

you then get a whole bunch of people to try to find out how they can beat them; and you tie it up quite tight and you run forward. Clearly if you have a risk you have to work out how you're going to deal with that risk if something overruns. And I think that is the point. I understand where HS2 Ltd are coming from in saying 'maybe we need to be a bit conservative'. Personally I would rather see it much more transparent so that you can actually see how you address it. I need to move on.

234. CHAIR: Alright. An hour-and-a-half ago there was some quite extravagant things made about saving money and it not costing the taxpayer anything to do the project. Are we about to get to the point of you explaining how you can do that?

235. MR GRIFFITHS: Yes. So Sean Ring is our expert on this area. I'm not going to ask Sean Ring to go through all of his CV other than to say that I notice that there are a couple of times that very recently he's been working for CH2M Hill so he could just as easily be here as the expert witness for HS2. He is an absolute expert in this field. Sean, are you able to hear?

236. MR RING: I'm struggling to hear, I'm afraid. I have a severe tinnitus problem that is at its worst.

237. SIR PETER BOTTOMLEY: Do both ears work the same or should you change places?

238. MR RING: No, he's on the best side.

239. MR GRIFFITHS: Okay, well we'll see how we go. We have asked Sean to give his answers in writing as well so I know more or less what he's going to say, and if it gets difficult we can have it here. So, Sean, how familiar are you with the fit-out scheme for rail systems and tunnels from Ruislip?

240. MR RING: Well, I've been working with Peter Brett Associates on both the London Borough of Hillingdon petition and also for the Chiltern long tunnel so I've looked at the schedules and I am aware of the proposals to fit out from Victoria Road box and from West Ruislip. And that also involves work on looking at Heathrow Spur. But, more importantly, I've been very aware of changes in the approach and schedules that have come out in correspondence and in the latest schedule in HS2's pack of

evidence.

241. MR GRIFFITHS: Okay. So as an expert in rail fit-out, is it clear what HS2 Ltd are proposing to do?

242. MR RING: No, it's no longer clear because it's difficult to see how various schedules from May, answers in correspondence and the schedule that now appears in the evidence are consistent. There are some discrepancies and confusion in that change of evidence.

243. MR GRIFFITHS: And do you think there are problems with what they're proposing to do?

244. MR RING: If one looked at them at first sight independently, one could foresee a number of possible problems to do with interdependencies. But they don't really have a bearing on the main thrust of the argument that fitting out from the work depot at the south portal at one end is a very simple system and it would produce a much quicker programme.

245. MR GRIFFITHS: Okay. I'm going to ask: how could that work? I'm going to skip the next question so why don't you tell us how that would be done, focusing just on how you would do it, not what HS2 have done.

246. MR RING: Well, when the TBM finishes the boring there are clean-out and preparation works to do. There's generally the drainage and base concrete work to go in. This can either be in the same contract as the civil engineering and the tunnelling work or it could be in a contract with the track and rail systems fit-out. In any event – and HS2 now acknowledge this in their latest schedules – the clearing out of the tunnel would normally, and generally should, follow the removal of the TBM. HS2 now say that the first bore will be cleared out during the two month lag before the second TBM finishes; and one can assume a similar programme for clearing out the second bore. And this will then allow the base concrete and drainage, with or without walkways depending on the track installation method that's to follow, to proceed with road trains that form contract arrangements and precede the track laying. And if this is done from the south portal that site is already nominated by HS2 to be reduced from the tunnelling compound to the track fit-out compound. It's excellently located for handling concrete

and concrete materials because that's the function it has during the tunnelling and therefore both the base concrete and the track laying can be handled very locally without recourse to the haulage from West Ruislip, and therefore the risks by using a longer run and dependency on other work site completion are eliminated.

247. HS2's latest schedule, the one in their evidence, reflects that in that they are now showing track fit-out of one bore completely and half of the second bore entirely from the south portal. And they have overlapping work in both bores for one quarter and then subsequently overlapping work in one bore for the finishing of the track laying and then a second bore for the start of the follow-up fit-out.

248. So the stages involved in laying the track and then following on with the other systems fit-out are already demonstrated, and in actual fact when a project is able to organise the logistics and develop effective programmes some fit-out work can precede the track lying: fixing of brackets, fixing of pipe work, fixing of light electrical components, the delivery using vent shafts of smaller components. So the fit-out does not have to be entirely a follow-on sequence to the track laying.

