the Grenfell Tower fire in June 2017, as
 19 revealed by these different narrative threads? Yes?
 20 A. That was what I attempted to do, yes.
 21 Q. And you discuss a number of what you call "missed
 22 opportunities", where the statutory guidance and
 23 regulatory compliance testing regime could have been
 24 made simpler or less permissive, I think?
 25 A. Certainly, yes.

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1 Q. You've also got, if you turn the page, please, to
 2 page 5 — it goes on, actually, to part III, "Closing
 3 Remarks", on page 7 {LBYP20000001/7}, and appendix A on
 4 the same page, which starts at page 268, which is about
 5 regulatory capture; yes?
 6 A. Yes.
 7 Q. If we turn very briefly to appendix A at page 268
 8 {LBYP20000001/268}, we can see that it's headed "The
 9 Purpose and Evolution of (Fire Safety) Regulation". If
 10 we go in that to paragraph 1641, at the beginning, you
 11 say:
 12 "Whilst I do not hold myself out as a social
 13 scientist, or as holding any particular expertise in
 14 science and technology studies (STS), I have had
 15 a demonstrated academic interest in the roles of
 16 regulation and education in fire safety engineering
 17 design, practice, and enforcement for more than
 18 a decade. I have also published peer reviewed papers in
 19 both areas, as noted in Section 31."
 20 If you look at 1644, you tell us that:
 21 "The evidence presented in this Appendix also
 22 underpins some of my interpretation of the evidence that
 23 I present in parts I and II of this report; however
 24 I have placed it in an appendix because I do not hold
 25 myself out as an independent expert in this area."

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1 That's right, is it?
 2 A. Yes.
 3 Q. You then offer, as we have seen, some closing remarks in
 4 part III.
 5 Now, I would like to start with part I, if I can,
 6 and can we go, please, in that to page 13
 7 {LBYP20000001/13}, paragraph 53. We start with some
 8 simple propositions, I hope. You start:
 9 "The purpose of testing is to allow an individual or
 10 an organisation to use the results of a test to make
 11 a claim about how a material, product, or system will
 12 perform in a real 'in-service' situation."
 13 You say, if you go on in the same paragraph,
 14 a little lower down:
 15 "Tests can never exactly mimic operational use of
 16 a technology because test designers seek to minimise
 17 uncontrolled variables and introduce instrumentation
 18 that would not normally be present. The differences
 19 between a test and operational use means that: 'Tests
 20 get engineers closer to the real world but not all the
 21 way.'
 22 That's a quotation from Pinch 1993.
 23 If we go to paragraph 54, you say:
 24 "The key issue therefore is not whether a test is
 25 'realistic' — because it can never be completely so —

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1 but rather whether it is sufficiently 'representative'.
 2 As Downer argues: 'Since even the most "realistic" tests
 3 will always differ in some respects from the "real
 4 thing", engineers must determine which differences are
 5 "significant" and which are trivial if they are to know
 6 that a test is relevant or representative.'
 7 And you quote from Downer 2007.
 8 Now, you use expressions there, and we'll come back
 9 to this point in relation to large-scale testing later,
 10 but can you explain, in summary, why it is the case that
 11 the question is not whether a test is realistic, but
 12 whether it is sufficiently representative?
 13 A. Why is that a relevant point?
 14 Q. Yes, can you explain the distinction, the reasons for
 15 your drawing it?
 16 A. Well, I mean, because of what it says in the first line
 17 of that paragraph, which is, you know:
 18 "The purpose of testing is to allow an individual or
 19 an organisation to use the results ... to make a claim
 20 about how a material, product, or system will perform in
 21 a real 'in-service' [condition]."
 22 Because one can never devise a standardised test
 23 that will reproduce exactly the end-use conditions of
 24 products, it's just not a practicable approach to
 25 testing, so one has to come up with a test that asks the

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1 questions that allow oneself to make a claim about how
 2 the in-service performance is going to be, recognising
 3 that the test cannot reproduce reality.
 4 So designing tests that ask the right questions,
 5 that are representative of the things that one wants to
 6 know about a product, is the trick with these tests.
 7 Q. If we go to page 15 {LBYP20000001/15}, paragraph 64, you
 8 explain there as follows:
 9 "Testing for fire safety needs to achieve two main
 10 purposes. First, and most importantly, it should enable
 11 regulation that achieves societal objectives with regard
 12 to safety. Second, it needs to be practical in
 13 operation, providing reasonably consistent results
 14 without being overly burdensome in cost and time."
 15 Then at 65 you say:
 16 "The first of these purposes hinges on attaining
 17 a useful correspondence between test results and
 18 real-world performance. In principle, it does not
 19 matter whether a test is realistic so long as it is
 20 useful in this regard."
 21 Just pausing there, what do you mean by "a useful
 22 correspondence with real-world performance" as distinct
 23 from a test which is realistic?
 24 A. A test that tells you something that you can make use of
 25 in order to achieve satisfactory fire safety outcomes.

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1 Q. What's the difference between that and realism?
 2 A. Well, realism is not practicable. I mean, that's the
 3 kind of compromise that I'm alluding to in this section.
 4 You can't have a test that would realistically — that
 5 would simulate end-use conditions for every product.
 6 Q. I see.
 7 A. So you have to have a test that tells you something
 8 useful.
 9 I mean, there's a nice expression about models,
 10 right, which is that all models are wrong but some
 11 models are useful. You could say something similar
 12 about fire tests; you could say, you know, all fire
 13 tests are unrealistic, but some of them are useful.
 14 Q. I follow.
 15 Let's go to page 19 {LBYP20000001/19}, and at the
 16 top of the page there you identify, during the period
 17 1932 to 2017, three categories of fire test used within
 18 the regulatory system in place in that period. You say
 19 that there are unrepresentative tests, model tests and
 20 technological proof tests.
 21 Now, that taxonomy there, is that your own or is it
 22 one that's articulated and recognised in the literature?
 23 A. No, that's a local taxonomy, if you like. It's mine.
 24 Q. It's yours?
 25 A. Well, mine, along with colleagues who I was working with

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1 on these reports. So Graham Spinardi, who I have
 2 mentioned in appendix A.
 3 Q. It's Grenfell-specific, your work-specific?
 4 A. Correct, yes.
 5 Q. I see.
 6 Now, am I right to understand that it is important
 7 to understand the difference between these types of
 8 test, the purpose of developing them and what they were
 9 intending to measure or demonstrate in order to
 10 understand the limits of their credible use and
 11 application?
 12 A. I mean, yes. I think it's important to think about what
 13 these different types — which is why this taxonomy has
 14 been written down in this report. I think it's
 15 important to think about different types of tests, the
 16 basis upon which they were developed, how realistic or
 17 representative they are and, therefore, what burden of
 18 responsibility lies with those people who use those
 19 tests.
 20 Q. Would it be right also to say that certain relevant fire
 21 safety tests in the UK were implemented and used in
 22 practice in the period before Grenfell in ways which did
 23 not align with the intention, the logic and the
 24 limitations of the test themselves?
 25 A. That's my view, yes.

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1 Q. Yes. We'll come to some specific examples of that
 2 shortly. But is the reason for that non-alignment
 3 regulatory influence? Is that one of your rationales?
 4 A. I think — by "regulatory influence", you mean the
 5 influence of regulatory processes by industry, for
 6 instance, or ...?
 7 Q. It was a bit of a cryptic question, perhaps.
 8 Is it the case that because the deployment of these
 9 tests within statutory guidance and practice,
 10 specifically ADB, gave them a specific status, that
 11 might have tempted people to ignore or perhaps
 12 misunderstand their applications?
 13 A. I think the answer is —
 14 Q. Their limitations.
 15 A. Yes, I mean, I think I would say yes to that. You know,
 16 it's clear that the way people were — it seems clear
 17 that the way people were thinking about what following
 18 the recommendations of Approved Document B was doing
 19 would indicate a misunderstanding of certainly this
 20 taxonomy of tests and the way that tests should be —
 21 you know, for instance, the idea that one passes —
 22 sorry, the idea that one performs a BS 8414 test, takes
 23 the data from the BS 8414 test, has those data
 24 classified in accordance with BR 135 and gets a free
 25 pass to use that combination of cladding products in any

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1 variation on any building, is, in my view,
 2 a misconception of what that test is and what it's for
 3 and how it should be used.
 4 Q. Yes.
 5 Now, turning to the first category, therefore,
 6 unrepresentative tests, can you describe for us, in
 7 summary, the main properties or characteristics of
 8 unrepresentative tests?
 9 A. These are tests that are typically very small, and they
 10 are tests that give you a piece of information which is
 11 used to try to make some claim, but which is essentially
 12 totally non—representative of an end—use condition,
 13 which is why I've called them unrepresentative tests.
 14 So they're tests where you ask a question; the way you
 15 ask the question is totally unrepresentative of any sort
 16 of real construction application.
 17 Q. Right.
 18 Now, if we go to page 29 in this report
 19 {LBYP20000001/29}, and let's look together at
 20 paragraphs 140 to 143, you set out the tests above that
 21 at paragraph 133 which, if we can just scroll up, we can
 22 see. You've got the BS 476s and the BS ENs there, the
 23 oldest of which dates from 1970, and you have set out
 24 a list of characteristics of paragraphs 139 to 143
 25 there.

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1 Are the tests that you list under that category
 2 those which deal with combustibility?
 3 A. So part 4, part 11, 1182 — yes, they are.
 4 Q. I think you then provide an overview of the history of
 5 the development of combustibility test methods at
 6 page 20 {LBYP20000001/20}, paragraph 93, and you
 7 describe that as the potential of a material to burn; is
 8 that correct?
 9 A. Correct.
 10 Q. So when you say "combustibility", that's what you mean,
 11 is it?
 12 A. In —
 13 Q. In the context of these tests.
 14 A. In non—regulatory terms, yes, combustibility to me would
 15 mean, yes, the potential of a material to burn. So, you
 16 know, in non—regulatory language, combustibility would
 17 be a material that can react with oxygen and thereby
 18 liberate energy in the form of heat and light, strictly
 19 speaking. So anything that has a heat of combustion is,
 20 strictly speaking, combustible. So combustibility is,
 21 if you like, an on/off switch; it either is or it isn't.
 22 In regulatory terms, the regulatory system chooses
 23 to blur that a bit and decide that some materials that
 24 have a very, very small amount of combustible content,
 25 ie content that could react with oxygen and release

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1 energy, can be deemed to be non—combustible. That
 2 doesn't make them non—combustible, it means they are
 3 deemed to be such.
 4 Q. Am I right to understand that, by 2017, there were four
 5 independent test methods by which a manufacturer could
 6 demonstrate that a product was "non—combustible"?
 7 A. Yes, that would be referring to the four that are
 8 listed.
 9 Q. That's the four that are listed.
 10 A. Yes, yes.
 11 Q. If we go back to page 23 {LBYP20000001/23} at
 12 paragraph 109, and we don't need to read it all out
 13 because it's quite long, but is it right that you
 14 conclude from your review of the evolution of those
 15 various different test methods is that both the
 16 definitions of "non—combustibility" and the thresholds
 17 chosen for those definitions are arbitrary?
 18 A. Yes.
 19 Q. Yes.
 20 A. Yes.
 21 Q. Specifically, if we go to page 24 {LBYP20000001/24},
 22 paragraph 116, is it right that you explain that there?
 23 In the third line you say:
 24 "There is no particular reason why the criteria for
 25 flaming should be set at zero seconds, five seconds, or

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1 ten seconds — these are arbitrary decisions made
 2 (typically by committee) on the assumption that the
 3 precise value selected does not particularly matter with
 4 regard to the expected in—service fire safety outcomes."
 5 A. That's right, yes. So, you know, what these — I mean,
 6 I should probably say semi—arbitrary, rather than
 7 arbitrary. These lines in the sand that get drawn on,
 8 you know, the permissible heat of combustion for
 9 a product — or, sorry, for a material to be considered
 10 non—combustible or limited combustibility, those
 11 decisions get taken by, you know, committees of people
 12 who decide where those lines should be drawn, under the
 13 assumption that something that would fall foul of those
 14 lines would burn too much and something that would not
 15 would not burn too much. But those are judgments that
 16 are made by people, you know, it's not a scientific
 17 truth, so to speak.
 18 Q. Now, in the third line, just before that sentence, you
 19 say "at least partly arbitrary", and then you go on to
 20 identify the timing criteria for flaming.
 21 Are there any other criteria which you would say
 22 were arbitrary?
 23 A. All of them, I mean, are at least partly arbitrary. You
 24 know, so in the part 4 and part 11 tests, the chamber
 25 that the sample is lowered into is heated to 750 degrees

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1 Celsius. Why 750 degrees Celsius? Why not 600 or 900?
 2 And the answer is because they tried a bunch of
 3 different temperatures when they were developing the
 4 test and they decided that 750 told them sort of what
 5 they wanted to know. Going to 900 was probably a bit
 6 difficult because it's quite hard to get something to
 7 900, and going to 600 maybe didn't quite get things hot
 8 enough to observe the behaviours that you're interested
 9 in. So, I mean, that's an example. The size of the
 10 samples. The shape of the samples. Are they cuboid?
 11 Are they cylindrical?
 12 If you look at the bomb calorimeter tests, 1716,
 13 ISO 1716 for instance, and you look at where the
 14 Euroclasses decide to draw the line between A1, A2 and
 15 B, those decisions were made by a committee of people
 16 sitting in conference rooms in Brussels deciding where
 17 that line should be drawn. Yes.
 18 So insofar as these are committee decisions taken by
 19 individuals, they are arbitrary. They're not based on
 20 science, which is what I mean. You know, they're not —
 21 as I said before, it's not a fundamental scientific
 22 truth; it's a decision that's taken.
 23 Q. I see. Yes, that's clear.
 24 Can we go then to page 45 {LBYP20000001/45},
 25 paragraph 224. You say there:

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1 "The 'non-representative tests' were used largely as
 2 set out above. The thresholds were set at
 3 a conservative level, the tests were (relatively)
 4 sensitive to detecting the degree to which a material or
 5 product may or may not burn. However, the regulatory
 6 influence of this category of tests was limited as
 7 regards their application to combustible cladding
 8 materials and products."
 9 That last sentence, are you able to clarify what you
 10 mean there?
 11 A. Well, if we're thinking about, for instance, the Euro
 12 classification, the European classification system, so
 13 the European classification system uses ISO — well, the
 14 bomb calorimeter test and the drop tests, similar to
 15 476-4 or 11, to define A1 and A2 classifications, which
 16 are, you know, the non-combustible, limited combustible
 17 classifications. Once you get down into B and lower
 18 down, B, C, D, E, those tests aren't relevant anymore,
 19 because the products don't — well, they're not
 20 non-combustible or limited combustible. So the
 21 differentiation between the combustible products is made
 22 not on the basis of the potential energy contribution on
 23 heat combustion; it's made on the basis of their
 24 reaction to fire in an SBI, predominantly. Yes.
 25 Q. I follow. So you're really just focusing on the upper

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1 end of the scale in that sentence?
 2 A. Yes, I mean, what I'm trying to tease out there is that
 3 the heat of combustion is used to draw a line that those
 4 who drew the line considered to be, based upon my
 5 assessment — I wasn't in the room — quite
 6 a conservative line. You know, a material that has
 7 a heat of combustion of less than 2 megajoules per
 8 kilogram, to use my language from last week, is not
 9 a very burny material. No matter what you do to that
 10 material, the amount of energy you're going to liberate
 11 is comparatively small.
 12 So, you know, you could have drawn that line at
 13 10 megajoules per kilogram or 30 megajoules per
 14 kilogram, but they didn't, they chose 2, and the reason
 15 is because they wanted a conservative line despite the
 16 fact that they were acknowledging that they were
 17 allowing some contribution to burning, just very, very
 18 small.
 19 Q. Right, and you say that consideration doesn't apply once
 20 you're down into B, C, D and —
 21 A. Yes, I mean, you could have defined B, C, D and E. You
 22 could have said, "Well, if something can only be given
 23 a B if, in addition to achieving X and Y in the SBI
 24 test, it has a heat of combustion less than 15", or
 25 something. But they didn't do that, right? They just

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1 set heat of combustion aside once they were down into
 2 the lower ratings.
 3 Q. Let's turn, then, to the model tests, which is the
 4 second category of fire tests that you describe.
 5 Am I right to understand that small-scale model
 6 tests are modelled on and underpinned by larger-scale
 7 research based on more realistic scenarios?
 8 A. Typically, yes. I mean, that's the way that I've
 9 outlined them here, yes.
 10 Q. Is it right that those scenarios, those scenario tests,
 11 are intended to be representative of real fire hazards
 12 which might be present in real buildings?
 13 A. The models that are chosen as the basis for the model
 14 tests, yes.
 15 Q. And the measurements in those small-scale tests are
 16 intended to — is this right? — correlate with the
 17 outcomes observed in the more representative scenario
 18 tests?
 19 A. That's right. The hope when developing a model test is
 20 that one takes a model that is relevant to the fire. So
 21 the best example is the single burning item test in the
 22 European classification system. I mean, the BS 476-6
 23 fire propagation test is also a pretty good example.
 24 Both of those test methods, the classifications that
 25 drop out of them are linked to a fire burning in the

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1 corner of the room. So the model that is the scenario
 2 is a fire burning in the corner of a room, and then the
 3 hope is that you can make a test that doesn't require
 4 the burning of a fire in a room to infer what would
 5 happen if you used that product in a room with a fire in
 6 the corner, and then you don't have to burn a room every
 7 time you want to know the answer, you can do a BS 476-6
 8 test instead, and still differentiate between products
 9 in a way that is faithful to what would occur in the
 10 room.
 11 Q. Yes, and I think your report gives three tests which
 12 fall into that category: the BS 476-6, BS 476-7 and the
 13 SBI test, EN 13501-1.
 14 A. Yes.
 15 Q. Now, I think each of those tests has been described
 16 previously to the Inquiry by Dr Lane and others, so we
 17 don't need to go through the methods or the apparatus or
 18 the associated classification systems, but I just want
 19 to ask you one or two specific questions.
 20 Is it right -- and I think it is right -- that for
 21 all three sets of tests, they can only be strictly
 22 applied to products, rather than materials, unless
 23 a product is homogenous?
 24 A. Strictly, yes.
 25 Q. Yes. Can you explain -- and this may be a very basic

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1 question -- what is the difference between a product and
 2 a material?
 3 A. I mean, that's quite a -- I'm sure we could argue this
 4 point all day.
 5 When I think about it, it has to do with the
 6 homogeneity of the sample. So a product is often going
 7 to be something that is made up from different
 8 materials. In the context of this Inquiry, the most
 9 important case would be like a flat, layered product,
 10 like a foil-faced foam insulation or an ACM product. So
 11 if you take, for instance, foil-faced insulation.
 12 You've got a polymer foam, that is a material, and
 13 you've got aluminium foil-facers, those are materials.
 14 Now, it's slightly muddy in that case because the foil
 15 facers, certainly of the Kingspan product, are not just
 16 foil, there's fibres and various other things in there.
 17 But, you know -- and so for an ACM product, the
 18 aluminium skins are a material, the core or filler is
 19 a material, polyethylene, and so the product is
 20 a composite.
 21 But you could have a product that is also
 22 a material. So a high-pressure laminate cladding panel
 23 which is uniform in composition throughout, homogeneous
 24 in composition throughout, is just the panel of
 25 a material. Right?

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1 Q. Yes.
 2 Now, you say in your report that -- and this is
 3 paragraph 178 on page 38 {LBYP20000001/38} -- these
 4 tests can only be strictly applied to products. You use
 5 the word "strictly" there. Why is it that those tests
 6 are to apply to products, strictly, rather than
 7 materials? What is the basis for that?
 8 A. Because what you're doing in the model test is trying to
 9 assess how products are going to perform in a model
 10 scenario. What is relevant to the model scenario is not
 11 necessarily the material response, but it's the product
 12 response. You know, you've developed a model of a room.
 13 The reason you've got a room with a fire in the corner
 14 is because you want to understand what's going to happen
 15 in rooms lined with that thing if there's a fire in the
 16 corner. Right? You want to understand how quickly that
 17 fire is going to grow and whether that fire is going to
 18 progress to flashover. So there's no point in taking
 19 the core of an ACM and testing it on its own in a room
 20 corner test, because that's not representative of the
 21 end-use condition. It's not sufficiently representative
 22 of the end-use condition. It's not helping you answer
 23 the relevant question, if that makes any sense.
 24 Q. Yes, I see. I'm really after the distinction between
 25 products and materials.

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1 Why do these tests only apply strictly to products
 2 and not to homogeneous materials?
 3 A. I think because they're model tests. Because they are
 4 tests that are supposed to be asking questions about
 5 performance of products in fire scenarios, you know, in
 6 the scenario that you've used to develop your test.
 7 Q. We know that part 6 says so. Part 6 of BS 476 actually
 8 says that it applies to products.
 9 A. That's right.
 10 Q. What is the logic, though? I know that it's a model
 11 test, but just to say that it's a model test explains
 12 why it only applies to products and not materials is
 13 somewhat circular. What's the underlying rationale for
 14 the distinction?
 15 A. With respect to the part 6 test, the underlying
 16 rationale -- I mean, I don't know. Again, I wasn't
 17 there. I wasn't born yet when that part 6 test was
 18 developed, I think in the 1950s originally. But the
 19 rationale from my perspective is that, taking the part 6
 20 test as an example, the part 6 test is asking questions
 21 about the ability of a product to contribute energy to
 22 a fire. So it's asking questions about the amount of
 23 energy that a product will liberate when heated in
 24 a compartment fire within a room, and about the
 25 timescales over which that occurs.

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1 Mr Chairman, you look like you want to say
 2 something.
 3 SIR MARTIN MOORE—BICK: Well, it struck me, listening to
 4 this exchange, that maybe one ought to be thinking in
 5 terms that the test is only designed to be applied to
 6 products. It's a test that was conceived in order to
 7 test products. Would that be right?
 8 A. Yes. I mean, again, I wasn't there, but based on my
 9 understanding of what the test is, what it does and the
 10 questions it asks and answers, I would agree with that,
 11 certainly.
 12 SIR MARTIN MOORE—BICK: I think Mr Millett's question was
 13 perhaps slightly tempered by the fact that you used the
 14 words "can only be applied to products".
 15 A. Okay.
 16 SIR MARTIN MOORE—BICK: It can be applied to any material
 17 that you choose to apply it to, I assume.
 18 A. Go for it, yes.
 19 SIR MARTIN MOORE—BICK: So wood, for example, or even a PIR
 20 insulation board without any foil facer, you could put
 21 through this test, couldn't you?
 22 A. You could put — well, you can put —
 23 SIR MARTIN MOORE—BICK: That would be a homogeneous product.
 24 A. Yes, yes, I mean, certainly, you can put anything you
 25 like through the test, yes, absolutely. Whether putting

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1 that thing through the test makes sense in terms of the
 2 questions you want answers to —
 3 SIR MARTIN MOORE—BICK: Quite.
 4 A. — and in terms of the regulatory outcomes that would
 5 eventuate is maybe a secondary question.
 6 SIR MARTIN MOORE—BICK: Quite.
 7 A. But, I mean, I think where I was going in my answer to
 8 Mr Millett was to say that the reason that I think these
 9 products can only strictly or credibly be applied — or
 10 these tests can only strictly or credibly be applied to
 11 products, in the case of the part 6 test, is if one is
 12 interested in understanding the contribution of
 13 a product to a fire in a room — the perfect example is
 14 within the evidence to this Inquiry, that, for instance,
 15 there were insulation manufacturers, Kingspan, who were
 16 performing BS 476—6 tests on the foil facers alone, with
 17 some notion that, you know, getting a class 0 rating for
 18 the foil facer meant that the product with an underlying
 19 insulation would be class 0. That is just utterly
 20 absurd, not least because the facer has perforations in
 21 it, but because the underlying foam insulation will
 22 contribute to the fire that you get in a room, which is
 23 the model scenario that you're interested in assessing.
 24 So to test the foil facer on its own is just completely
 25 and utterly nonsensical and could never be defended, in

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1 my view.
 2 So that's sort of why I say that. It's so that we
 3 don't get situations like people testing foil facers on
 4 their own and claiming that that tells them something
 5 useful about the reaction to fire for a product, unless
 6 of course you're selling foil.
 7 MR MILLETT: Just picking up your example, which I think is
 8 one you've used in your report, actually, at page 180
 9 {LBYP20000001/180}, at paragraph 994. Let's go to
 10 paragraph 995, where you say this:
 11 "995. Bearing in mind the logic of the 'third way'
 12 it is my understanding that tests might be undertaken in
 13 this way in order that a claim could be made that the
 14 surface of the K15 was Class 0 — despite the fact that
 15 the product as a whole was not. Such an approach would
 16 allow Kingspan to generate the appearance of a product
 17 being Class 0, and thereby generate the appearance of
 18 compliance with Approved Document B, and hence the
 19 appearance of compliance with Paragraph B4 of the
 20 Building Regulations.
 21 "996. I note that I would consider this practice to
 22 be utterly indefensible, both by any manufacturer and/or
 23 by any compliance testing laboratory who knowingly
 24 undertook and reported such testing."
 25 Then you have a footnote at 537:

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1 "In my opinion, the BS 476 Part 6 ... testing
 2 standard is absolutely clear [in italics] that the
 3 Part 6 test method is to be used to assess the 'fire
 4 propagation' performance of products [italics]. I am
 5 not aware that Kingspan sell aluminium foil facers (on
 6 their own) as distinct products for the construction
 7 industry ..."
 8 Then if we turn the page, please, to the foot of
 9 page 181 {LBYP20000001/181}:
 10 "... and so I do not understand how either Kingspan
 11 or any competent testing laboratory could undertake
 12 BS 476 Part 6 testing on this basis. I am aware of the
 13 view Approved Document B could be interpreted so as to
 14 indicate that 'the surface of a composite product' can
 15 be assessed independently of the rest of the composite
 16 product. I consider any such claim to be patently
 17 absurd. In discussing the 'test specimens' to be used
 18 in BS 476 Part 6 ... the testing standard explicitly
 19 states that: '4.2.2 Products of normal thickness 50 mm
 20 or less shall be used to full thickness', and '4.2.3 For
 21 products of normal thickness greater than 50 mm, the
 22 specimens shall be obtained by cutting away the
 23 unexposed face of the product to reduce the thickness to
 24 50 [+0—3] mm.' The product in this case is Kingspan K15
 25 foil-faced phenolic foam insulation, and so I consider

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1 it self—evident that the foil facer must be tested
 2 alongside a phenolic foam backing [with measurements]
 3 ... regardless of the specific definition of Class 0
 4 given in Approved Document B.”
 5 Now, that's a long footnote addressing a potential
 6 interpretation of the regulations and Approved
 7 Document B. Is your reasoning based on your scientific
 8 experience or just on a reading of the language?
 9 A. My reasoning for what?
 10 Q. Your view.
 11 A. For the assertion that it's absurd to test the foil
 12 facer alone?
 13 Q. Correct.
 14 A. I mean, I would argue that you don't need much
 15 experience to make that assertion, frankly. As you can
 16 sense from the language I've used here, when
 17 I discovered that this was going on, I was absolutely
 18 incredulous. I could not believe that this was going
 19 on. I simply — I refused to believe that it was
 20 happening until I saw the evidence.
 21 So, yes, I mean, I guess it is based on my technical
 22 knowledge, but I think, to me, it's plainly obvious that
 23 you just can't do that.
 24 Q. Now, am I right to understand that for all three of the
 25 model tests, BS 476—6 and 7 and the SBI tests — there

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1 are four of them, I think, in total, actually — which
 2 you talk about in this part of your report, the real
 3 fire relevance, the "reference scenario", was a fire
 4 growing inside a compartment or a room or a corridor
 5 within a building?
 6 A. That's right.
 7 Q. Not an external wall?
 8 A. Correct.
 9 Q. Now, we know that national class 0, achieved by
 10 a combination of results from tests carried out under
 11 parts 6 and 7 of BS 476 or, after 2002, the Euroclass
 12 regime, were the classifications recommended in ADB for
 13 external walls over 18 metres in height. Do you know
 14 why?
 15 A. Do I know why ...?
 16 Q. Do you know why or do you know the rationale for using
 17 class 0 as a classification regime, or class B as
 18 a classification standard, for an external wall, given
 19 the reference scenario was a fire inside a room or
 20 a corridor?
 21 A. No, I don't know why. I mean, it's a very important
 22 question, and I'm a bit surprised that I have to say no,
 23 I don't know why. I mean, I know why the tests came
 24 into existence, and I know how they came into existence,
 25 and I know, you know, the structures of the committees

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1 and the experimental underpinning research and all of
 2 those things. Why class 0 was able to persist, let's
 3 say, for so long within the English regulatory system,
 4 I don't know. I mean, I have some views. I presume
 5 we'll talk — which I've intimated about in this report,
 6 but no.
 7 And with respect to the European classification
 8 system, you know, in the development of the European
 9 classification system, you know, from the late 1980s
 10 through until 2002, when they became — when they were
 11 inserted into the Approved Document B, based on my
 12 understanding of what was going on in those years, there
 13 was an understanding or at least a hope that
 14 a classification system for products that was based on
 15 different reference scenarios that would be relevant to
 16 external cladding would also — that that would occur,
 17 you know, an activity would be undertaken in order to
 18 define a classification of products that would be more
 19 relevant to a reference scenario involving external
 20 cladding, but that never occurred. Why that never
 21 occurred is a very important question, and I don't know
 22 the answer to it.
 23 Q. Right. Thank you.
 24 Let's go to page 39 of your report
 25 {LBYP20000001/39}, then, paragraph 193. You start at

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1 189 by identifying three important conclusions which can
 2 be drawn from the development of the model fire tests.
 3 First, you say they were created on the basis of
 4 underpinning research and a body of knowledge.
 5 "Second, the classification thresholds are
 6 essentially arbitrary in terms of fire safety
 7 outcomes ..."
 8 Then:
 9 "Third, all of these tests were developed on the
 10 basis that the relevant hazard was a fire growing inside
 11 a room (or corridor)."
 12 Then at 193 you say:
 13 "None of the above test standards was designed (or
 14 originally intended) to represent the fire hazards that
 15 might be presented by a fire impinging on the external
 16 cladding of a building, or its potential for
 17 calculation; the 'reference scenario' used was (and is)
 18 far removed from the circumstances of a cladding fire
 19 potentially resulting in promotion of external fire
 20 spread."
 21 My question showing you all of that, is this: why
 22 does that matter?
 23 A. Why does it matter? It matters because the physics that
 24 we are interested in, that govern the way a fire grows
 25 and spreads on the outside of a building, are very

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1 different than those that would be experienced inside
2 a room.
3 I mean, to give you one example, all of those tests
4 that I've discussed previously, the maximum heat fluxes
5 to which the product samples would be exposed would be
6 considerably less than we would expect in a cladding
7 fire scenario, if you have a fully developed fire
8 venting from a compartment. So the products are not
9 exposed to representative heat fluxes, would be just one
10 example of one of the differences.

11 But, you know, the scale, the mechanical issues —
12 I mean, Professor Torero I think outlined a whole host
13 of reasons why cladding systems are complicated in his
14 presentation last week, and all of those factors are
15 relevant.

16 I mean, I would also just add that — I, Mr Millett,
17 have also noticed that the screens have gone blank,
18 a mild confusion.

19 Q. I wasn't going to stop you.

20 A. But, I mean, I think it's also worth noting that, you
21 know, it's important for me to say that just because
22 a test is based on a model scenario that is not the
23 scenario that you're interested in doesn't mean that the
24 test has no value. You know, it's not that BS 476—6, 7,
25 SBI tests tell you absolutely nothing of interest; they

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1 have the potential to tell us lots of interesting things
2 about the way products behave when they are exposed to
3 fire. But they're not asking the question in a way that
4 is immediately relevant to the scenario that we're
5 interested in.

6 To me — you know, which is what I would say about
7 all experiments, or test methods, rather — what is
8 important is not criticising this test or that test
9 because, you know, it uses a different model scenario,
10 but how are people using the outcomes of these tests?
11 How are people understanding the questions that these
12 tests are asking? How are they using their
13 understanding of how these tests are performed and their
14 understanding of the outcomes to make decisions about
15 what is okay or what is not okay on the outside of
16 a building? So it's about — we have a mantra in my
17 research group at Edinburgh, which is, you know, the
18 test is the test; it's what people do with the test that
19 is worthy of our scrutiny, or more worthy of our
20 scrutiny.

21 So I wouldn't want to get too hung up on that
22 reference scenario business. It's important to be aware
23 of it and it's important for the people who use the
24 tests to be aware of it, but it doesn't mean that the
25 tests are useless, and I would be quite careful about

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1 saying that.

2 Q. Understood.

3 Let's see if I can just explore this just a little
4 bit more.

5 Can we go, please, to page 174 {LBYP20000001/174}
6 and go in that to paragraph 958 there. You say:

7 "The reference scenario for the European (and,
8 notably, also the National) material/product
9 classifications is a room, with the materials/products
10 in question used as internal linings. By contrast, the
11 relevant scenario for vertical fire spread on the
12 external wall (as notionally represented by BS 8414 or
13 similar testing) is the impingement of the plume from an
14 already large fire on the external cladding."

15 Then you say this in italics:

16 "These two scenarios present fundamentally different
17 thermal and mechanical conditions to the exposed
18 materials/products."

19 You say they're fundamentally different; the
20 question is whether those fundamental differences
21 matter. In other words, does the fact that class 0 or
22 SBI tests might tell you something, does it matter that
23 they are telling you something in the context of the
24 application of the relevant product to the external wall
25 build—up as opposed to a room?

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1 A. Yes, it does matter. But what matters is not that it's
2 different; what matters is that the person who is using
3 what is observed, the outcome, thinks about the extent
4 to which the differences might matter, given that
5 they're going to use that result for some other purpose,
6 if that makes sense. It may be quite a mild
7 distinction.

8 SIR MARTIN MOORE—BICK: But isn't that partly because the
9 circumstances in which the test is carried out brings
10 with it a host of undefined factors which do actually
11 have a bear on the outcome? So if you light a fire on
12 the inside of a building, in a room, you've got various
13 factors in play, and a fire on the outside is subject to
14 different factors, so you're not actually going to be
15 comparing the same thing, are you?

16 A. Absolutely, and what's important from my perspective is
17 that the people, the practitioners who are using these
18 tests, have some understanding of that, have some
19 understanding of, you know, where did this test come
20 from?