249. Possibly the only area where dependency on Ruislip might make sense is the actual catenary wiring. It's a quick process, it uses a specialist train and it would be probably logical to wire all the tunnels from one depot. But that's fairly late in the day and so it doesn't have to follow a series sequence; there is the potential for concurrent working which is now reflected in the most recent correspondence and schedules from HS2.

250. MR GRIFFITHS: Okay, Sean, I think you've covered quite well some of the things in some of the other questions that we've got here so I'm going to move forward a little bit. Now, the draft environmental statement gave the fit-out duration of 1.75 years for the Chiltern tunnel whereas the ES gave 2.5 years. Is the increase reasonable?

251. MR RING: No, unless it's based upon the dependencies of other work sites and other schedules, particularly basing it from one construction depot. And I noticed in HS2 documentation a number of the compounds and the satellite compounds have up to a year of suspension of operation between the civil engineering works and the track installation and rail system fit-out. So there are some delays and dependencies built into

the current programme, but if you isolate the work from one end and remove those dependencies there is no reason why the programme should be extended.

252. MR GRIFFITHS: Okay. Again I'm going to fast-forward a little bit. I'm going to ask if we can go back to the schedule slide. It's three back I think. No, I'm sorry, I've taken you too far. One forward. Okay. Now, Sean, you've explained in some detail – and we have more detail – on how it could be done, but the case that we have in G and the fit-out of that, that is basically where you came to in terms of your approach to this as to what could be achievable.

253. MR RING: Yes.

254. MR GRIFFITHS: You have made the point to me – the same point that Sir Peter raised – that if we went for that then we probably haven't left a lot of float to be able to catch up if something goes wrong. But if you could just explain for the Select Committee whether you think what is in there is reasonable.

255. MR RING: Well, yes, it is reasonable and it's certainly what I would expect the contractor to achieve, if not better than that. As Sir Peter said, it's not realistic to make your sharpest possible programme your draft programme at a planning stage. There's very wide range between the rates of fit-out in the different HS2 documents and they range for the track fit-out, for example, from five to seven metres a day which is an exceptionally low rate of progress. That's achieved by hand-building of switch and crossing and specialist work to 36 metres a day elsewhere in their figures; whereas contractors regularly achieve an average of 100 metres a day on this type of project and achieve up to 300 metres a day at their peak performance. So when you look at that programme there, which is still based upon quite conservative rates of progress, it is quite clearly achievable as long as the contractor has control of the constraints and the logistics to be able to deliver that.

256. MR HENDRICK: Can I ask, yesterday it was described as prudent by the proposer.

257. MR RING: Sorry?

258. MR HENDRICK: Yesterday it was described as prudent by the proposers and the

scheme as proposed was seen as pessimistic, but that was the difference between 100 and 80 metres. You're proposing 120 metres.

259. MR GRIFFITHS: We're looking here at the out-fitting. The 80 / 100 / 120 are tunnel boring rates and we'll be coming to that.

260. MR HENDRICK: But I'm coming to that as well because obviously the fitting in the tunnels obviously is all part of the same programme and you're going to get a total at the end as to how long the programme is going to take.

261. MR GRIFFITHS: Yes.

262. MR HENDRICK: So if yesterday they were saying that HS2 were pessimistic, are you saying that they're going out of their way to slow this down as much as possible? What's the point you're making?

263. MR GRIFFITHS: I think I need to take that. They're not going out of their way to try and slow it down; it's the ramifications of developing a project schedule and finding the best way to do it.

264. MR HENDRICK: But are you saying they're not capable of coming up with a scheme as fast as the one you're proposing?

265. MR GRIFFITHS: No, I think they're perfectly capable of coming up with a scheme as fast as this. I don't think they've done that yet; I don't think that is what is represented in the schedules that they have provided. I think that they have got, as in case B, some time in the middle and we've struggled to find out what it is. There's a period of time there and I think in three different versions, sometimes it's install slab track, sometimes it's clear the tunnel. So we've struggled there. But I think the evidence that Sean has put forward, dealing with the out-fitting, is that it could be done as per G. It may be prudent to make it a little bit longer. To prove our case, if you like, it needs to be as it is in E which is very relaxed compared to what Sean has been presenting.

266. And I would say again that I'm embarrassed that we're here with this because we all agree that it could be done from both ends and then that's an issue of a bit of cost and a bit of disruption. My personal view is that whilst HS2 Ltd might not want to commit to doing it from one end – they may want the ability and the right to do it from both ends

– when it actually comes to it they will in all probability be doing it from one end from the south. So we should have been able to settle this rather than coming here.