21 I mean, to give you an example of the tests on foil
22 facers and my disbelief that that was going on,
23 I immediately sort of asked myself: who on earth was
24 running these tests? Who on earth was performing tests
25 on foil facer stapled to calcium silicate board on

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1 behalf of Kingspan and didn't know to ask the question:
 2 "What are you guys doing? This is not appropriate."
 3 And who signed these reports off, recognising what was
 4 going on, and didn't say, "Well, hang on, this is not
 5 appropriate, you cannot be doing this". Right? And I'm
 6 still not sure I know the answers to those questions.
 7 But that's the issue. The issue is not that
 8 a BS 476 test is never useful. The issue is that
 9 somebody somewhere within this process of building
 10 regulation and oversight needs to be the person who
 11 stands up and says, "No, this is not okay, we cannot be
 12 doing tests like this", and that didn't happen, and
 13 that's the issue.
 14 MR MILLETT: Just going to the differences, though, do the
 15 fundamental differences between the thermal and
 16 mechanical conditions for a room corner test, SBI or the
 17 476-6 and 7 tests on the one hand, and the use of
 18 a product on the external wall of a high-rise building,
 19 did they go so far as to invalidate the assumptions of
 20 the underlying research and reference scenario?
 21 A. The —
 22 Q. In other words, did the fact that the product was going
 23 to be used on the external wall of a high-rise building
 24 mean that the differences between its application there
 25 and the circumstances in which it was tested were so

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1 fundamentally different that the assumptions
 2 underpinning the test were inapplicable?
 3 A. I think the assumptions — hm. I mean, I can only
 4 answer this question in a more general way.
 5 I don't believe that it is ever okay to blindly
 6 apply the results of a compliance test. So if someone
 7 wants to take results from a test that was developed on
 8 the basis of a fire burning within a room, and they want
 9 to take the product, assessed on that basis, and put it
 10 on the outside of a building, then, yes, they absolutely
 11 must think about the ways in which their application of
 12 the product might differ from the test scenario in which
 13 it was evaluated. And, yes, if you're going to use
 14 a product that is tested on the inside of a room with
 15 a small fire burning in a corner and then you say,
 16 "Okay, well, now I'm interested in how that product is
 17 going to react when it's vertically oriented on the
 18 outside of a building and exposed to a plume from
 19 a post-flashover compartment fire", very, very different
 20 scenarios, and, yes, you had better think very hard
 21 about whether the assessment from the room corner test
 22 or the model that's based on the room corner test is
 23 relevant, and probably it's not, in a bunch of ways.
 24 MR MILLETT: I have one question flowing from that,
 25 Mr Chairman. May I ask it before I call for the break?

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1 SIR MARTIN MOORE-BICK: All right, Mr Millett.
 2 MR MILLETT: What is there in Approved Document B, when it
 3 presents class 0 as the applicable classification
 4 standard or class B as the applicable classification
 5 standard in diagram 40, which tells you, the building
 6 designer, that you have to ask yourself those questions?
 7 A. In Approved Document B? I mean, off the top of my head,
 8 now you've asked the question, I'd want to go back and
 9 read through Approved Document B. I can't point to
 10 a specific clause that says that, but I don't
 11 necessarily believe that Approved Document B is obliged
 12 to say it.
 13 MR MILLETT: That's another matter. But thank you,
 14 professor.
 15 Mr Chairman, is now a convenient moment for the
 16 break?
 17 SIR MARTIN MOORE-BICK: Yes, I think it is, Mr Millett.
 18 Thank you very much.
 19 We'll break there so we can all get some lunch,
 20 professor. We'll come back, please, at 2.05, and usual
 21 thing: please don't discuss your evidence with anyone
 22 while you're out of the room.
 23 THE WITNESS: Thank you.
 24 SIR MARTIN MOORE-BICK: Thank you very much.
 25 (Pause)

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1 Thank you, Mr Millett. 2.05, please.
 2 (1.07 pm)
 3 (The short adjournment)
 4 (2.05 pm)
 5 SIR MARTIN MOORE-BICK: All right, Professor Bisby?
 6 THE WITNESS: Yes, thank you.
 7 SIR MARTIN MOORE-BICK: On we go then. Thank you very much.
 8 Yes, Mr Millett.
 9 MR MILLETT: Thank you, Mr Chairman.
 10 Professor, we were talking about class 0 earlier as
 11 an external wall classification, given its internal room
 12 or corridor reference scenario, before the break.
 13 Afterwards, or later, we will come on to the differences
 14 between the national and the European classification
 15 systems and the underlying tests that underpin them, but
 16 on this particular point, you have an observation.
 17 Can we go, please, to page 174 in your report
 18 {LBYP20000001/174}, paragraph 957 at the top of your
 19 screen, and you say this:
 20 "However, the modernisation brought by the new
 21 European classification system, having been developed
 22 based on a reference scenario that was only loosely
 23 applicable to external fire spread hazards, was
 24 inadequate to address these more fundamental concerns.
 25 The reason for this emerges from Messerschmidt's 2008

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1 analysis of the European system — that the European
 2 methods for classifying products were almost entirely
 3 based on an assessment of the likelihood of a fire's
 4 growth to flashover inside a compartment."
 5 Then we have 958, which I read to you before.
 6 Now, what do you mean by "loosely applicable" in
 7 paragraph 957 there?
 8 A. I mean that products are installed on a surface and
 9 there's a fire involved. You know, it is a test that
 10 does assess the way the products react to a fire and the
 11 extent to which they'll burn, so it's not entirely
 12 remote, if you like. The products are being subjected
 13 to a fire. It's that simple, really.
 14 Q. Right. I mean, that's no more than saying that it's
 15 a fire test.
 16 A. Absolutely.
 17 Q. Right, I see.
 18 Can I then turn to technological proof tests, which
 19 is the third category of test that you describe in your
 20 report. I think you would include in that the BS 8414
 21 series, would you?
 22 A. Yes.
 23 Q. Is it right that the test apparatus and the method are
 24 designed to imitate as closely as practicable
 25 a real-world use scenario?

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1 A. That's my understanding, yes.
 2 Q. You characterise those tests if we go to page 44
 3 {LBYP20000001/44}, please, paragraph 216. I'm
 4 summarising here, really, but you characterise them as
 5 used when there's little scientific understanding of how
 6 various materials or products might behave on a real
 7 building; yes?
 8 A. That's right, yes.
 9 Q. Is it right that we should understand that, in the
 10 absence of such an understanding, the closeness of the
 11 resemblance of the test rig to a real-life building is
 12 important in allowing designers to make judgments about
 13 how a particular system would behave in the event of
 14 a real fire in that building?
 15 A. In my view, yes.
 16 Q. Are there any other factors in play?
 17 A. With respect to what?
 18 Q. With respect to the resemblance between the test rig and
 19 a real-life building? In other words, not just
 20 subjective judgments, but other things too.
 21 A. I'm not sure I follow the question.
 22 Q. All right. Let's see how we go with the next paragraph.
 23 Can we go to page 45 {LBYP20000001/45},
 24 paragraph 222, and you say there:
 25 "Technological proof tests are different; they rely

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1 almost entirely on similarity judgements made by the end
 2 users about each specific system. The implicit (and, in
 3 the case of BR 135, explicit) onus of responsibility
 4 falls almost entirely on the end user — to make
 5 a judgement about whether any particular testing outcome
 6 is applicable to any particular real-world situation."
 7 Can you expand on that and, in particular, in
 8 relation to BS 8414. In particular, why do they place
 9 reliance on the end user in the way you've described?
 10 A. Because the outcome of a technological proof test or the
 11 observations that would arise if you conducted
 12 a technological proof test are going to be — the reason
 13 you're doing the technological proof test is because of
 14 the complexity of the system that's in play, and that
 15 complexity also means that small changes in the system
 16 could lead to differing outcomes, and so if you perform
 17 a technological proof test and you observe an outcome,
 18 the extent to which the same outcome would be observed
 19 if that external wall arrangement, to use, you know,
 20 sort of the terminology of the Inquiry, would manifest
 21 on a building in the case of an actual fire is something
 22 that you have to think very hard about.
 23 You know, I think that's why there are some
 24 statements in BR 135 that kind of draw that out, and
 25 they warn users, quite specifically, that this test is

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1 only applicable to what you've tested, and if you're
 2 going to take this result and you're going to apply it
 3 on an actual building out there in the world, you need
 4 to make some assessment, make some judgment, as to
 5 whether or not the result that you get in the BR 135
 6 assessment is going to lead to what you consider to be
 7 adequate fire safety outcomes in the real world.
 8 Q. We'll come back to that very topic later.
 9 If we go to paragraph 226 at the foot of page 45,
 10 you say this:
 11 "The 'technological proof test' (i.e., BS 8414) was
 12 invoked within Approved Document B and BR 135 in
 13 accordance with the logic identified above; it was made
 14 explicit that the onus was on the user to ensure that
 15 a test result was applicable to any particular
 16 situation. However, as has been demonstrated in the
 17 evidence to the inquiry, the manner in which it was
 18 actually used in practice was more as
 19 a non-representative or model test — where little
 20 thought appears to have been given about the extent to
 21 which the tested system was genuinely relevant to the
 22 end use situation."
 23 Now, is it right, in other words, that in your view,
 24 Approved Document B and BR 135 made it clear that the
 25 user of the test had to ensure that a particular test

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1 result was applicable to a particular building
 2 situation?
 3 A. Certainly BR 135, yes, and I think Approved Document B
 4 kind of in an overarching way, you know, given its legal
 5 status as guidance, rather than the law.
 6 Q. Well, that's the next question. How, in your opinion,
 7 did ADB itself do so, even implicitly?
 8 A. You know, ADB, there are statements both within the
 9 Building Regulations and within ADB that, you know,
 10 there's no requirement for a user to meet the
 11 requirements of — or to meet the recommendations — to
 12 adhere to the recommendations of Approved Document B,
 13 and designers can do things whatever way they want. The
 14 Building Act itself basically says that if one — and
 15 prior editions of ADB basically have said that, you
 16 know, if one wants to do that, that is fine, but in the
 17 event that something goes wrong and you're found not to
 18 have followed the rules, then, you know, you're on your
 19 own. If you have followed the rules, then there is
 20 a tending to negative liability associated with those
 21 actions. So there is some kind of comfort in following
 22 the rules of ADB, but it is not an absolute defence of
 23 behaviour, if you like, or of design decisions, if that
 24 makes sense.
 25 So, you know, the approved documents don't require

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1 you to do anything and, by virtue of that, I don't see
 2 that they can be used as a bulletproof defence of
 3 actions. You might follow the recommendations of the
 4 approved document and still end up with a system that
 5 does not adhere or does not adequately resist the spread
 6 of fire on the outside of a building.
 7 Q. Now —
 8 A. It's conceivable that that could happen.
 9 Q. In that last answer, you used the word "rules", at least
 10 twice.
 11 A. I probably misspoke then.
 12 Q. Well, I was going to see if I could understand why you
 13 misspoke.
 14 A. Sure.
 15 Q. Why did you refer to them as rules?
 16 A. You would have to show me the transcript to see where
 17 I did it in order for me to —
 18 Q. I can read it back to you. I'm just interested in what
 19 lies underneath this. You say:
 20 "... prior editions of ADB basically have said that,
 21 you know, if one wants to do that, that is fine, but in
 22 the event that something goes wrong and you're found not
 23 to have followed the rules, then, you know, you're on
 24 your own. If you have followed the rules, then there is
 25 a tending to negative liability associated with those

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1 actions."
 2 A. Yes.
 3 Q. I just wonder whether, when you use the word "rules",
 4 even you, professor, might be indicating some kind of
 5 underlying tacit understanding of how ADB was supposed
 6 to work.
 7 A. I mean, it's possible. I'm not in a position of ever
 8 having used ADB in my practice, so I can't tell you how
 9 I would have thought about Approved Document B prior to
 10 the Grenfell Tower fire, but I have always known, or at
 11 least to the extent that I've ever thought about it,
 12 that the building regulation system in the
 13 United Kingdom was functionally based, and that the
 14 consequence of the Building Act was that designers are
 15 free to do whatever they want, if you like, provided
 16 they can meet the requirements that are stated within
 17 the Building Regulations, and that I suppose, in
 18 practice, provided that one can get the necessary
 19 approvals for what one sets out as a designer, one can
 20 do those things. If something goes wrong down the road,
 21 how one would defend oneself I think is sort of relevant
 22 to that, that status of the approved documents.
 23 But, I mean, yes, it's easy to slip into using the
 24 word "rules", because whilst they are not, I guess,
 25 formal — I'm not a lawyer, of course, but whilst

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1 they're not formal legal rules, it is not prescriptive,
 2 deemed to satisfy guidance, they are — if you like,
 3 they are effectively written as rules, so yes. Yes.
 4 I mean, I think that's a misuse of language, for sure,
 5 on my part.
 6 Q. But a helpful explanation nonetheless, thank you.
 7 Can I take you, then, to paragraph 225 which starts
 8 at the foot of the previous page, page 45
 9 {LBYP20000001/45}. You say there, it's really a third
 10 of the way through the paragraph:
 11 "Thus, so long as the literal rules of the test
 12 standards and Approved Document B were 'followed', in
 13 practice the regulatory system appears to have placed no
 14 onus whatsoever on the user to ensure that the
 15 particular testing framework applied to any specific
 16 situation was suitable for that product, or for its
 17 application on a building. The regulatory influence of
 18 this category of tests was much more significant as
 19 regards the application of combustible cladding
 20 products. In particular, classifications of British
 21 national Class 0 and European Class B—s3, d2, both of
 22 which are based entirely on model tests, appear to be
 23 profoundly relevant to what occurred at Grenfell Tower
 24 (and to many other UK buildings with problematic
 25 cladding, now constituting the UK's 'cladding crisis')."

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1 Now, I'm interested in what you say there when you
2 say that — sorry, then you go on to say, as we've seen
3 already, that the manner in which 8414 was actually used
4 in practice was more as a non—representative or model
5 test.

6 Taking those two paragraphs together, are you able
7 to tell us what you really mean by 8414 being used more
8 as a model test?

9 A. Being used in a way such that if one is able to — not
10 that this language is used, but "pass" an 8414 test, you
11 know, achieve a classification under BR 135 for an 8414
12 test, it is viewed as a result that can be relied upon
13 to give a great deal of confidence that, when applied to
14 a building, the outcome in the event of a fire would
15 also be positive, if you see.

16 Q. And therefore it's treated, but mistreated — is this
17 your view — as a model, really, rather than as
18 a representative test, which is what it was designed
19 for?

20 A. Yes. Yes, that's right. Yes. It's treated as a — you
21 know, a non—representative test, a pass/fail result is
22 something that I'm willing to call a pass/fail result.
23 A technological proof test is something where I'm not
24 happy to call it a pass/fail result. A model test is
25 somewhere in the middle, where there's this discretion.

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1 So it's a question of the level of discretion, the
2 onus of responsibility and discretion on the end user,
3 with an increasing level of onus and responsibility on
4 the end user — the user of the test, as you go from
5 non—representative through to model through to
6 technological proof test.

7 So the technological proof test requires a great
8 deal of responsibility and awareness from the user, and
9 that was not in my — as far as I can tell, that was not
10 deployed out there in the industry, it seems to me.

11 Q. I'm going to examine 8414 in a little bit more detail
12 shortly but, before we do, can I just ask you, arising
13 out of the last series of answers, this: our class 0 and
14 the European classes that give rise to class B, both of
15 which are placed within diagram 40, are those model
16 tests or are they technological proof tests?

17 A. They're model tests.

18 Q. They're model tests?

19 A. Yes.

20 Q. So moving on to the next stage then, we find those,
21 don't we, identified in Approved Document B at
22 paragraph 12.5, which says you can either follow what is
23 called the linear route, 12.6 to 12.9, or satisfy the
24 performance criteria derived from tests under BS 8414;
25 yes?

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1 A. That's right.

2 Q. Is it your opinion that, in expressing satisfaction of
3 the guidance in that way, the person using Approved
4 Document B is being presented with two alternatives that
5 are not strictly alternatives: one is a model test, but
6 its alternative is not also a model test, it is
7 a technological proof test?

8 A. Yes, that's a very good insight. Yes, I think that's
9 true. I think that that type of language could create
10 the false impression within the user community of ADB
11 that there is an equivalence of, let's say, approach in
12 terms of how one uses those two routes, let's call them.
13 I think that's probably a fair — yes. I'd not thought
14 of it that way. It's a good insight.

15 Q. Let's move on to BS 8414, then, and at a later stage
16 we'll look at the performance criteria.

17 Can we go to page 42 of your report
18 {LBYP20000001/42}, please, and paragraphs 210 to 211.
19 You say there:

20 "210. What emerges from this specific framing of the
21 technological proof test is a realisation that to
22 criticise the BS 8414 test for being 'unrealistic' is to
23 reveal the critic's fundamental misunderstanding of the
24 nature and purpose of testing. It should be obvious
25 that BS 8414 tests can never be faithful reproductions

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1 of anything other than BS 8414 tests.

2 "211. In other words, the test is the test — it is
3 what competent professionals do with the test's results
4 that is most deserving of scrutiny."

5 For completeness, at the end of paragraph 5 of your
6 report on page 2 {LBYP20000001/2}, if we skip back to
7 that, please, it's the same point. You say there at the
8 end of paragraph 5:

9 "Fundamentally, I aim to demonstrate that it is
10 usually unfair to criticise a test for being too small,
11 too unrealistic, too variable — a test is just a test;
12 it is what people choose to do with the results from
13 a test that matters."

14 Now, in that description, in both those paragraphs,
15 when you refer to "people", who are you referring to?

16 A. I'm referring to the people who are making design
17 decisions.

18 Q. What about the people who are creating the regulatory
19 regime in the first place? Do you include them as well?

20 A. Yes, those — and I've discussed this somewhere in the
21 report, I can't remember where exactly — those people
22 do have a responsibility in terms of both articulating
23 clearly for the users all of these embedded assumptions
24 and intents that sit behind the test methods, and in
25 setting, let's say, the pass criteria or setting the

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1 bars that need to be met in a way that is credible given
 2 what the test is doing for you. Right?
 3 So I set this out in the report. So the
 4 unrepresentative tests, they — so if you were to say,
 5 "I'm only going to allow A2 products and I'm going to do
 6 bomb calorimeter tests, which are non-representative
 7 tests, and I'm going to pick a very, very low heat of
 8 combustion as my criteria that I can use", well, then,
 9 I'm pretty confident that the user of that result
 10 doesn't really need to know how a bomb calorimeter
 11 works, doesn't really need to know much about what bomb
 12 calorimetry is, but needs to understand a little bit
 13 about heat of combustion. But if they adhere to the
 14 less than 2 megajoules per kilogram or whatever it is,
 15 then probably your outcomes are going to be not so bad.
 16 Right? Because it's quite a conservative test and is
 17 not representative.

18 But at the other end of the spectrum, when you have
 19 BS 8414 tests, I mean, understanding exactly how
 20 adequacy is defined in those tests is a bit of
 21 a challenge, as I'm sure we'll come to, but you can have
 22 much less confidence that the outcome of that test will
 23 lead to a satisfactory outcome, because it is less
 24 conservative and more complex and more fraught with
 25 challenges, and more difficult to take from the lab out

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1 there into the real world. So that's kind of what I'm
 2 alluding to here.

3 But, yes, you're right. There are responsibilities
 4 and expectations that we must place both on those people
 5 who use the tests and on those people who set those
 6 tests out for use by others, I think. Absolutely, yes.
 7 I think maybe that latter point probably doesn't come
 8 through as strongly as it ought to, reading this back
 9 now. Yes.

10 Q. Now, building on that, can we then go to page 13
 11 {LBYP20000001/13}, please, paragraph 54. This covers
 12 a point that we've seen already. You explain here that
 13 the key issue is not whether a test is realistic, but
 14 whether it is sufficiently representative.

15 You go on to quote from Downer, and I've read that
 16 to you already. This is footnote 8 in paragraph 54.
 17 I'll read it again, halfway through the paragraph:

18 " ... 'Since even the most "realistic" tests will
 19 always differ in some respects from the 'real thing',
 20 engineers must determine which differences are
 21 'significant' and which are trivial if they are to know
 22 that a test is relevant or representative.'"

23 Now, looking at the engineer who was to make this
 24 determination that you describe, who is this person?
 25 What is their minimum level of academic qualification

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1 that they need to have reliably to be able to consider
 2 the design of a test which you would expect to be
 3 adequate when testing a cladding system?

4 A. Are you asking me who it is in practice in England or
 5 are you asking me who I think it is, who I think it
 6 ought to be?

7 Q. Well, the latter.

8 A. I mean, it's not for me to say, I don't think. You
 9 know, I'm just an academic engineer who works at the
 10 University of Edinburgh who has opinions about the
 11 levels of competence that people ought to have.

12 In my view, there ought to be some mechanism by
 13 which society, all of us, can have some confidence that
 14 the people who we are going to charge with making those
 15 assessments and decisions as we move from the lab to the
 16 real world know what they're doing, have some
 17 fundamental technical understanding, have some, you
 18 know, moral and ethical standards that they're operating
 19 with, have some uncertainty about the things that they
 20 know and are willing to be thoughtful about that
 21 uncertainty, you know, to demonstrate competence and
 22 an awareness of their own incompetencies, and how one —
 23 I mean, to me, this is, in a way, the issue of
 24 everything I've done with respect to this Inquiry: how
 25 do we as a society ensure that the people that we charge

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1 in making these decisions have the relevant
 2 competencies? How do we define them? How do we assess
 3 them? How do we police them? And what do we do when
 4 people don't display them or have them? You know, what
 5 measures do we put in place to make sure that society
 6 can have that confidence? If we're going to have
 7 a functionally-based building regulation system that
 8 permits anyone to do anything, what do we do to make
 9 sure that that doesn't go horribly wrong? That is
 10 a very fundamental question.

11 But, I mean, I can't sit here and tell you: the only
 12 people who should be doing this should be people that
 13 have this degree in this subject area, this — you know,
 14 they've passed these examinations, they undergo this
 15 amount of annual CPD training as recorded by some
 16 regulatory authority. But the idea that we should
 17 regulate and register the people who are making these
 18 decisions is very fundamental to my views now.

19 I'm not sure if that's a long-winded and slightly
 20 peripheral answer to your question.

21 Q. It's certainly an answer to the question as interpreted
 22 as I put to you, the latter, but try the former: who are
 23 the people now? Looking at the body of available
 24 expertise out there, as at June 2017, were those
 25 qualifications defined or assessed or policed in a way

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1 which you, in your opinion, would consider satisfactory
 2 or satisfactorily safe?
 3 A. No. I mean, they're — I mean, what controls are there?
 4 There are effectively no controls over who can claim to
 5 make that assessment. The only control that seems to
 6 exist in practice is the tolerance of the approving
 7 authority, whoever they are, and therefore the
 8 competence also of the approving authority, which is
 9 also not very well controlled, as far as I can tell.
 10 Q. When you say "approving authority", do I take it you
 11 mean building control officers?
 12 A. Yes, typically — I mean, if we're talking about doing
 13 something to a building, building a building or doing
 14 something to it, to the extent that what's being done
 15 requires building control approval, then yes.
 16 Q. Let's go to page 41 of your report {LBYP20000001/41},
 17 please, paragraph 203. You've covered mock-ups and the
 18 representative nature of the 8414 test itself. You say
 19 at paragraph 203:
 20 "More challenging, however, are the relatively
 21 inflexible parameters that are defined within the
 22 testing standard itself. Although BS 8414 has
 23 intentionally been made to be 'more' representative,
 24 some compromises to reproducibility appear to have been
 25 necessary in its design. For example, the BS 8414

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1 testing apparatus does not include any windows. It
 2 could, of course, but the window openings in a real
 3 building might be situated differently to those in any
 4 BS 8414 test arrangement. Would it be necessary to
 5 retest for every possible window size, type, and shape?
 6 Or every possible window frame material? What if the
 7 windows in the real building are open at the time of
 8 a fire? How open are they? What if they are open in
 9 'tilt' versus 'turn' mode? The list of potentially
 10 influencing parameters has (literally) no end."
 11 Now, in light of that litany of variables, do you
 12 consider that the BS 8414 test rig, as required, and the
 13 example test rig shown at A1 of the third edition of
 14 BR 135, which we can look at if we need to, should have
 15 been designed as it was, in other words omitting all
 16 windows or apertures?
 17 A. Do I consider that it should have been designed that
 18 way?
 19 Q. Yes. Was it an appropriate design, given that it is
 20 a rig which has no apertures or windows at all?
 21 A. It depends what you want to do with the result. I mean,
 22 yes, sure. Yes. I mean, I can't criticise BS 8414 for
 23 all of the reasons that I've mentioned there, and, you
 24 know, as I've said before, the test is the test. We can
 25 criticise it for being unrealistic and we can say: well,

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1 I want to use the result of an 8414 test in a building
 2 that has windows and those windows are this size and
 3 shape and they are directly one above each other and
 4 this is the storey height, and I build a rig and I test
 5 it. But if you go down that path, quite quickly you
 6 realise that every time you want to build a building,
 7 you have to build it and burn it down, and that's not
 8 going to work out there in the world, so we have to make
 9 compromises. But when we make compromises, we have to
 10 be clear about what those compromises are, and we have
 11 to be clear about the extent to which we're going to
 12 demand that the people who take the result then
 13 understand those compromises and account for them when
 14 they go off into the real world.
 15 Q. I follow.
 16 A. So I think no.
 17 I mean, to take the window example as an example.
 18 So let's say I decide, "Well, okay, that's unrealistic
 19 and I want to have windows in my test rig", so I put
 20 some windows in my test rig. Well, what kind of glass
 21 do I put in? Do I put single glazing? Do I put double
 22 glazing? Do I put toughened glass? Do I put, as is
 23 common in buildings now, reflective films on the outside
 24 of the glazing to help me with building energy
 25 performance that might impact on the radiative

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1 properties of the glass? You know, all of these
 2 questions.
 3 And it's important to recognise that if I'm
 4 interested in evaluating the fire performance of, let's
 5 say, a cladding system that might incorporate
 6 combustible products, either insulation or rainscreen,
 7 and I displace some of those products by inserting
 8 windows into my rig, maybe I've actually made it more
 9 likely that I'll pass by inserting windows and not less,
 10 because I've displaced fuel, fuel that would otherwise
 11 be there and burn.
 12 So, you know, as soon as you start tinkering with
 13 a test like this, the potential for tinkering in
 14 a direction that is not what you hoped or, you know,
 15 more worryingly, the potential for tinkering by people
 16 who might seek to tinker to their advantage, is immense.
 17 So BS 8414, whilst being unrealistic in many
 18 respects, and, as I've said, it can only be truly
 19 representative of a BS 8414 test, so unless my building
 20 is literally an 8414 test rig, then I have to ask the
 21 question: how might my building, how might this system,
 22 this overall build—up of products on my building, given
 23 that the joints are going to be in different places, the
 24 windows are going to be in different places, the cavity
 25 barriers are going to be in different places, the

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1 fixings might be different, maybe I have a wing wall,
2 maybe I don't, all those questions, you have to — and
3 this is why I say you can't just take a BR 135
4 classification, point at it and say: everything's fine.
5 You have to think about how this is going to be applied
6 to your building, and I think BR 135 is very clear about
7 that. It says: this is the classification based on
8 a BS 8414 rig, not on a building, and if you're going to
9 put it on a building, you had better think about it.

10 Now, granted, it doesn't give you a huge amount of
11 help in terms of how one would do that, but that's why
12 the people who are doing this type of work need to be
13 competent if we're to have any faith in the outcomes.

14 Q. Can we just look at BR 135, then, please,
15 {BRE00005555/2}. Let's have a look at the first page,
16 please, first of all. The second page is the one which
17 tells you this is the third edition.

18 If we go in it, please, to page 26 {BRE00005555/26},
19 we can see the rig design there. You can see in it,
20 under "Test Method", that's an example of a test
21 facility, and the principle of the test.

22 If you go, please, to page 28 {BRE00005555/28},
23 there is the warning. Under the three bullet points, it
24 says:

25 "The classification applies only to the system as

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1 tested and detailed in the classification report. The
2 classification report can only cover the details of the
3 system as tested. It cannot state what is not covered.
4 When specifying or checking a system it is important to
5 check that the classification documents cover the
6 end-use application."

7 Now, is that what you're referring to when you say
8 in your last answer that you need to think about it?

9 A. Yes.

10 Q. In fact, where it says it cannot state what is not
11 covered, would it be right for an engineer, reading
12 that, to understand that actually what is covered is
13 pretty limited, given all the other variables you've
14 referred to — the geometry, the fixing joints, the
15 apertures, the windows, matters of that nature — so
16 that actually the test rig as tested and covered by the
17 classification report is some way away from the end-use
18 application, even if the materials and the geometry of
19 the use of the materials in relation to each other is
20 the same?

21 A. Yes, I mean, that's certainly how I read it and have
22 always read it, to the extent that I've looked at it.
23 I mean, I've had to accept that my reading of things
24 appears kind of atypical in this community, but that's
25 certainly how I've always read it, yes.

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1 Q. So forgive the simplicity of this question or perhaps
2 the bluntness of this question, but what's the point of
3 BS 8414 as a test, as a system test, if it is
4 unrepresentative of the end-use building to such
5 a degree? What help does — a test is a test, but what
6 does it actually tell you?

7 A. It can tell you what is — it can tell you what would be
8 a really bad idea, is what it can tell you.

9 Q. Right.

10 A. And it can't tell you much more than that.

11 MR MILLETT: Right.

12 SIR MARTIN MOORE-BICK: Sorry, before we go on, can I just
13 check with you: this paragraph here that you've just
14 been asked to look at is the only paragraph that you are
15 aware of, is it, which tells the end user or the user of
16 the test that he's actually got to think about the
17 results he's got from the test and how they apply to his
18 building, not just to accept the pass as a pass as if it
19 were a model?

20 A. I think it — I would want to check the rest of the
21 document before saying definitively, but I think yes.
22 I think this is probably the only place where it would
23 be stated explicitly — and it's not even that explicit
24 here, if we're being honest with ourselves — at least
25 that it's stated here, certainly intimated, I think,

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1 I — as I say, I have always read it that way, but
2 I have had to realise I am a bit unusual.

3 SIR MARTIN MOORE-BICK: Yes.

4 A. I do think that, as I've said, if one understands one's
5 role as a designer within the broader regulatory system,
6 and one considers the Building Regulations and the
7 Building Act, that one should recognise one's
8 professional responsibility, regardless of what BR 135
9 says. Even if BR 135 was completely and utterly absent,
10 there would still in my view — any competent
11 professional should understand that they just cannot
12 blindly follow rules or recommendations and hope that
13 that's them dispensing reasonable skill and care.
14 I mean, we just cannot accept that from the engineering
15 community, and that I just — I would refuse to accept
16 a view that competent professionals practising
17 engineering in safety critical area should be permitted
18 to say, "Oh, well, the document never told me so".

19 I just can't. I can't accept that.

20 SIR MARTIN MOORE-BICK: It sounds to me from what you have
21 just been saying that you would feel more comfortable if
22 the warning, which I think you're saying it really is
23 intended to contain, were much more explicit.

24 A. It would certainly be helpful if it were much more
25 explicit, and it may well have prevented some of the

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1 sort of misconception around the use of this document,
 2 the application of this document, I think.
 3 SIR MARTIN MOORE-BICK: Would it also follow, in your view,
 4 that it may or may not be appropriate for ADB to advise
 5 people that they can satisfy the Building Regulations by
 6 getting a pass under BR 135?
 7 A. Yes, I mean, if that's how one reads ADB, yes.
 8 SIR MARTIN MOORE-BICK: All right, thank you very much.
 9 A. It would have been helpful if clause 12.5 said —
 10 although, you know, I think as I said before the break,
 11 I am not sure ADB is obliged to say this, but given what
 12 we have observed about the behaviour of people within
 13 the industry, perhaps it would have been helpful for ADB
 14 to say in a number of places, "Just to remind you,
 15 everyone, even if you follow the rules in this document,
 16 that's still not you home free, so to speak, you still
 17 have to think about" — not rules, apologies,
 18 Mr Millett, recommendations of Approved Document B,
 19 "Even if you follow these recommendations that are set
 20 out in Approved Document B, it is still on you, as the
 21 competent professional, as the designer". And I think
 22 that the more people out there in the world can be
 23 reminded of that, and to the greater extent that people
 24 out there in the real world can be held responsible for
 25 design decisions that they've made, all the better.

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1 MR MILLETT: Do I take it from that series of answers to
 2 the Chairman that, actually, the putative competent fire
 3 safety engineer or a competent fire strategy relying on
 4 this document would not need to have this spelled out to
 5 him, even if it is a spelling-out, they would know it
 6 intrinsically?
 7 A. My view is that they ought to, yes.
 8 Q. They ought to.
 9 Were you aware that this paragraph was added to
 10 appendix A at the same time as appendix B was introduced
 11 in this third edition in 2013 and had been absent from
 12 the second edition, which only contained annex A in very
 13 much similar form, in 2003? Did you know that?
 14 A. Possibly. I mean, as you're telling me, I'm thinking,
 15 "Oh, that's interesting". I'd want to go back and look.
 16 Q. Okay.
 17 Let's just move on, then, with the question of
 18 windows.
 19 First of all, are you able to offer us a view, in
 20 simple terms, on which would tell you more about the
 21 potential for external fire spread: a rig with window
 22 gaps or a rig without?
 23 A. I mean, it would tell you — it might tell you different
 24 things. Yes.
 25 Q. Let's go to figure 2, please, page 11 of this document

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1 {BRE00005555/11}, which is BR 135, third edition.
 2 Here is a photograph under figure 2 of
 3 Garnock Court, Irvine, and you can see the fire damage
 4 from the windows directly in line with the vertical fire
 5 spread.
 6 A. Mm—hm.
 7 Q. Yes?
 8 If we go down to page 13 {BRE00005555/13}, figure 3
 9 is a graphic representation of a fire scenario with fire
 10 climbing the building and re-entering the building via
 11 windows; do you see?
 12 A. Mm—hm.
 13 Q. Under "Mechanisms of fire spread", it says:
 14 "The key stages associated with fire spread on the
 15 outside of a building envelope are ..."
 16 Then they're in order:
 17 "■ initiation of the fire event.
 18 "■ fire breakout.
 19 "■ interaction with external envelope."
 20 Then across the column:
 21 "■ fire re-entry.
 22 "■ fire service intervention.
 23 "These stages are discussed below, and are
 24 illustrated schematically in Figure 3."
 25 You can see the process there: the secondary fire is

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1 entering through the windows on each floor, or through
 2 apertures, at least, on each floor.
 3 That's dealing then, isn't it, with re-entry of fire
 4 into the building through windows; yes?
 5 A. Mm—hm.
 6 Q. That's the assumption here.
 7 A. Yes.
 8 Q. As it travels vertically.
 9 Now, given that BR 135 is overtly directed at the
 10 hazard posed by cladding fires and re-entry, is it right
 11 to say that some compromises to reproducibility appear
 12 to have been necessary in its design? My question is:
 13 is this not a pretty major compromise, when the rig
 14 itself doesn't have any windows to let fire back in?
 15 A. Okay. My understanding of what BS 8414 and BR 135
 16 testing is trying to tell you/us/them, whoever is using
 17 it, is whether or not, or perhaps the extent to which,
 18 a combination of cladding products on the outside of
 19 a building is likely to contribute to the upward
 20 progression of fire. It's not a test that is trying to
 21 tell you necessarily whether or not that contribution to
 22 the upward progression of fire is going to go in
 23 a window. I think the assumption is that if the
 24 cladding system contributes to the upward progression of
 25 fire, that is going to make it more likely that more

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1 windows will become compromised, if that makes sense.