267. CHAIR: I'm not sure how much detail we need to go in. Essentially Mr Ring is someone who has a lot of experience with the industry. His view is that it could be done on schedule and with a saving – I think we just take that on board.

268. SIR PETER BOTTOMLEY: Can I repeat that? The Chairman was saying we may not need too much detail. You, with your expertise, are saying what you professionally believe could be done.

269. MR RING: Yes.

270. MR GRIFFITHS: Okay, well thank you, Sean.

271. CHAIR: I hope the hearing gets better. Mr Mould, do you want to ask any questions before he goes?

272. MR MOULD QC (DfT): No.

273. CHAIR: Okay, right.

274. MR GRIFFITHS: I'm now going to ask Rodney Craig to join us, and Rodney is our expert for the tunnelling and this is where the 80 / 120 will come in. Now, Rodney, I believe you briefly gave evidence to the Committee yesterday.

275. MR CRAIG: Yes, I did.

276. CHAIR: Can we all make sure we speak up please?

277. MR CRAIG: Yes, I will try to. Yes.

278. MR GRIFFITHS: Rodney, we can see from this slide that you have a lot of experience with this. You're a recognised figure. Can I just ask, in 2004 you got the James Clark medal. What was that given for?

279. MR CRAIG: It was given for work I did for the tunnelling industry.

280. MR GRIFFITHS: And I think your membership status is somewhat unique, isn't

it?

281. MR CRAIG: When I retired from the committee after 20 odd years I was given honorary membership of the BTS.

282. MR GRIFFITHS: Okay, if we can move to the next slide. This slide frames the problem. HS2 Ltd have assumed 80 metres per week average across most of what they've done. The REPA work proposes a central case of 120 and two other cases. I don't know whether we've agreed a common historical database or not. We thought we had but we don't want to claim that if HS2 Ltd say not, but there's a pretty obvious group of tunnels we should be looking at for comparison.

283. MR CRAIG: If I can just make one comment. Mr Smart in his evidence on 20 October talked about 100 metres a week in clay and 80 metres a week in sands and gravels but there was no rate of progress quoted for chalk. But they seem now to have come down to 80 metres a week across the board.

284. MR GRIFFITHS: Okay. If we move forward please.

285. MR CLIFTON-BROWN: Can I just, Mr Craig, doesn't that vary according to what machine they use?

286. MR CRAIG: Yes, it will do but it also varies with the ground. But we will show later that in fact 80 is still very low.

287. MR GRIFFITHS: Okay, this debate about realistic rates and putting slack in and what have you – there's a number of reasons to use realistic rates for the rest of the planning purposes – but in particular, Rodney, why is it important not to have conservative planning rates particularly with regard to support system design criteria?

288. MR CRAIG: Well, you've got to make sure that you cover the peak rate of progress as well as the average; and the peak will probably be three times the average in broad terms. Two or three times. So you've got to make sure that the casting of the rings is well advanced when you start tunnelling so that you –

289. SIR PETER BOTTOMLEY: Keep up.

290. MR CRAIG: – don't run out. And the removal of the spoil, you've got to make

sure that either the conveyor belt is big enough or the pumping system or a number of trains is sufficient to take the peak progress.

291. MR GRIFFITHS: Okay. Thank you. If we can move forward. This slide just covers the areas that you're going to be providing evidence on so we'll move straight forward. If I start with this one. Now, what this slide shows us is the red line is the HS2 assumption; the green 120 line is the REPA assumption. Plotted on here are all the tunnels under the four categories that we have said are potentially comparators. But, Rodney, you have recommended that we should remove the really short tunnels and also those that are not in chalk. And why do you recommend that we do that?

292. MR CRAIG: Well, sorry, if we can just come back to that one. The ones on the right there, the diamonds are the Channel Tunnel that was in chalk. But it was 25 years ago. The Crossrail ones are down at the blue diamonds. And then Channel Tunnel rail link, or what is now called HS1, are the orange and the Thames Water Beckton to Abbey Mills is the red diamonds.

293. MR GRIFFITHS: Okay. But you've suggested that for comparator purposes we should remove the really short ones and also those ones that aren't in chalk. If we move to the next slide, this is the effect of doing that apart from we haven't actually removed the really short ones; we've left them in simply because if we didn't there would only be one dot on that graph that would be anywhere near 80. And all of the rest of them are up and around the 120 mark. So it seems we're pretty sure that HS2 will want to make a case for those short tunnels so we've left it on the slide there. Now, Rodney, do you think that the fact that the Channel Tunnel have a faster average rate is due to them being longer tunnels because they were in a chalk marl rather than a chalk – it's not just one type of chalk – or possibly because they were well planned and executed?

294. MR CRAIG: I think it's a mixture of various reasons. They did have problems on the Channel Tunnel about three or four kilometres in that they hit a wet patch. And they recovered that because they went much faster towards the end of the drives. There was a service tunnel first of all so they knew the ground when the two running tunnels came through, so that's helped, and they were able to do any treatment ahead of the tunnel if it was required. And the logistics employed were planned for the peak rate and therefore they were able to get some quite high rate of progress.

295. MR GRIFFITHS: HS2 Ltd are at 80; REPA are at 120. I mean, you really believe that the 120 is a reasonable rate?

296. MR CRAIG: I think it's a realistic rate to plan for. And that is the rate from day one to the end of the drive and allows for driving through shafts and for maintenance of the TBM, etc.

297. MR GRIFFITHS: Okay, if we move forward one slide please.

298. MR CRAIG: It's been commented that in fact Mr Smart in his evidence on 20 October had a slide which gave the impression that the longer the drive the slower the rate of progress. Well, on the Channel Tunnel there you'll see that in fact the rate of progress increased as the drive went on. And, in fact, it started off on programme and it ended on programme but it was away from programme during the course of the drive.

299. SIR PETER BOTTOMLEY: Well, did it end on programme because that was planned or is it events?

300. MR HENDRICK: It slowed down near the end.

301. SIR PETER BOTTOMLEY: No, but did it slow down on purpose or was it more difficult?

302. MR CRAIG: Well, I think the next slide shows it didn't really slow down at the end.

303. MR GRIFFITHS: Yeah, I think they've recovered so they speeded up ahead of the planned rate because they had the systems there to be able to do that.

304. SIR PETER BOTTOMLEY: And was the meeting point closer to France because of different geology?

305. MR CRAIG: The meeting point, because it was a project that was done from two ends, changed on the service tunnel towards France because the English one was going faster than the French. But on the other two again the meeting point changed depending on which machine was going faster at the time.

306. SIR PETER BOTTOMLEY: And was that speed normally determined by the

conditions that they were going through?

307. MR CRAIG: The French definitely had a lot more water, yes.

308. SIR PETER BOTTOMLEY: And water can slow you down?

309. MR CRAIG: Sorry?

310. SIR PETER BOTTOMLEY: And water can slow you down?

311. MR CRAIG: It can do, yes.

312. SIR PETER BOTTOMLEY: And just as a matter of interest, are we going through watery chalk?

313. MR CRAIG: We will be going through watery chalk. The two slides on the right show the monthly progresses of the tunnel drives for the north tunnel and for the south tunnel which show that there was the learning curve at the beginning of the drive. There were a few problems occasionally for various things but generally if you look at those they show an increase in drive speed with increase in length.

314. SIR PETER BOTTOMLEY: Coming back to HS2 were not proposing a very long tunnel in these terms. How long is the Channel Tunnel?

315. MR CRAIG: Well, the particular drives in question here were 15 to 21 kilometres in length.

316. MR GRIFFITHS: The REPA tunnel is 17.1. So these are the representative tunnels.

317. SIR PETER BOTTOMLEY: So unless you think you're going to earn a second James Clark medal by having a tunnelling machine that will start at full pace and go off like a rocket, we have to assume you're going to have the same kind of gain as you start.

318. MR CRAIG: Yes.

319. SIR PETER BOTTOMLEY: So you go more slowly at the beginning?

320. MR CRAIG: Yes, because there is the learning curve: the men have got to learn

the machine and how the machine acts in the ground that they're working with.

321. MR GRIFFITHS: This is why sensibly you need to exclude the really short tunnels.

322. SIR PETER BOTTOMLEY: It's also why sensibly you ought to exclude the second half of each of the tunnels you're showing us, because you aren't going that far.