2 Q. Yes, it does. I see.

3 In what way does the 8414 test series actually test
4 for the risk actually depicted here in figure 3, given
5 those five key mechanisms/stages?

6 A. Only insofar as one assumes that if you have a fire
7 spreading up the outside of a building and it finds
8 a window, that it's likely to enter that window.

9 Q. Right. So is it right that, in your understanding,
10 BR 135 appears to consider a specific risk which the
11 associated test, BS 8414, doesn't in fact seek to
12 address, namely fire re-entry?

13 A. Yes, it doesn't address it explicitly, in that it
14 doesn't reproduce that, but in order — I mean, the
15 problem is that, in order to address it explicitly, you
16 would end up with a litany of further questions about
17 the particular characteristics of the windows, which
18 would become an impossibility. You know, even if you
19 said, "Okay, we're not even going to have glass there,
20 we're just going to have a big void", then what are you
21 going to put inside the void to check whether ignition
22 occurs? Do you have curtains? And if you have
23 curtains, what are they made of? And do you have
24 a sofa? And, you know, it just goes on and on.

25 So I guess I just — I mean, I'm perfectly happy to

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1 sort of be critical of the BS 8414 test in terms of how
2 it's used and various other aspects of it, but to
3 criticise it for not having windows I just don't think
4 makes any sense.

5 Q. And you've given the reasons for that. My question is
6 slightly different though.

7 Is there not, though, a mismatch between the
8 mechanisms of fire spread addressed in BR 135 on the one
9 hand, which does address fire re-entry, or at least the
10 key stages of fire spread externally involving fire
11 re-entry on the one hand, but the BS 8414 test not doing
12 so?

13 A. I take the point. I think that if I were to try to
14 argue on behalf of BR 135 — I'm not quite sure why I'm
15 doing that, but if I were to try to argue on behalf of
16 BR 135, I would probably say that if the cladding system
17 is seen to result in upward progression of the fire, you
18 know, 5 metres above the hearth, then that is giving you
19 an indication that there's a larger potential that
20 you're going to get break-in to of a fire — of a window
21 above the fire of origin, if you like. So it's
22 indirectly addressing the question, in a way.

23 Q. I see.

24 I don't want to put words in your mouth, but does it
25 come to this: that the mechanisms for fire spread

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1 addressed by BR 135, which is not just a list of

2 criteria, it has some background to it as well, which

3 includes fire re-entry through windows, include but not
4 exclusively include the mechanism for interaction with
5 external envelope?

6 A. Sorry, you'll have to ask me that question again.

7 Q. Yes, let me try that one again.

8 Is the right way of reading these two elements
9 together — BS 8414, the test, and BR 135, the criteria
10 document on the other — that the criteria document goes
11 further than the test, because BS 8414 tells you only
12 about interaction with the external envelope, it doesn't
13 tell you anything about fire re-entry?

14 A. I think that a classification of a system to BR 135,
15 after having performed a test on that system to BS 8414,
16 equally doesn't go any further than what the 8414 test
17 is telling you.

18 I'm not sure I'm answering — I'm not sure I either
19 understand nor am answering the question, Mr Millett.

20 Q. Let me try this the other way round.

21 If you met the performance criteria on the basis of
22 test data derived from BS 8414—1 and 2, would that
23 eliminate the risk of fire re-entry?

24 A. If you were to meet the criteria?

25 Q. Yes.

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1 A. No. No, it wouldn't.

2 Q. Why not?

3 A. Because your real building has windows, probably.

4 Q. Yes. And what is there in either the BS 8414 rig design
5 or BR 135 to tell the designer that?

6 A. Explicitly? Nothing. From memory, nothing.

7 Q. Let's talk about 1919 and the path to Grenfell. I want
8 to pick up from part 2 of your report.

9 You've given us a detailed overview of the evolution
10 of the building and testing landscape and the regulatory
11 regimes in place from 1919 onwards.

12 We land, I think, in the mid-1980s at page 90
13 {LBYP20000001/90}, if we can pick that up. At page 90,
14 paragraph 442, you tell us:

15 "There had, therefore, been a fundamental shift in
16 the way designers could practice[sic]. In principle,
17 there were no prescribed constraints on how the adequacy
18 of proposed design could be demonstrated against the
19 requirements of the Building Regulations (1985). There
20 had not, however, been any fundamental changes in the
21 testing standards which underpinned the approved
22 documents. Indeed, to maintain continuity with the past
23 it was logical to retain the majority of the existing
24 testing methods and performance standards; even if these
25 were no longer mandatory, or if new test methods or

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1 classifications were available to supersede pre-existing
 2 ones".
 3 You then go on at 443:
 4 "The idea of linking a performance standard and
 5 a test method had been enshrined in law since the 1950s.
 6 It was necessary to continually review the tests and the
 7 performance standards to ensure that they were fit for
 8 purpose; to check that they had not been invalidated by
 9 a new material, product, or system. This had been the
 10 fundamental objection of RIBA and the FRS to mandatory
 11 performance standards in 1958; that such mandatory
 12 standards constrained innovation. Breaking this link
 13 was expected to allow unconstrained 'flexibility'."
 14 Now, that's the background to what I now want to
 15 show you, which is 444, and you say this:
 16 "Since the performance standards and tests were no
 17 longer seen as constraints, the need to continually
 18 review and update became less urgent. If a new and
 19 innovative product failed to meet the stated performance
 20 standard, then the product manufacturer could simply
 21 find 'alternative means' by which to 'demonstrate
 22 safety'. In this new, functionally-based model of
 23 building regulations, devising ways to circumvent the
 24 prescribed guidance of the approved documents was not
 25 'finding loopholes', it was the intent of the regulatory

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1 system."
 2 I just want to focus on the last part of that
 3 paragraph there.
 4 Why do you say that finding ways to circumvent the
 5 statutory guidance was the intent of the system?
 6 A. Because the point of a functionally-based regulatory
 7 system is to promote innovation and flexibility — one
 8 of the points is to promote innovation and flexibility,
 9 and so provided you can "demonstrate" that your product
 10 or system meets the functional requirement, then you
 11 don't need to follow any particular performance standard
 12 or test method. You know, it's up to you to meet the
 13 requirement — the functional standard in whatever way
 14 you choose. And that removal of "deemed to satisfy"
 15 routes, let's say, to compliance with the Building
 16 Regulations was, you know, quite explicitly the point of
 17 these changes to the regulatory procedures.
 18 You know, to remove these constraints that were
 19 quite, you know — it's quite difficult to update a test
 20 standard and change things as a consequence of new
 21 products and things. So if you want to promote
 22 innovation and flexibility in the interests of industry,
 23 then it does make sense to allow people to do what they
 24 like.
 25 Q. So are you saying that instead of having a prescribed

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1 system where people would look for loopholes with which
 2 to circumvent, you created a new, open-textured,
 3 flexible system where you no longer needed to do that?
 4 A. Yes, I mean, you could argue that the system was created
 5 specifically to enable people to circumvent the rules.
 6 Q. And how could they demonstrate safety other than by
 7 reference to adherence to a classification system based
 8 firmly on reliable tests and reliably applicable
 9 outcomes?
 10 A. In practice?
 11 Q. In practice.
 12 A. They would make some justification and they would write
 13 that up as their design and they would seek the approval
 14 of the approving authority, and if the approving
 15 authority said that they were satisfied, then I guess
 16 you would build it.
 17 Q. At what point would you know, to a reasonable degree of
 18 certainty, whether or not you had met the functional
 19 requirement?
 20 A. In practical terms?
 21 Q. Yes.
 22 A. With respect to fire safety?
 23 Q. Yes.
 24 A. If you had a big fire and everything went horribly
 25 wrong.

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1 Q. Right. So while that happened, you would be taken to
 2 have complied, until it happened, when you suddenly
 3 realised that you hadn't?
 4 A. Mm—hm.
 5 Q. Now, at page 91 {LBYP20000001/91}, we have Malhotra.
 6 You start the quotation in the previous paragraph — in
 7 fact, let me show you what Malhotra says at
 8 paragraph 446 actually {LBYP20000001/90}. I've jumped
 9 ahead a little too far.
 10 "... Malhotra, then a long-time veteran of the Fire
 11 Research Station, summed up the significance of these
 12 fundamental changes as follows:
 13 "446. 'Historically over the last three centuries we
 14 have moved from strict constructional specifications to
 15 functional or semi-functional requirements with
 16 performance oriented objectives as and when feasible.
 17 Rigid controls are being replaced progressively by
 18 a more flexible system which permits alternative
 19 solutions to be considered. The burden of
 20 responsibility is being shifted from the central or the
 21 local authorities to the individual or corporate
 22 designer/contractor for the adequacy of his [sic]
 23 system."
 24 That's a quotation from Malhotra in 1986.
 25 Then you say this at 447 {LBYP20000001/91}:

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1 "447. Malhotra concludes:
 2 "448. 'It will be perhaps another 2 or 3 decades
 3 before the consequence of this approach can be seen'."
 4 Now, we can see that Malhotra was only a year or so
 5 out in his prediction; yes?
 6 A. Mm—hm.
 7 Q. What was it then, do you know or do you think, that
 8 Malhotra saw which people did not see in the intervening
 9 30 years?
 10 A. I don't know, again because I wasn't around and I never
 11 met Malhotra, unfortunately. But, to me, this quote
 12 expresses concern. It expresses a concern that, you
 13 know, this shifting to individual corporate designer
 14 contractors for adequacy, without some appropriate level
 15 of oversight, has the potential to cause significant
 16 problems, but that because we're working in fire safety,
 17 and because severe fires are thankfully rare, it might
 18 take a long time in order for the chinks in the armour,
 19 if you like, to manifest. Yes.
 20 I mean, when I found this quote, I thought: wow,
 21 yeah; spot on.
 22 Q. Let's move on to some of the missed opportunities that
 23 you identify to address key problems relating to the
 24 regulation of and industry practices prevailing in
 25 testing, design and construction of external wall

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1 systems.
 2 We start, I think, with Knowsley in 1991, 5 April,
 3 Liverpool, about which we have heard some evidence in
 4 the course of Module 6.
 5 Let's go, please, to page 95 of your report here
 6 {LBYP20000001/95}, paragraph 470. You say there:
 7 "In the early hours of 5th April 1991, a fire
 8 occurred at Knowsley Heights. On arrival, the
 9 fire brigade reported that 'it was the most frightening
 10 thing any of us had ever seen as fire—fighters', and
 11 that 'flames were coming from every landing window
 12 between the ground floor and the roof'.
 13 That is a quotation from Shennan, 1991.
 14 "There were no fatalities and the fire brigade were
 15 eventually able to bring the fire under control."
 16 If we go to paragraph 465, you confirm there,
 17 page 94 {LBYP20000001/94} that:
 18 "The rainscreen used at Knowsley Heights was a glass
 19 fibre reinforced polymer (GRP) sheeting product with an
 20 aggregate finish on its outside face ... The product's
 21 marketing literature suggested that the polymer used was
 22 a polyester polymer resin. The GRP rainscreen was
 23 a product called 'Cape Stenni' sheeting, and was
 24 presented as being a 'Class 0' product."
 25 Now, I think you've reviewed the BRE's 1992

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1 investigation report into that fire, written by
 2 Penny Morgan and others; yes?
 3 A. Yes.
 4 Q. For reference purposes, that is at {BRE00035385}.
 5 I think you have also looked at her witness statement;
 6 yes?
 7 A. Yes.
 8 Q. That's at {BRE00043866}.
 9 Your report at page 95 {LBYP20000001/95} at
 10 paragraph 472, foot of the page, you say this:
 11 "The investigations concluded that the primary
 12 reason for the rapid and widespread progression of the
 13 fire had been the complete absence of cavity barriers
 14 between the rainscreen cladding and the (mineral fibre)
 15 insulation. As a result, the first major revision of
 16 Approved Document B (which was already underway at the
 17 time of the fire) increased the degree to which cavity
 18 barriers were recommended within rainscreen cladding
 19 systems."
 20 If you go down to page 98 {LBYP20000001/98} and
 21 paragraph 486, you say there:
 22 "From my perspective, what is most notable about the
 23 report of the BRE investigation into the Knowsley
 24 Heights fire is the striking absence of any explicit
 25 discussion regarding the degree to which the GRP

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1 rainscreen product may have contributed fuel to the
 2 fire. I find this particularly notable since Knowsley
 3 represented a highly significant project in the
 4 development of rainscreen cladding systems. I have
 5 found no documentary evidence to suggest that anyone
 6 openly asked the question: 'what was burning within the
 7 cladding at the top of the building?'. It appears that
 8 the sole focus regarding the fuel for the fire was on
 9 the refuse judged to have initiated the fire at the
 10 building's base.
 11 "I find it surprising (and alarming) that nobody
 12 appears to have taken an explicit and active interest in
 13 the combustibility of the 'Class 0' GRP rainscreen
 14 product; at the time of writing I have seen no such
 15 interest evident in the documents made available to me."
 16 Now, why is your reaction one of surprise and alarm?
 17 A. There have been two moments in this Inquiry when I've
 18 thought — when I've been speechless, and one was when
 19 I read that it was GRP cladding at Knowsley Heights.
 20 The reason that I was speechless was because I was aware
 21 of Knowsley Heights, had been for many years, and I'd
 22 read BR 135 and various other reports and things over
 23 the years, and the problem at Knowsley was the absence
 24 of cavity barriers. Right? That's what I believed.
 25 That's what I was told. Because that's the problem,

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1 that's the narrative of Knowsley: the narrative of
 2 Knowsley is that there were unobstructed cavities all
 3 the way up the building and that's why there was a big
 4 fire.
 5 Now, my professional background, I come from
 6 a structural engineering background, and the way I got
 7 into fire was because I was interested in using GRP
 8 materials in structural engineering applications, and
 9 they burn quite nicely. So my route into this
 10 profession was through understanding the way GRP burns.
 11 So when I, for the Inquiry, thought — when I was asked
 12 to look at the regulatory regime and the testing,
 13 I thought, "Right, where do we start? We start at
 14 Knowsley, so let's go back and look at Knowsley".
 15 I looked at Knowsley, and as soon as I started reading
 16 the documents that had been provided to me about
 17 Knowsley and I realised it had been GRP, I thought to
 18 myself — well, the question here: what was burning ten
 19 storeys above the refuse, if this was a non-combustible
 20 cladding system and it had no cavity barriers? Can
 21 I really get flame extension ten storeys up
 22 an unobstructed cavity due to fuel only being at the
 23 base? I immediately went and spoke to my colleagues and
 24 said, "Guys, am I crazy, but does it seem pretty
 25 unrealistic that you get fire coming off the top of

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1 a building due to refuse burning at its base, even if
 2 you have an unobstructed cavity?", and they agreed with
 3 me.
 4 So, you know, the fact that — and then I started to
 5 look for mentions of the combustibility of the cladding
 6 over decades, and I found none. And then I looked at
 7 all of the work that came after Knowsley and I looked at
 8 trying to understand how class 0 kind of perpetuates
 9 within the system, trying to understand the sort of
 10 slightly odd British focus on cavity barriers in these
 11 systems that doesn't exist in many other jurisdictions
 12 around the world, and it all goes back to Knowsley, and
 13 it all goes back to Knowsley in the absence of any
 14 significant discussion about the GRP cladding.
 15 So I can't remember now what the question is, but,
 16 to me, that was really, you know, a sit-up-straight
 17 moment, and I've tried quite hard to understand why.
 18 Like why was it not mentioned?
 19 Q. Have you found an answer?
 20 A. No.
 21 Q. Now, if we go to page 99 {LBYP20000001/99},
 22 paragraph 496 you say:
 23 "On the basis of the above summary it is apparent to
 24 me that the BRE investigation into Knowsley Heights
 25 failed to fully address the degree to which the presence