323. MR CRAIG: Yes, the rate of progress could be slightly less. Yes. But that argument hasn't been put forward yet.

324. SIR PETER BOTTOMLEY: I've just aired it.

325. MR GRIFFITHS: Okay, let's move forward. HS2 Ltd, we met with them on 26 June and they said that they had allowed a month to go through shafts and the Channel Tunnel wasn't relevant because it didn't have shafts. Now, Rodney wrote a paper on this in 2004 and, Rodney, could you just tell us a little bit about the issue with shafts? Sorry, we're on the previous one. I've confused you.

326. MR CRAIG: Yes, although I have a few grey hairs I'm still active in the industry and I do visit sites and write articles. And I wrote in 1994 a supplement on the Channel Tunnel rail link and in that I showed or gave details of each drive, when it arrived at a shaft and when it left.

327. SIR PETER BOTTOMLEY: Can I, Mr Griffiths, suggest that we accept this because I think that when you start going onto page 44 we can get a summary of the things that matter. I don't want to cut things out but there's some detail.

328. MR GRIFFITHS: That's fine. I think all we're trying to do is to make sure that we haven't just come up with a number. I think probably then we will move to 44. The staggered starts issue, it's not a huge thing but it is in there. Okay, so this is the summary of what we've gone through here. And basically we're proposing the 120. And I'm just going to ask again so there's no doubt whether, Rodney, you believe that using 120 by REPA is a reasonable assumption.

329. MR CRAIG: Yes, I think it is. Yes. And we only need 105 to actually finish at the same time as the existing tunnel.

330. MR GRIFFITHS: Okay. Thank you, Rodney. Okay, just to summarise then where we are on the schedule. You've heard the two components of it. HS2 Ltd say it can't be done; we say it can and it's basically based on the 1.7 years for the fit-out and 3.2 for the tunnel boring. So we have this fall back fit-out from both ends. We do not want that to be HS2 Ltd's best case but we could understand if they wanted to make provision as a fall back to be able to do that. So I could take us back to the schedule slide but I think we've probably over-laboured the point already so we'll move on.

331. Okay, I'm not going to go through this slide in detail. This is on your aide memoir. We're now getting to the cost dispute. This frames the differences. We're going to be talking about those that are highlighted in the brown colour. It's basically the bore tunnels and the cuttings where most of the difference occurs.

332. So if we move on, basically the way REPA have done this is they've worked from HS2 Ltd's annex A of the 2012 cost and risk report. The approach that they've taken is based on that. Now, from HS2's perspective they have what they have given us at this time as one level of costs. They've then issued the tunnel guide which is a little bit below, and we're going to explain why we believe the tunnel guide costs are significantly above what should be achievable and what would have been consistent with the 2012 figures. So we've got five areas of evidence to do this.

333. SIR PETER BOTTOMLEY: Just going back to your 46, we need to compare the HS2 15 July with REPA 19 July amended?

334. MS WHARF: Yes.

335. SIR PETER BOTTOMLEY: Thank you.

336. MR GRIFFITHS: Okay. So if we move forward. This comes from the Infrastructure UK report that was done in 2010 to compare the overall costs of UK tunnels with European tunnels. And they concluded that they were sort of more or less the same. Now, for the purposes they were using that's probably okay, but as you can imagine there was a real mix of tunnels in there. Different ground conditions, different lengths, different tunnelling methodologies. HS2 Ltd have said, in documents, this is one of the key sources for information that they've used from this study, and in fact when they completed the tunnel guide they plotted their example tunnel on this graph,

and that's shown there with the blue highlighting. And I'm going to ask Rodney a number of questions on this. Rodney, are you – you're familiar with the tunnels in this database?

337. MR CRAIG: Yes, I am. Can I just make the comment that in fact I was handed a copy of this drawing this morning from HS2, so I suspect they're going to ask me question on it. So perhaps it is relevant.

338. MR GRIFFITHS: You are familiar with the data?

339. MR CRAIG: Yes. I know the data. There are a few points on the graph that in fact I haven't been able to find the tunnel, and I think they're probably bogus ones that they could be – that the black ones should be red ones, rather than vice-versa, but that's a minor point. But some of the tunnels are shorter – in fact most of them – in fact, they're all shorter, and some of the bigger ones which are relevant as far as HS2 is concerned weren't constructed with a TBM; they were either roadheader by spray – by some other type of machine.

340. MR GRIFFITHS: Okay. If we move to the next slide. Now, given that – Rodney's assistance, we've developed four comparator tunnels, and these are they. And in order to do the cost analysis I might just mention that Bruce Weston has been doing the cost work for REPA on all of this. So although we've brought in, with Rodney and Sean, experts and asked them what we should be doing, it's actually Bruce that's actually done the cost information.