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1 of a combustible rainscreen may have contributed to the
 2 spread and magnitude of the fire. Even with the
 3 considerable benefit of hindsight, I struggle to
 4 understand how this factor could have been overlooked
 5 during these investigations. This is particularly the
 6 case given that the rainscreen product used at
 7 Knowsley Heights was a glass reinforced polyester
 8 composite, which will almost certainly have had some
 9 (and perhaps significant) potential to contribute fuel
 10 to an escalating external fire."
 11 Are you able, professor, to offer any possible or
 12 plausible scientific basis which could justify or
 13 explain the omission of any discussion of the
 14 combustibility of the GRP cladding from BRE's work?
 15 A. Only that those who investigated the fire on behalf of
 16 BRE may have not understood themselves that something
 17 that is class 0 isn't necessarily non-combustible.
 18 Right? So those who investigated the fire on behalf of
 19 the BRE may have been operating under the
 20 misapprehension that class 0 means won't burn, and if
 21 they were, then you can kind of understand. They
 22 wouldn't have considered that the rainscreen could
 23 possibly have contributed if they thought it was
 24 non-combustible.
 25 Now, they would have been wrong to think that, but

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1 nonetheless they may have thought that. So, you know,
 2 Penny Morgan, for instance, may not have realised that
 3 class 0 and non-combustible are not the same thing.
 4 Q. Well, let's look at her witness statement, which is
 5 I think one of those things that you read,
 6 {BRE00043866/21}. If we go, please, to paragraph 115,
 7 she says — and this actually answers a question at the
 8 foot of page 20 {BRE00043866/20}, which we need to look
 9 at, at paragraph 114. If we could just pick that up,
 10 I'm sorry. The question at the foot of 20 is:
 11 "Did you understand the fact that the GRP rainscreen
 12 cladding applied to the external walls of the Knowsley
 13 building had achieved Class 0 to relate to the
 14 combustibility or otherwise of the product? Please
 15 explain your answer."
 16 At the top of page 21 {BRE00043866/21}, she says
 17 this:
 18 "To the best of my recollection, I understood that
 19 the GRP rainscreen cladding had achieved Class 0, which
 20 did relate to the combustibility of the product."
 21 Then if you go to page 22 {BRE00043866/22}, I'll
 22 show you two things. Page 22, paragraph 125, she says:
 23 "While I cannot recall due to the passage of time,
 24 I assume that I did consider the cause of the vertical
 25 fire spread to be a matter of significance, as

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1 a ground-based fire had spread over what was purported
 2 to be non-combustible cladding."
 3 Now, what do you make of that evidence?
 4 A. It would appear that she doesn't understand the
 5 distinction between class 0 and non-combustible.
 6 Q. Do these passages that I've read you from her statement
 7 throw any light on the state of knowledge — assuming
 8 her to be representative for the moment — in fire
 9 engineering circles in the early 1990s about the
 10 limitations of class 0 and the risks of external fire
 11 spread presented by products like GRP?
 12 A. Well, I wasn't there, so I can't really speak to whether
 13 or not this view would have been typical. It does seem
 14 to me that, over the years, there has been quite a lot
 15 of confounding of these two concepts, yes.
 16 Q. The two concepts being ...?
 17 A. Class 0 and non-combustible.
 18 Q. When you say "confounding", you mean conflating?
 19 A. Sorry, conflating, yes.
 20 Q. It's the same thing, but people understand "conflate"
 21 better than "confound".
 22 A. Yes.
 23 Q. Can we then go to page 99, paragraph 491 of your Path to
 24 Grenfell report {LBYP20000001/99}. You have quoted from
 25 the passage I have just read to you, and then you also

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1 quote at 490 from a later BRE report which says this,
 2 I'll just read this to you:
 3 "The most significant of the historic [external]
 4 fires is that of the 1991 fire in Knowsley Heights;
 5 a residential block of flats which had been refurbished
 6 with the addition of thermal insulation to the external
 7 walls of the block. The fire started external to the
 8 block and ignited the combustible cladding system,
 9 resulting in extensive fire spread across the face of
 10 the building (mostly upwards)."
 11 Then you say at 491:
 12 "I agree that the Knowsley Heights fire was the
 13 'most significant of the historic [external] fires',
 14 which is why the apparent failure to properly
 15 interrogate the key issues or make the necessary changes
 16 to the relevant guidance is so tragic with hindsight.
 17 The above quote also suggests an unarticulated knowledge
 18 of this issue within BRE going back for decades."
 19 For what reasons do you consider that this fire was
 20 the most significant of the historic external fires in
 21 the years between 1991 and 2017?
 22 A. Because of what it ought to have caused people to think
 23 about but didn't, apparently.
 24 Q. What interrogation do you think should have been carried
 25 out into what you describe as the key issues?

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1 A. Those who were investigating this fire ought to have
 2 tried to understand the extent to which the escalation
 3 of the fire vertically was a consequence of the
 4 continuous cavity or a consequence of the combustibility
 5 of the rainscreen, rather than focusing, as far as I can
 6 tell, uniquely on the continuous cavity.
 7 You know, I mean, Knowsley Heights is why, as far as
 8 I can tell, we have such a strong focus on the use of
 9 cavity barriers. If, after Knowsley, someone had stood
 10 up and said, "Well, actually, a significant proportion
 11 of the adverse outcome at Knowsley was because we had
 12 a class 0 combustible rainscreen", then maybe we
 13 wouldn't have had, well, many other fires, including
 14 Grenfell Tower. You know, I think it's impossible to
 15 overstate the importance of what was missed here.
 16 Q. And in paragraph 491, where you say "failure to ... make
 17 the necessary changes to the relevant guidance", what
 18 are you referring to? What are the necessary changes
 19 that should have been made?
 20 A. A reconsideration of class 0.
 21 MR MILLETT: Right.
 22 SIR MARTIN MOORE-BICK: Presumably the GRP panels from
 23 Knowsley were removed and examined, were they?
 24 A. Well, I don't know. I mean, Knowsley was reclad, as far
 25 as I'm aware. I certainly don't think, and hope, that

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1 those panels are not on Knowsley Heights still —
 2 although I have to say, given what we have observed, it
 3 wouldn't surprise me if they were.
 4 SIR MARTIN MOORE-BICK: I ask the question because, if they
 5 were removed and examined, fire damage to the internal
 6 faces would have been apparent, wouldn't it?
 7 A. Yes, I mean, there are photos in the fire investigation
 8 report, BRE's investigation report, that clearly show
 9 what someone who understands the way GRP burns would
 10 expect. You see — GRP is glass reinforced polymer,
 11 glass fibres that are placed inside a polymer matrix,
 12 I think polyester probably would be typical for this
 13 era, and when they burn, the polyester burns off and the
 14 glass fibres remain, and you end up with stringy glass
 15 fibres, you end up with a mess of — a tangle of glass
 16 fibres that is what was pre-existing inside the resin
 17 before the polymer burned off, and in the photos after
 18 Knowsley, you see it, you see glass fibres hanging all
 19 over the place. You see partially burned rainscreen
 20 cladding panels. It's abundantly clear what has
 21 happened. The polyester resin — assuming it was
 22 polyester — the polymer resin has burned away and has
 23 left the fibres. There is ample evidence of exactly
 24 what occurred.
 25 So the rainscreen panels at Knowsley Heights did

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1 burn, there is no question.
 2 SIR MARTIN MOORE—BICK: But people didn't really pick it up;
 3 is that what you're saying?
 4 A. That's what it appears, yes. As I say, for me, when
 5 I realised they were GRP panels and I went back and
 6 looked at the photos and realised what I was looking at,
 7 you know, having had in my head all these years that
 8 Knowsley had a non-combustible rainscreen and the
 9 problem was the absence of cavity barriers, again it was
 10 just one of those moments where I just thought: what?
 11 This cannot be. This cannot be the truth.
 12 Yes, it's absolutely clear to me that the fact that
 13 the rainscreen at Knowsley Heights was GRP was one of if
 14 not the reason why that fire spread.
 15 MR MILLETT: Mr Chairman, one more question before the
 16 break, if I may.
 17 In your experience and knowledge of GRP, does it or
 18 did it routinely achieve a class 0 classification?
 19 A. I couldn't say. One of the things that's interesting
 20 about — and I couldn't say because it depends on, you
 21 know, the type of polymer, what fillers or fire
 22 retardants you might have in the polymer, the ratio
 23 between fibres and polymer. There's all sorts of
 24 reasons why it's quite difficult to say whether
 25 something would or would not.

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1 What's interesting about the Knowsley panels is that
 2 they were GRP panels, but they had an aggregate outer
 3 surface, as is mentioned in the reporting, and so they
 4 had little stones that were kind of, I guess, pressed in
 5 or formed into the outer surface to make it look like it
 6 was a render or, you know, a rough cast kind of finish
 7 to the outside of the building, and I can imagine that,
 8 if the rainscreen product at Knowsley were tested in
 9 BS 476—6 and 7, the presence of that rough cast stone
 10 finish would assist the product to achieve potentially
 11 class 0.
 12 What's interesting is that, after Knowsley, one of
 13 the changes that was made, quietly, to the guidance was
 14 that rainscreen panels need to achieve class 0 on both
 15 the outside and inside faces, and so I believe that it's
 16 plausible that the reason that change was made is
 17 because somebody realised but did not say that the
 18 rainscreen panels at Knowsley were not class 0 inside
 19 the cavity, and that's one of the reasons why the fire
 20 spread so quickly. But that's conjecture on my part.
 21 MR MILLETT: Yes, thank you.
 22 SIR MARTIN MOORE—BICK: Is that a good point?
 23 MR MILLETT: Yes, Mr Chairman, thank you.
 24 SIR MARTIN MOORE—BICK: Good.
 25 We'll have the afternoon break at this point, then,

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1 Professor Bisby. We'll come back at 3.35, please, and
 2 usual rules apply. All right?
 3 THE WITNESS: Thank you.
 4 SIR MARTIN MOORE—BICK: Thank you very much.
 5 (Pause)
 6 Thank you very much, Mr Millett. 3.35, please.
 7 Thank you.
 8 (3.21 pm)
 9 (A short break)
 10 (3.38 pm)
 11 SIR MARTIN MOORE—BICK: Right, ready to carry on?
 12 THE WITNESS: Yes, thank you.
 13 SIR MARTIN MOORE—BICK: Thank you very much.
 14 Yes, Mr Millett.
 15 MR MILLETT: Yes, thank you very much, Mr Chairman.
 16 Professor, in the exchanges before the break, you
 17 said that there were two moments in your work for the
 18 Inquiry which left you speechless. You explained what
 19 one of them was. I'm afraid that, during the break, the
 20 press of curiosity has become too much for us. What was
 21 the other?
 22 A. The other was when I discovered what had been tested in
 23 the cc1924 project in the early 2000s.
 24 Q. Right. Somebody behind me has just won a bet.
 25 A. Ah, okay, congratulations!

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1 Q. Now, in relation to Knowsley, if we go, please, to
 2 page 100 {LBYP20000001/100}, paragraph 500, you say
 3 there that:
 4 "Knowsley Heights was a pilot scheme for the Estates
 5 Action programme, wherein government investment was
 6 intended to support local improvements; it was a pilot
 7 scheme for the new overcladding technologies that had
 8 been the subject of BRE review; it was a pilot scheme
 9 for the fire safety of such systems as informed by BRE's
 10 earlier large scale fire testing programme; it was also
 11 (to some extent) a pilot scheme for the new building
 12 regulatory system whereby new technologies could be
 13 deployed without meeting specific performance standards
 14 and via 'alternative routes', rather than by strict
 15 compliance with Approved Document B."
 16 Are you able to tell us from your review of the
 17 history and the documents relating to it whether there
 18 may have been some other reason for the investigation
 19 into the classification of GRP not being picked up as
 20 a feature?
 21 A. Of the Knowsley investigation?
 22 Q. Of the Knowsley investigation.
 23 A. I mean, I've tried quite hard to think of an alternative
 24 reason, other than what we might call the potential for
 25 embarrassment or the self-interest of the parties

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1 involved in that scheme in one way or another. I've not
 2 been able to come up with one that I consider plausible.
 3 You know, it may be the case that Penny Morgan,
 4 who — you know, my understanding of her background is
 5 that she didn't necessarily come from fire science or
 6 even a physics or engineering background, that she may
 7 not have understood what she was looking at. But,
 8 I mean, other people who were within the organisation,
 9 the BRE, at that stage, these were the top fire
 10 scientists in the country. If any of these people
 11 looked at this evidence, I can't see how they would not
 12 see what I saw the moment I looked at it.
 13 So I am at a bit of a loss to explain it, other
 14 than — I mean, the statements I've made here, and there
 15 is also — obviously we — Graham Spinardi, who works in
 16 my team, went to the archives at Kew and started looking
 17 at some of the files at Kew and uncovered, you know,
 18 this memo that the Inquiry has seen that alludes to
 19 certainly the potential for some embarrassment, in my
 20 view, around the fire at Knowsley Heights.
 21 Q. Was GRP, whether Cape Stenni or otherwise, in wide use
 22 at the time, the late 1980s/early 1990s?
 23 A. That would have been a period when GRP was — I mean,
 24 certainly in that period, people were using GRP on
 25 buildings for — you know, it's a modern material,

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1 a space age material, and people were using it for
 2 cladding panels and various other things at that time.
 3 Yes, certainly there were a number of buildings in
 4 London that were clad with GRP that didn't age
 5 particularly well over the years.
 6 Q. Moving on, then, to a little bit later in the decade,
 7 1994, Raymond Connolly, can we go, please, to page 109
 8 of your report {LBYP20000001/109}, and at paragraph 568
 9 you address the full — scale fire test research which was
 10 carried out as a result of the fire at Knowsley by the
 11 BRE, through Dr Raymond Connolly, which led, I think, to
 12 a report from him in 1994, about which the panel has
 13 heard some evidence —
 14 A. That's right.
 15 Q. — during the course of this module.
 16 Now, is it right that you consider that the primary
 17 focus of that research work, which included ten
 18 full — scale tests, was on cavity barriers?
 19 A. It appeared to be interested primarily in cavity
 20 barriers, yes, on reading it.
 21 Q. At paragraph 569 you observe — and I'm summarising —
 22 that one of the tests, namely test 2, carried out on
 23 a system incorporating class 0 GRP rainscreen cladding,
 24 appeared to be an almost exact reconstruction of the
 25 cladding system used at Knowsley.

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1 A. Certainly very similar, yes.
 2 Q. What observations recorded from that particular test
 3 do you consider to be significant?
 4 A. From the test 2?
 5 Q. From test 2, yes.
 6 A. From memory, I mean, that test 2 escalated quite rapidly
 7 and went off the top of the rig. You know, it behaved
 8 in much the same way that one would have expected, given
 9 what had occurred at Knowsley.
 10 Q. You go on to say at 572 that — this is Connolly:
 11 "... that 'the reaction to fire properties of the
 12 sheeting materials [i.e. that the rainscreen sheeting
 13 was Class 0 on both faces] do not give a true indication
 14 of the potential fire hazard' ..."
 15 Yes?
 16 A. Yes, that's Connolly being quite clear, yes.
 17 Q. Yes. Then at 350 there's a footnote. You conclude, and
 18 I'll read it aloud:
 19 "Thus, by at least as early as 1994 BRE and the
 20 Construction Sponsorship Directorate of the (then)
 21 Department of the Environment (DOE) should have been
 22 aware that Class 0 did not give a true indication of the
 23 potential fire hazard of a rainscreen product, and that
 24 this fact could contribute to a cladding system
 25 experiencing 'unlimited vertical spread of fire over the

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1 full height' of a cladding system."
 2 A. That's right, yes.
 3 Q. Are you aware of anything done within government at the
 4 time from your reading of all the material about that?
 5 A. No. I mean, other than potentially, you know, the
 6 requirements on cavity barriers being enhanced. It's
 7 conceivable that those involved felt that implementing
 8 a greater requirement for cavity barriers would address
 9 the problems. I don't know what basis they would have
 10 had for that belief, but it's possible that they held
 11 it.
 12 Q. Focusing on Dr Connolly's conclusions at paragraph 572,
 13 which I have just read to you, how significant was that
 14 conclusion?
 15 A. I mean, I think it's a hugely significant conclusion,
 16 yes.
 17 Q. You go on to say that Dr Connolly concluded that it was
 18 necessary to consider the system as a whole, and that
 19 there was still a need for full — scale testing to
 20 determine appropriate cavity protection. I'm
 21 summarising your paragraphs 576 to 577.
 22 Is it fair to say, professor, that the focus on
 23 cavity barriers and protection reflects the report as
 24 a whole, Dr Connolly's work as a whole?
 25 A. That he was focused on cavity barriers?

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1 Q. Yes.
 2 A. Yes, I mean, the kind of — what I'm left with, when
 3 I look at that work in the context of Knowsley Heights
 4 and some of the reputational issues around it, is this
 5 idea that cavity barriers could be a way to address,
 6 either wholly or in part, the poor performance that had
 7 been observed, yes.
 8 Q. The focus was on cavity barriers and protection rather
 9 than the risks presented by using what appeared to be
 10 class 0 rainscreen material?
 11 A. Yes. What is surprising is that it doesn't appear that
 12 anybody said, you know, "Well, hang on, maybe we just
 13 should not use combustible rainscreens. Maybe we should
 14 find some other way to restrict the reaction to fire
 15 behaviour of rainscreen products. You know, maybe, in
 16 addition to class 0, we should have some other
 17 requirement, or maybe we should develop a bespoke
 18 requirement that is applicable to rainscreen systems and
 19 how they might behave in a fire scenario". But it
 20 doesn't appear that anyone did that, other than to argue
 21 that a BS 8414 test — what would eventually become the
 22 BS 8414 test — that a large-scale test was needed.
 23 So it doesn't appear that anybody thought, "Well,
 24 let's think about restricting the combustibility of
 25 rainscreens, let's instead think about ways we can

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1 satisfy ourselves by other means or other assessment
 2 techniques that we can still use these products in ways
 3 that would be adequate, as far as we're concerned".
 4 You know, and there is a kind of narrative that
 5 flows through this, from Knowsley Heights all the way
 6 through to the parliamentary inquiry and subsequent,
 7 that what is needed is a large-scale test, rather than
 8 what is needed is some further restriction on the
 9 combustibility or the extent to which rainscreen
 10 products might contribute to a fire. Yes.
 11 You know, there were two paths or two lines of
 12 thought that could have been followed, and the one that
 13 was followed, you know, uniquely was the large-scale
 14 testing path.
 15 Q. Yes. Let's see if I can just tease out a little bit
 16 more on that.
 17 Can we go, please, to paragraph 111 of your report
 18 and look at paragraphs 580 to 581. You say in 580:
 19 "580. Connolly's approach appears to have been as
 20 follows: Given that ADB allows Class 0 rainscreens, and
 21 given that Class 0 does not fully address the fire
 22 hazards associated with Class 0 (yet combustible)
 23 rainscreens, what mitigations could/should be introduced
 24 in order to reduce the hazards to acceptable levels?
 25 The question of whether a Class 0 rainscreen was/is

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1 appropriate does not appear to have been asked; or, if
 2 it was asked, this was not articulated or investigated.
 3 "581. I consider the Knowsley Heights fire, its
 4 investigation, and Connolly's subsequent research to
 5 represent significant missed opportunities to explicitly
 6 address the potential hazards associated with
 7 combustible Class 0 rainscreen products."
 8 Now, do you consider the fact that whether a class 0
 9 rainscreen was or is appropriate should have been asked
 10 or investigated at that point?
 11 A. Yes.
 12 Q. Notwithstanding that that was not the focus of the
 13 Connolly report, is it your opinion, professor, that the
 14 experiments identified significant potential hazards
 15 associated with the use of a class 0 product?
 16 A. Yes.
 17 Q. Had Connolly been asked to consider the question, do you
 18 consider that he would have been justified in
 19 concluding, based on his tests, that class 0 was not
 20 a suitable measure for assessing the hazard posed by
 21 an external cladding system, with a view to satisfying
 22 functional requirement B4?
 23 A. Yes, I mean, I think he says as much in his report, yes.
 24 Q. Is there a scientific justification for not asking
 25 Dr Connolly to investigate that question?

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1 A. I mean, I would have asked the question, is all I can
 2 say, and I would have expected anyone in the room, so to
 3 speak, to have a discussion about that question. Maybe
 4 they did. I don't know. Maybe they did have that
 5 discussion. Maybe they talked it over and they decided,
 6 "Well, no, instead what we're going to do, because we
 7 can't come up with an alternative approach here that's
 8 based on small-scale or medium-scale tests, and we don't
 9 want to restrict the industry, we don't want all of
 10 a sudden there to be this problem of all these
 11 rainscreen products that are being used to reclad
 12 high-rise tower blocks, we don't want to create
 13 a problem, so we're going to really push hard for
 14 a full-scale test as an alternative and we're going to
 15 get rid of class 0 and we're going to do it with
 16 a large-scale test".
 17 You know, it seems that is what was being argued for
 18 in those years between this and the parliamentary
 19 inquiry, the 1999 inquiry, that the goal was to supplant
 20 or replace class 0 with a large-scale fire test that
 21 would be used for all products and systems. Now,
 22 obviously that's not what happened, as it happens,
 23 but ...
 24 I see your question. I would have wanted to ask
 25 that question about class 0 quite carefully, because the

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1 thing that's important to recognise about class 0 that
 2 seems to get a bit lost in the conversation is that
 3 class 0 covers all manner of products, with all manner
 4 of particular hazards associated with them, you know,
 5 whether they are composite products, what types of metal
 6 faces they have, how thick those faces are, whether the
 7 cores are foamed or solid polymers or metallic
 8 honeycombs with adhesives or whatever, you know, whether
 9 the faces are metallic or cementitious, come to that.
 10 So the problem with class 0 is that it just simply
 11 cannot address the responses of the full range of
 12 products that it was being applied to, and a view may
 13 have been taken that a large-scale test could do that
 14 and, therefore, a switch to a large-scale test may be
 15 appropriate.

16 Q. Now, let's look to see how Dr Connolly describes the
 17 approach.

18 Can we go to his statement at {BRE00047667/12}. I'm
 19 afraid there aren't paragraph numbers on this page, but
 20 let's pick it up at the top. He says at (f):

21 "As outlined previously, Test No. 2 confirmed that
 22 the guidance in Approved Document B relying on Class 0
 23 as a sufficient measure of fire performance was
 24 inadequate unless also associated with the guidance
 25 requiring provision of cavity barriers, which were

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1 problematic for reasons of dampness control. Rather
 2 than raising a concern, Test No. 2 validated the need
 3 for a full-scale fire test to allow for an examination
 4 of an integrated external wall system rather than an
 5 individual component-by-component based specification.
 6 As an alternative outcome, had Class 0 rated materials
 7 exhibited sufficiently robust fire performance at
 8 full-scale, then the need for cavity barriers and/or
 9 full-scale testing would have not been necessary. In
 10 this context, I would respectfully suggest that the BRE
 11 research programme was significant. With the benefit of
 12 hindsight, it is recognised that a
 13 component-by-component specification would have been
 14 an alternative and valid approach to have adopted
 15 subject to that specification being entirely one of
 16 'non-combustible' materials. Such an option was never
 17 thought of by me at the time as being necessary and
 18 I never heard any other person involved in the research
 19 suggesting at the time that such an approach was
 20 potentially necessary."

21 Now, it looks from that that Dr Connolly considered
 22 that the tests confirmed the need for a full-scale test,
 23 and that small-scale component testing would only have
 24 been a valid alternative approach if comprised of
 25 entirely non-combustible materials or products. Do you

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1 agree with that?

2 A. No. No, I don't. I mean, another way of reading the
 3 result of test number 2 is that test number 2 is telling
 4 you, "Don't use these rainscreens", and it's telling you
 5 that pretty forcefully, actually.

6 Q. What does that tell you about what test --

7 A. Well, it means you don't necessarily need -- I mean,
 8 there's this weird -- yes, there's this strange kind of
 9 sort of one-way set of blinders that people appear to
 10 have on in this period where, when something went badly,
 11 what it was showing was the need for a full-scale test,
 12 as opposed to it was showing that you shouldn't use that
 13 product. So in all of the narrative throughout this
 14 period, there's this strange kind of single-mindedness
 15 pushing towards this idea that the way to solve this
 16 problem was with a large-scale fire test.

17 You'll have to remind me, it escapes me at the
 18 moment, but was there a test number 2 that was performed
 19 but with cavity barriers? I can't remember off the top
 20 of my head.

21 Q. I don't believe so.

22 A. Okay. But from memory, there were a number of tests
 23 that involved cavity barriers, and many of those were
 24 deemed inadequate as well in this study.

25 So, you know, what Dr Connolly seems to be saying

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1 here is that test number 2 confirms that we need
 2 a large-scale fire test, and if we do a large-scale fire
 3 test but it incorporates cavity barriers, then there
 4 seems to be this presumption that everything would be
 5 fine. But having not performed that test, I don't
 6 think, I'm not sure on what basis he's arguing that
 7 that's the case.

8 Q. This would, wouldn't it, treat small-scale tests and
 9 large-scale tests as functional equivalents?

10 A. In what respect? I'm not sure I follow.

11 Q. Well, in the sense that they would both arrive at the
 12 same point, namely that you could use this particular
 13 product or material if you passed, or didn't fail.

14 A. Yes, if you're going to stick with class 0, yes.

15 Q. Yes.

16 A. Yes, if you're going to stick -- but my argument is that
 17 they shouldn't have stuck with class 0, they should have
 18 done something different, or at least thought very hard
 19 about doing something different.

20 Q. Now, he says it's with the benefit of hindsight that
 21 a component-by-component specification with
 22 non-combustible materials would have been an alternative
 23 and valid approach. But what was it that the scientists
 24 like Dr Connolly did not know in 1994 that they came to
 25 know later so as to be able to invoke the wisdom of

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1 hindsight, as he does?

2 A. You know, I would disagree with that statement. I don't

3 think you need the benefit of hindsight to make that

4 statement.

5 Q. Is it fair to say that, in fact, no hindsight was

6 needed, given what the Knowsley Heights fire

7 demonstrated about what class 0 panels could do in the

8 event of an external fire?

9 A. Presuming that Dr Connolly had been briefed on what had

10 occurred at Knowsley, yes, I would agree with that.

11 Q. Can we go back to your report, then, at page 40

12 {LBYP20000001/40}, please, paragraphs 195 to 197. You

13 say there in 197:

14 "One approach would have been to revisit the

15 reference scenario and (re)develop new model tests."

16 Just pausing there, is that a reference to class 0?

17 A. Yes.

18 Q. "A new, more appropriate, reference scenario could have

19 been defined, and the possibly voluminous and costly

20 underpinning research conducted to determine if it was

21 possible to link the results of a new small-scale (and

22 hopefully reproducible) product test to the results in

23 a larger reference scenario. Indeed, it may have been

24 possible, with sufficient underpinning research, to more

25 credibly link the existing model tests to reference

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1 scenarios involving external fire spread. This is not

2 the course of action that was taken.

3 "198. The alternative approach was to prioritise

4 representativeness over reproducibility — and to create

5 a more 'realistic' test. This second route was the one

6 suggested by Connolly — who was apparently keen

7 (possibly for both technical and commercial reasons) to

8 create a test that included cavity protection,

9 insulation, and external rainscreens. Connolly

10 therefore proposed the creation of an external fire

11 spread 'system test'."

12 Was that work of revisiting the reference scenario

13 and developing new model tests ever carried out?

14 A. Not that I'm aware of, no.

15 Q. Was it your view that it ought to have been carried out?

16 A. It ought to have been very seriously considered and

17 I would have expected that consideration to have been,

18 you know, written down and documented somewhere.

19 Q. And given what happened, what is your opinion of the

20 appropriateness of continuing to use class 0, developed

21 as it was for an internal reference scenario, in the

22 context of assessing the safety of external cladding

23 systems?

24 A. It should not have been. It should have been

25 reconsidered. I mean, it should have been reconsidered

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1 immediately after the Knowsley fire.

2 Q. If we go to page 253 {LBYP20000001/253}, paragraphs 1578

3 to 1580. I won't read it all out to you, just remind

4 you of what you said there under the summary. 1578,

5 1579 and 1580, you summarise your views there.

6 Just on the basis of what you say there, is it your

7 view that the continued use of class 0 in the context of

8 the safety of external cladding systems represented

9 a hazard to life safety?

10 A. Yes.

11 Q. Do you consider that the focus on mitigation obscured

12 the extent to which the continued use of class 0 was

13 a hazard?

14 A. Yes.

15 Q. And what ought to have changed after Knowsley and

16 Connolly, given what they showed?

17 A. What ought to have changed? I mean, the machine of

18 government regulation, you know, BRE, the relevant

19 government departments, should have removed class 0 as

20 the means by which cladding products could be assessed

21 and accepted for use on the outside of buildings. They

22 should have thought about the products that were being

23 used across the industry, how those products react when

24 exposed to heating and what that means for the

25 performance with respect to external fire spread.

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1 Now, they might claim that that's what the BS 8414

2 test was trying to do, and that, had the BS 8414 test

3 been implemented as an alternative to class 0, rather

4 than as a parallel stream or a parallel approach to

5 class 0, it would have addressed those issues, and maybe

6 it would have. It's hard to say with hindsight.

7 You know, if you test ACM PE on an 8414 test,

8 notwithstanding all my comments about complexity and

9 differences in behaviour, I defy you to pass that test.

10 Q. Let's turn to Garnock Court, 1999.

11 A. Sure.

12 Q. 11 June in that year. 14-storey block of flats in

13 Irvine in Scotland, overclad as part of a refurbishment.

14 Again, GRP; yes?

15 A. Yes.

16 Q. If we go to page 123 of your report {LBYP20000001/123},

17 paragraphs 634 and 635, under the heading "Garnock ...

18 (1999)", you describe the fire in paragraph 634, and

19 then in 635 you say:

20 "As had been the case at Knowsley Heights,

21 Garnock Court had been reclad using a GRP cladding

22 product, however in this case the GRP was installed over

23 a more localised portion of the building, essentially as

24 pre-formed 'spandrel' panels installed below the living

25 room windows along isolated vertical lines up the sides

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1 of the building (see Figure 15). At Garnock Court,
 2 however, the refurbishment GRP cladding was not
 3 a ventilated rainscreen and the cladding system
 4 therefore also did not (and did not need to) incorporate
 5 cavity barriers."

6 Now, it is right, I think, as with the fire at
 7 Knowsley Heights, the Garnock Court fire was
 8 investigated by the BRE on behalf of central government.

9 A. Yes.

10 Q. This time the Department of the Environment, Transport
 11 and the Regions, as I think it had become; yes?

12 A. Yes.

13 Q. It was reported as part of the August 2000 Investigation
 14 of Real Fires report done by the BRE under contract with
 15 the government; yes?

16 A. Yes.

17 Q. And also the subject of reports prepared by the BRE for
 18 the Procurator Fiscal's Office and for Irvine Council,
 19 both in Scotland; yes?

20 A. That's my understanding, yes.

21 Q. And you've read those reports; yes?

22 A. I have.

23 Q. If you go, please, to 637, just in the middle of your
 24 screen {LBYP20000001/124}, you say:
 25 "The fire investigation report issued by BRE to DETR

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1 (in August 2000) described Knowsley Heights'
 2 refurbishment GRP cladding in considerable detail, as
 3 follows ..."

4 And then you set all that out.

5 Then you say, a couple of paragraphs on at 639:
 6 "The only substantive technical commentary on the
 7 role of the cladding in the fire spread at Garnock Court
 8 is contained in the following passage ..."

9 Then you say this at 640:
 10 "'The video from Tesco's security camera shows full
 11 involvement 15 minutes after the call to the brigade and
 12 for the next seven minutes. The video shows even
 13 burning up the external surface of the GRP with the
 14 production of flames and dense black smoke. This
 15 indicates the involvement of the GRP alone rather than
 16 the contents of the flats as the burning pattern would
 17 vary according to the materials burning."

18 Is it fair to say that the report into the
 19 Garnock Court fire contains less detail as to the nature
 20 of the GRP cladding than the Knowsley Heights report?

21 A. Contains less detail? I would say it contains probably
 22 a bit more.

23 Q. A bit more detail?

24 A. Yes. It at least makes it clear what we're dealing
 25 with.

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1 Q. Right.

2 You say at 641:
 3 "It is clear from the above descriptions that the
 4 presence of the combustible GRP spandrel panels was the
 5 primary contributor to the rate and extent of external
 6 vertical fire spread at Garnock Court. The video has
 7 unfortunately not been made available to me."

8 Are you able to tell us how you reached that
 9 conclusion, that the GRP spandrel panels were the
 10 primary contributor to the rate and extent of the
 11 external fire spread at Garnock?

12 A. I mean, largely based on the information that's given in
 13 the BRE's report. The only thing on the outside of the
 14 building that's there that's combustible is these GRP
 15 panels. These are, you know, pre-formed GRP spandrel
 16 panels, essentially. I imagine they're quite polymer
 17 rich at their surface, and I can imagine that they would
 18 burn pretty enthusiastically, based on my knowledge of
 19 GRP.

20 Q. You go on to say at paragraphs 642 and 643, at the foot
 21 of page 124 and over to page 125 — and I'm
 22 summarising — that no further testing on the spandrel
 23 panels and no explicit comment was made in the DETR
 24 report as to whether the panels were class 0 or whether
 25 there were any implications for the Building Regulations

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1 in England. You say you consider that surprising.

2 Have you seen any evidence in the form of a document
 3 or a witness statement that would provide what you might
 4 consider to be a tenable explanation for those
 5 omissions?

6 A. No.

7 Q. If we go to page 133 {LBYP20000001/133}, then,
 8 paragraph 701, you observe that testing on the spandrel
 9 panels was carried out between August 1999 and May 2000
 10 under confidential contract to North Ayrshire Council;
 11 yes?

12 A. Mm—hm.

13 Q. So some testing was done?

14 A. Later.

15 Q. Later?

16 A. Yes.

17 Q. But not by central government, only under contract to
 18 the local council?

19 A. That's right. I believe that work was done on behalf of
 20 the local council and in some way in association with
 21 the Procurator Fiscal.

22 Q. Yes.

23 Can we go to the next page, page 134
 24 {LBYP20000001/134}, paragraph 703. You say there:
 25 "As part of my work for The Grenfell Tower Inquiry,

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1 I have performed a side-by-side comparison of the
 2 reports prepared by BRE for North Ayrshire Council, and
 3 the report prepared by BRE for Department for Energy,
 4 Transport and Regions. The reports for North Ayrshire
 5 Council (dated August 1999 and April 2000) were prepared
 6 by Penny Morgan, Brian Martin, and Tony Morris. The
 7 report for DETR was submitted to Anthony Burd as part of
 8 the August 2000 Investigation of Real Fires Report and
 9 was prepared by Penny Morgan. I have noted what
 10 I consider to be some potentially significant
 11 differences."