341. So what we have done with these comparator tunnels, we've taken the costs per metre. We have adjusted those costs to make them as if they were the same outside diameter as the Chilterns tunnel. We have to do that, and Rodney, you told us how to do that with the 1.4 factor.

342. MR CRAIG: Yes, I have a rule of thumb that the cost of a tunnel goes up by a factor – not by square of the diameter but by roughly 1.4.

343. SIR PETER BOTTOMLEY: Just a reminder, are we talking about twin tunnels or are we talking about –

344. MR CRAIG: This is particularly relevant, as in fact the data that has been used in

fact for twin tunnels, but because you divide the cost of a tunnel by the total length – divide it by the total length, i.e. the Channel Tunnel Rail Link longest tunnel was down as 15 km in length, when it was actually on seven and a half, because they were twin tunnels, and that’s – it’s relevant to this.

345. MR GRIFFITHS: If I can just say there, there are issues with this data. The Infrastructure UK work was done on single tunnels, so the adjusted cost is the single tunnel; we have doubled it for the route cost, and to the best of our knowledge there are no problems with the four tunnels that we’ve got here in terms of data.

346. So the average that comes out of this comparator is the 20.1. The tunnel guide figure, if you work through that, you come to 33.1. So we believe that we’re looking at a 64% increase. The average for two that comes from this is the 40.2, and REPA have used 42.5. So they’ve used higher figure than has come out of this comparator exercise, and it is consistent with the HS2 Ltd Appendix A figure, which was for a 7.25 ID tunnel, that again has been adjusted to get to the figure that REPA has used.

347. SIR PETER BOTTOMLEY: Translate ‘ID’ again for those who are listening.

348. MR GRIFFITHS: It’s internal diameter. Basically, the internal diameter is what you’re left with, the outside diameter have to create to put it in.

349. SIR PETER BOTTOMLEY: Have to bore.

350. MR GRIFFITHS: And Bruce has done this work of doing the comparator. So Rodney, shall we move on?

351. MR CRAIG: Yes.

352. MR GRIFFITHS: If we go to the next slide. Why don’t you just tell us?

353. MR CRAIG: The one at the bottom there is the one that Mr Smart put out on 20 October last year, which shows – what he suggested was that the cost goes up with length. There is no scale on it so it’s a bit difficult to tell, but presumably each of those shafts are at 3 km lengths. So he says – if you look at the slope of the lines it goes up after each shaft. So that gives impression that in fact the rate of progress goes down because the cost has gone up.

354. MR GRIFFITHS: And that contrast –

355. MR CRAIG: The top one is from the Treasury report, which plots all those tunnels and gives a declining slope on the thing, giving the impression that in fact the cost goes down the longer the tunnel. However, if you take that – a tunnel at 15 km long, it is in fact only 7.5 km long. So some of these figures need to be brought back into the lower or middle part of the graph.

356. MR GRIFFITHS: Okay, thank you. Right, if we move on. Now, REPA have used the marginal rate for the extension, which basically means all the fixed costs are already there. They made an assumption of 80% variable cost versus 20% fixed. This has been confirmed in an FOI which I haven't personally seen, but it's from HS2 Ltd that confirmed that figure. So we believe that this is a pretty sound assumption. And in fact I think it's consistent with the tunnel guide, isn't it?

357. MR CRAIG: Yes, it is, yes

358. MR GRIFFITHS: So if we move on. Now, if you go faster you do save money. It may not be as much as some people think. I think, Rodney, this is the area yesterday where you gave evidence to the Select Committee.

359. MR CRAIG: Yes, Mr Hendrick asked that question yesterday about if you go faster how does it affect the costs, and I said the costs – with the 20% increase in progress you reduce the costs by about 5%. And if you use the HS2 guide the figure comes out very similar to it.

360. MR GRIFFITHS: Okay, thank you. If we move to –

361. SIR PETER BOTTOMLEY: Essentially you save more time than cost.

362. MR CRAIG: Yes.

363. MR GRIFFITHS: Okay, so if we just sum up, then, on the tunnel costs, our position is that the tunnel cost guides are not representative; they're above what the benchmark shows. We believe HS2 Ltd have used an even higher cost, but it is quite complex and there is some confusion in that. I really think the summary – you can read that as well as I can go through it. Okay, Rodney, thank you very much.