12 And you've done that.

13 You then go on to say at 705, in the last line or
 14 last sentence:

15 "The removal of mentions of Class 0 from the reports
 16 to DETR appears to have been performed intentionally."

17 Now, you opine there that the removal of mention or
 18 the omission of a mention of class 0 was intentional.
 19 To be clear, are you offering no more than a lay view of
 20 the evidence as opposed to your expert opinion?

21 A. If you — I mean, if you perform — I mean, I suppose
 22 so. If you perform a side-by-side comparison of the two
 23 reports, what's striking is that they are, in the
 24 relevant sections, verbatim, or almost verbatim, and
 25 yet, you know, the sentence that deals with class 0 or

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1 the specific set of words that deals with class 0 has
 2 been removed from the reporting to government but is
 3 present in the North Ayrshire reporting. I suppose
 4 that's a lay assessment.

5 What is interesting to me or what I'm puzzled by is
 6 why that information is considered sufficiently
 7 uninteresting to government that it should be explicitly
 8 removed from text which is otherwise verbatim.

9 Q. What is the significance of the omission of the mention
 10 of class 0 in the report that went to government?

11 A. That it, by its omission, does not flag the issue of
 12 class 0, you know, that it appears to not want to draw
 13 attention to class 0. Yes, I mean, that's all I can
 14 really say about it.

15 You know, I've watched, obviously, much of the
 16 testimony that's been given in Module 6, and I recognise
 17 a number of the witnesses were kind of questioned about
 18 this discrepancy and none of the witnesses were able to
 19 give a very suitable rationale for why that discrepancy
 20 existed, which I think is also a bit puzzling.

21 The only explanation that I have been able to come
 22 up with is that, in the reporting to government, which
 23 I think occurred — sorry, the reporting to
 24 North Ayrshire Council was, I believe, temporally
 25 earlier than the reporting to government, where those

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1 relevant sections of text are included, and it may be
 2 that, in the intervening time period, certain decisions
 3 had been taken and certain replacement products had been
 4 installed that meant that the mention of class 0 was not
 5 necessary anymore. But it is striking by its absence
 6 from any of the reporting to government, in my view.

7 Q. We come on, then, to the select committee's
 8 recommendations and the government's response as another
 9 missed opportunity in your list, I think.

10 I'm not going to ask you any questions about the
 11 evidence given or whether you agree or disagree with the
 12 recommendations, but if we look at the recommendations
 13 themselves, you summarise those on page 133
 14 {LBYP20000001/133}, if we can go back to that, please,
 15 at paragraph 697. We could see that there. In the
 16 middle of the paragraph, you record as follows:

17 "Thus, they suggested that the new BRE test (i.e.
 18 the test described in Fire Note 9, which would later
 19 become BS 8414) should be re-issued as a British
 20 Standard and be substituted in Approved Document B to
 21 replace previous recommendations relating to the fire
 22 safety of external cladding systems (i.e. that Class 0
 23 should no longer be used in this context)."

24 I think we can agree that that recommendation was
 25 not subsequently acted upon as a fact, but you then go

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1 on at 720 on page 137 {LBYP20000001/137}, if we go to
 2 that, please, to note that:

3 "'Class 0' was not mentioned within the government's
 4 response to the first report of the 1999 Select
 5 Committee inquiry."

6 Is that the Nick Raynsford response of 6 April?

7 A. I believe so. I would have to check the reference
 8 somewhere on that page. Yes, I see that.

9 Q. Right.

10 A. I think so, yes.

11 Q. Yes.

12 In your view, was the failure to implement the
 13 select — well, let me put it neutrally, perhaps: how
 14 would you characterise the failure by government to
 15 implement the select committee's recommendations?

16 A. How would I characterise it? Foolish. Irresponsible.

17 Q. A missed opportunity?

18 A. A missed opportunity, for sure.

19 Q. I want then to ask you, finally on Garnock, what we
 20 should have learnt from it.

21 Can we start with that question, with page 138
 22 {LBYP20000001/138}, the following page, paragraph 726.
 23 You say this:

24 "Given that Garnock Court's GRP overcladding fell
 25 significantly short of meeting the recommendations for

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1 Class 0, and hence did not even comply with the
2 recommendations of Approved Document B at the time of
3 Garnock Court's overcladding refurbishment, the key
4 issue at Garnock Court was actually one of inadequate
5 adherence to the existence guidance, rather than the
6 existing guidance necessarily being inadequate. It is
7 not clear what accepts were subsequently taken by
8 government — if any — to enhance oversight of adherence
9 to building regulations guidance or to verify that
10 similar oversight had not occurred on other buildings
11 across Britain."

12 Does it follow that, in your view, there was nothing
13 about the circumstances of the Garnock Court fire that
14 suggested that a large-scale test was required?

15 A. The Garnock Court fire itself, that's right, yes,
16 I would agree with that statement. The Garnock Court
17 fire showed that someone had put something on the
18 outside of a building that you should not put on the
19 outside of a building and that everyone knew you
20 shouldn't put on the outside of a building.

21 Q. Right. So was the lesson from Garnock not that there
22 was something wrong with class 0 per se, but there was
23 something wrong with adherence and enforcement of the
24 regulatory system as it stood?

25 A. And/or the competence of those people who were doing

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1 that type of work, yes.

2 Q. Right.

3 You say at paragraph 727:

4 "Rather than eliminating the use of Class 0 for
5 external cladding products, or alternatively more
6 tightly restricting its application to products where
7 the testing methods underpinning a Class 0
8 classification were more technically credible, the
9 Government chose to simply add a new — and potentially
10 lucrative to the recently privatised BRE — alternative
11 route to demonstrating compliance with the
12 recommendations of the Approved Document B; i.e. large
13 scale fire testing to BS 8414."

14 Standing back, and on a full and fair view of what
15 transpired at Garnock Court — namely, as you say,
16 inadequate adherence to the guidance rather than
17 inadequate guidance itself — was elimination of class 0
18 justified?

19 A. Not on the basis of Garnock Court, but on the basis of
20 evidence that was heard during the select committee
21 inquiry, I think certainly some pretty deep thought
22 about reconsidering class 0 would have been appropriate.
23 You know, the evidence given by Dr Bob Moore, for
24 instance, a number of comments made by various people
25 who gave evidence in that inquiry, who were highlighting

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1 concerns around class 0, concerns around the use of
2 small-scale tests for a variety of reasons and, you
3 know, that's the basis upon which I think there was
4 a missed opportunity. It's not that Garnock Court —
5 what's interesting about Garnock Court is that a fire
6 that happened for quite a straightforward and obvious
7 reason precipitated a select committee inquiry that then
8 ended up asking the really important questions. They
9 were unrelated to the fire that had initiated the
10 inquiry, but nonetheless were questions that had been
11 asked and demanded some response, in my view.

12 Q. Yes, thank you.

13 Is it your view that introducing large-scale fire
14 testing as an alternative, a choice, as an alternative
15 way of demonstrating compliance with the functional
16 requirement was not an appropriate response?

17 A. Yes, I think that's — I think it actually made matters
18 worse.

19 Q. Why worse?

20 A. Because it introduced, you know, another way that people
21 who couldn't get through the class 0 route might be able
22 to get through. You know, it opened up opportunities
23 for people to attempt to game the regulatory system
24 which otherwise wouldn't have existed, you know. If all
25 you have is class 0 to try to game, then certain

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1 products would just never be able to do it. But if you
2 have large-scale testing as well, then other products
3 might be able to get through the alternative route.

4 Q. We'll see that shortly, perhaps, with the introduction
5 of the Euroclass regime and the work done around that.
6 Let's go to that, then.

7 You have explained a little bit about the European
8 SBI, single burning item, test. We know that in 2000
9 a decision of the European Commission led to the
10 adoption across Europe of the European reaction to fire
11 system, EN 13501-1, to harmonise methods of
12 classification, and you've covered that in your report
13 at paragraph 600.

14 Am I right in thinking that EN 13501 is a composite
15 classification system?

16 A. That's correct, yes. It depends on a number of tests.

17 Q. There's a number of tests. The single burning item
18 test, which is EN 13823, is one of a number of tests
19 used to classify products or materials under the
20 Euroclass system.

21 A. That's right.

22 Q. You tell us in your report that although the British
23 Standards test methods used to establish national
24 class 0, which is 476-6 and 7, and the SBI test are very
25 different tests, they are nonetheless strongly allied,

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1 or aligned perhaps, conceptually; is that correct?

2 A. Yes. I mean, they are both model tests and they are

3 both — part 6 and 7 are separate tests and SBI is

4 a single test notionally based around a reference

5 scenario of a fire growing in the corner of a room, as

6 we discussed earlier.

7 Q. Yes. In terms of the alignment you referred to, both

8 sets are focused, as you say, I think, on a fire in an

9 internal reference scenario.

10 Can you describe what the differences between the

11 tests are?

12 A. Other than by explaining what the tests are, not really.

13 I mean, if you look at the BS 476—6 test, you know,

14 you have a little plate of material in a little box and

15 you heat it and you measure how much heat comes off it,

16 essentially.

17 In the part 7 test, you have the lateral flame

18 spread, so you've just got a flat sample and you have

19 a heat flux exposure that decreases as you move along

20 the sample, and you ignite a fire at one end and you see

21 how far the fire goes. Quite straightforward.

22 The SBI test is a more complex test, is a model that

23 looks more like, if you like, the model that it's

24 intending to simulate, and captures and kind of mixes

25 a lot of the physics that would be more separately

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1 interrogated in part 6 and 7.

2 So, you know, part 6 is about how much heat is

3 coming off or out of a product; part 7 is about flame

4 spread across a product; SBI is doing both of those

5 things and others in a single test method.

6 Q. What is the significance of the differences?

7 A. Well, the significance of the differences between

8 476—6/7 versus SBI?

9 Q. Yes.

10 A. I mean, they're very different test methods. They're

11 measuring similar things in different ways. I mean, one

12 good example would be that the SBI test uses oxygen

13 consumption calorimetry to measure heat release rates,

14 to calculate the various limits that define the class

15 limits in the Euroclass system. The part 6 test

16 measures temperatures and uses the measure of

17 temperature as a proxy for energy release, rather than

18 measuring energy release directly.

19 So, you know, there's a whole host of differences

20 that, again, are relevant to how one uses the outcomes

21 or thinks about using the outcomes in a real—world

22 application.

23 Q. Dr Debbie Smith of the BRE told us that they were

24 completely different tests, like comparing an apple with

25 an orange; both items of fruit but they are different.

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1 That's what she told us at {Day235/185:7—13}. Would you

2 agree with that characterisation?

3 A. I could go along with that, yes, both fruit but

4 different fruits, sure.

5 Q. Right.

6 A. Yes.

7 Q. Let's then turn to composite panels with combustible

8 cores.

9 Is this right: that there were concerns in 2000,

10 when harmonisation was being considered, about the

11 adequacy of the SBI test adequately to reflect the fire

12 hazards presented by metal—faced polymer—filled core

13 panels?

14 A. There were concerns — I wouldn't be able to date the

15 concerns, I don't think, but there certainly were

16 concerns during the development of the SBI, and

17 subsequently, that the SBI did not do a good job of

18 predicting the outcomes of the scenario tests upon which

19 it was calibrated. So the SBI did not do a very good

20 job of assessing the fire hazards associated with

21 metal—faced foam—core panels, for instance, sandwich

22 panels, yes.

23 Q. Right. Let's look at page 116 {LBYP20000001/116} and

24 see if we can pin this down. On page 116, there is

25 paragraph 607 and 608. At 607 you say this:

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1 "As already noted in Part I, despite the SBI's

2 implementation via the European Directive of 2000, there

3 was disquiet in some quarters because it could not

4 easily classify some products. EN 13501—1

5 classification of 'exotic' composite panels — with

6 combustible cores and external metal skins — was felt by

7 some to be dangerously misleading."

8 You have footnote 386 there, which is a reference to

9 Messerschmidt, 2008.

10 Now, is that a quotation of what

11 Birgitte Messerschmidt said in 2008?

12 A. Use of the word "exotic" is a quotation, yes, and,

13 I mean, that's probably a paraphrase of what she will

14 have said, yes.

15 Q. Right.

16 A. So the 2008 reference is to an event that was actually

17 held in Edinburgh shortly after I moved to the

18 University of Edinburgh, and Messerschmidt gave a talk

19 at a conference that had been organised by the

20 University of Edinburgh, and she set out her concerns as

21 someone who had been involved in the process of

22 developing the SBI test through the preceding decades.

23 Q. Right. Can you recall whether her views were

24 well—respected and shared commonly, or was she regarded

25 as perhaps something of a Cassandra?

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1 A. No. I mean, I certainly respected her and I think
 2 everybody in the room respected her. Whether that's
 3 a representative sample of the community is hard to say.
 4 The only caveat that is probably worth mentioning is
 5 that, at the time, Birgitte Messerschmidt was working
 6 for Rockwool, who are a mineral fibre manufacturer, and
 7 the products that the SBI did not well predict were
 8 polymer foam-cored products, so products that will
 9 likely have been manufactured by her competitors. But
 10 I think she would have been totally open about that;
 11 I don't think she was trying to hide that fact from
 12 anyone.
 13 Q. Are you able to shed any light on, first, whether the
 14 Birgitte Messerschmidt views, if I can put it that way,
 15 as you've described it here, were any part of the
 16 British mainstream in the early noughties and beyond?
 17 A. I think there was a recognition in some parts of the
 18 community that metal-faced sandwich panels in particular
 19 had the potential to cause significant problems in real
 20 fires but, from a regulatory perspective, were able to
 21 achieve classifications that were perhaps more positive
 22 than they might deserve when faced with the reality of
 23 fires, if that's a diplomatic way of putting it.
 24 Q. It's diplomatic to the point perhaps of inviting
 25 a further question: which parts of which community?

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1 A. Well, so, for instance, colleagues at Edinburgh in the
 2 years after 2008 were involved in a research project
 3 where metal-faced foam-cored panels were tested in room
 4 corner tests, so tests with boxes made — room-sized
 5 boxes made of metal-faced sandwich panels. Those
 6 sandwich panels were very slightly damaged, you know,
 7 with a small hole or something in the metal skin, and
 8 the outcomes of those tests were not good. So it didn't
 9 take much of a chink in the armour of the metal-faced
 10 sandwich panel to demonstrate very poor fire behaviour.
 11 And, you know, one can argue, as was argued by the
 12 manufacturers of those products at the time, that that
 13 was not a fair thing to do, because the regulatory tests
 14 that were giving them their very nice ratings said that
 15 they were okay and these tests seemed to indicate that
 16 they weren't.
 17 So — and this is the problem, it's the fundamental
 18 problem when you set up an unthinking, incompetent
 19 regulatory system, is that people will make those
 20 arguments and they will succeed. They will hide behind
 21 a test that allows them to do something that everyone
 22 knows they shouldn't.
 23 MR MILLETT: Mr Chairman, I've come to the end of part of
 24 this topic, but I'm reluctant to start on the next one,
 25 which is the final element of the harmonisation regime,

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1 which is quite long and we will not finish before 4.30.
 2 SIR MARTIN MOORE-BICK: Would it be better to finish there?
 3 MR MILLETT: It would be better to finish there. I am
 4 confident that we will finish Professor Bisby's evidence
 5 at some stage during the morning of Wednesday, given we
 6 are not sitting tomorrow.
 7 SIR MARTIN MOORE-BICK: Right, thank you.
 8 Well, Professor Bisby, it is a little earlier than
 9 usual, but it sounds as though it would be a sensible
 10 point at which to stop. I think you were already
 11 arranging to come back on Wednesday, were you not?
 12 THE WITNESS: Yes.
 13 SIR MARTIN MOORE-BICK: So it sounds, from what Mr Millett
 14 is saying, that you will be away, shall we say, by
 15 lunchtime, or can hope to be away by lunchtime. You can
 16 never quite be sure of these things.
 17 THE WITNESS: Yes.
 18 SIR MARTIN MOORE-BICK: All right. So we will break there,
 19 and we will look forward to seeing you again on
 20 Wednesday. We are not sitting tomorrow, as you know.
 21 I think it is probably right that I should remind you
 22 not to talk to anyone about your evidence or anything
 23 relating to it over the break, since it's a long one.
 24 THE WITNESS: Certainly. Sure.
 25 SIR MARTIN MOORE-BICK: All right? We'll look forward to

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1 seeing you again on Wednesday. 10 o'clock Wednesday
 2 morning.
 3 THE WITNESS: Thank you.
 4 SIR MARTIN MOORE-BICK: Thank you very much.
 5 (Pause)
 6 Well, thank you, Mr Millett. As I indicated
 7 a moment ago, we shall not be sitting tomorrow in
 8 recognition of the fact that tomorrow is the fifth
 9 anniversary of the fire. So we shall resume hearings on
 10 Wednesday morning at 10 o'clock, when Professor Bisby
 11 will be back to answer some more questions.
 12 MR MILLETT: Yes, Mr Chairman, thank you very much. Thank
 13 you.
 14 SIR MARTIN MOORE-BICK: Good, thank you very much.
 15 10 o'clock on Wednesday, please.
 16 (4.27 pm)
 17 (The hearing adjourned until
 18 Wednesday, 15 June 2022 at 10.00 am)
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