364. CHAIR: Mr Mould, do you have any questions you wish to ask?

365. MR STRACHAN QC (DfT): Can I just ask Mr Craig, very quickly, two questions about the information?

366. CHAIR: Okay.

367. MR STRACHAN QC (DfT): The first is – can we just put up on the screen P7533(1), which is the –

368. SIR PETER BOTTOMLEY: If you want to ask the question directly –

369. MR STRACHAN QC (DfT): I'll just get it put up on screen. Which is the Appendix G of the benchmarking for tunnels.

370. MR CRAIG: Yes, I've got that –

371. MR STRACHAN QC (DfT): And, Mr Craig, this is the document that you've included in your – an extract from – in your slide we've just been looking at. Hoping it's coming up on the screen. P7533(1).

372. CHAIR: Carry on, Mr Strachan.

373. MR STRACHAN QC (DfT): I'll try and make progress, if it comes up on screen – in front of the graphs that you've quoted from, on the benchmarking studies, there's an explanation in text. And it reads as follows, paragraph G.8: 'There are a number of reasons why a range of results exists, including ground conditions, tunnelling method and lining type.' And: 'The all-in rate for tunnelling also depends on tunnel length, and this is explored further below.' And the table you've put in is explained, that: 'The BTS study explored the influence of tunnel length on its cost, and the figure below is taken from the report. Whilst there is a large scatter in the results, a slight trend of reducing unit cost with the length of tunnel can be seen.' So that's the extent of what they're identifying. A slight trend, but a large scatter of results.

374. MR CRAIG: Yes, but I did make comment that those figures aren't correct because they've been taken out of the BTS report. And that gives a length of 15 km for that one there. But it's two tunnels of 7.5.

375. MR STRACHAN QC (DfT): There's no difference, I don't think, between you and Mr Smart, that what is important is to compare, for example, ground conditions and tunnelling methods, both in establishing boring rates and indeed costs.

376. MR CRAIG: Yes.

377. MR STRACHAN QC (DfT): And linked to the same study you – for the purposes of your costs of comparator tunnels on slide A1238(49), if we just show that, you put in costs of tunnels UK 1, UK 3, UK 4, UK 8.

378. MR CRAIG: Yes.

379. MR STRACHAN QC (DfT): And you took that from the Infrastructure UK tunnelling cost study.

380. MR CRAIG: Yes.

381. MR STRACHAN QC (DfT): And that document, which I don't think you've included, but it does have a number of UK tunnels.

382. MR CRAIG: Yes, it does.

383. MR STRACHAN QC (DfT): And we've got the data if you want; it's P7535(13). The only tunnel there which is equivalent to the type that we're proposing, which is in chalk with a slurry machine, is one haven't included in your comparator costs: UK 2.

384. MR CRAIG: Yes, well that – UK 2 is a slightly odd – sorry, UK 2 is the Thames Crossing contract C20 of the Channel Tunnel Rail Link, and it was – two thirds of tunnel was in fact cut and cover, and so there isn't a definitive cost for the actual tunnelling part of it, as far as I'm aware.

385. MR STRACHAN QC (DfT): Well, I've got P7535(13), if we can find that. It does give the UK tunnel cost –

386. MR CRAIG: It gives the costs, but that is very similar to the contract cost, and so I think that probably it includes cut and cover as well. So it's not –

387. MR STRACHAN QC (DfT): Alright, well Mr Smart can respond to that. If it's relevant, it's relevant because it's using a slurry machine, which is a type necessary for

use. In this, none of the other ones that you included were for slurry machines, were they?

388. MR CRAIG: No, but that was the reason that it wasn't included, that in fact it is predominantly cut and cover. And anyway, the actual length is only about 3 km so you can't –

389. MR STRACHAN QC (DfT): I understand on length that we've looked at the bit that said there's a slight trend to do with length, I've looked at that bit. But if we can turn it – just turn the – if we could turn the cost of such a tunnel –

390. SIR PETER BOTTOMLEY: We've been trying to for a time.

391. CHAIR: We're going to have to lie on our side.

392. MR STRACHAN QC (DfT): Can you just rotate it clockwise? You can't rotate.

393. CHAIR: Okay.

394. MR STRACHAN QC (DfT): The hard copies are – well, I think what we'll do – no doubt you can agree this with Mr Smart, I think, but perhaps we can check the figures, but the short point, Mr Craig, is that if one takes UK tunnel 2 costs it actually comes out – and you make the same adjustment that you did for the tunnel diameter – because it's a smaller diameter – if you make the same adjustment for our tunnel it actually comes out at 95,000 –

395. SIR PETER BOTTOMLEY: We're in business.

396. MR STRACHAN QC (DfT): So, if you look at UK tunnel 2, it's a bored TBM. Look at the fourth line across. Tunnelling method: 'Bored TBM slurry'. That's the only equivalent tunnelling method that cost – in those documents, to the one we've got.

397. MR CRAIG: To this, yes.

398. MR STRACHAN QC (DfT): And we go across, we can see it's 8.15, so you have to scale it for the – that's the internal diameter. You have to scale it up by the same figure you did. We're told that lining type is pre-cast concrete tunnel segments manufactured in – that's the same as us. And the ground conditions are chalk, which is

the same as us. Carry on across to the right, if you just pull this screen across to the right, if you get to the headline figure you can see it's a lot more expensive cost per kilometre: 38,954. And if you adjust that by the 1.25 figure you adjusted it for the 1.25 diameter adjustment it comes out at 47,500 per kilometre, and you double that up because it's only measuring the costs of one bore – we can see that from the cubic metres – the costs per kilometre are 95,000 per kilometre, aren't they?

399. MR CRAIG: Yes.

400. MR STRACHAN QC (DfT): And in fact that is a figure which is considerably higher than the one that we've used in our tunnelling guide, which is 66,000.

401. MR GRIFFITHS: I'm just wondering, Rodney, do you want to respond to that? Mr Chairman, do you want us to continue with this dialogue or find some other place to – this is one tunnel, and do we continue?

402. SIR PETER BOTTOMLEY: The simple thing in front of us is that it's agreed there's going to be a slurry tunnel through here. We have in front of us two examples of slurry tunnels: UK 2 and European 3, both of which have costs significantly higher than the other tunnels on this schedule. I think it might be sensible if the Chairman said, 'Why don't we have a break for two or three minutes' and then decide whether the Promoter's in the position of wanting to go on in front of us, or whether we can accept that when Mr Smart comes there's opportunities for the petitioners to ask him questions, and that might be a way forward.

403. MR STRACHAN QC (DfT): If it helps for that process, I don't have any further questions at this stage and I was going to let Mr Smart pick up on –

404. CHAIR: Yeah, we'll let Mr Smart pick up on – I think we've had a good run around this, and clearly there are some issues. Mr Griffiths, do you want to ask – any re-direct questions for Mr Craig?

405. MR GRIFFITHS: I think it's really a case of whether we rebut this now, because we will be rebutting it, or whether we rebut by virtue of questioning of Mr Smart. I think that's what it comes down to.

406. CHAIR: Well, do you want to ask the question of Mr Craig now, does he rebut

this?

407. MR GRIFFITHS: I wish that we could go to the costs of the Channel Tunnel tunnels, and clearly we can't because they haven't been able to be brought forward to this point. I think the question is REPA have used HS2 Ltd's 2012 cost and risk report, Annex A. That's what they're based on. Their case is that this evidence would appear to support that. Within this database, Rodney has found a whole series of things that have been a bit anomalous. As he's explained on this one, the fact that part of it's cut and cover. So I don't know, Rodney, do you want to come back on this point?

408. MR CRAIG: If I could just come back on one thing: on that table the total cost of tunnelling it said, including shafts and features, is £165 million. Well, the tender price was in fact £128 million, and I've written down somewhere – I'll have to find it – that about half to two thirds of the cost was in fact in the cut and cover. So that would show that in fact the figure quoted is a bit high. But I don't know whether we're going to be able to get anywhere because we've got to find someone who knows about the project. But the project did finish on time and on programme.

409. CHAIR: Okay. Well, thank you very much, Mr Craig.

410. MR CRAIG: Thank you.

411. CHAIR: We're going to adjourn for five minutes before your next witness. Order, order.

*Sitting suspended*

*On resuming—*

412. CHAIR: Order, order. Welcome, Mr Craig. Are you still in charge, Mr Griffiths?

413. MR GRIFFITHS: I guess so. You're in charge, Mr Chairman. Okay, if we move then to slide 54. I'm really going to hand over to Chris now. He's going to take us through his CV and take us through this part of the presentation.

414. MR BRIDGER: Just about good afternoon, gentlemen. My name is Chris Bridger. I spent 40 years as contractor, so I suppose I should apologise in advance,