



Welsh Affairs Committee

Oral evidence: [the future of nuclear power in Wales](#), HC 699

Monday 11 April 2016

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Written evidence from witnesses:

- [Professor Wade Allison](#)

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Members present: David T.C. Davies (Chair); Chris Davies; Dr James Davies; Gerald Jones; Liz Saville Roberts

Questions 109 – 141

Examination of Witness

Witness: **Professor Wade Allison**, Emeritus Professor of Physics, University of Oxford, gave evidence.

Q109 Chair: Good afternoon, Professor Allison. May I begin with an apology? Obviously, when we arranged this a couple of weeks ago, we had not realised that there were going to be certain statements today that were a matter of great interest to many Members. I apologise for the delay.

Professor Allison: I understand that it was due to activities elsewhere.

Q110 Chair: You have come at an eventful time. Thank you also for the book that you sent to the Committee, which we will make available for the Committee to use.

Professor Allison: My previous book is also relevant—perhaps I can leave it with the Clerk. You might like to have a look at it.

Q111 Chair: Obviously, this is a fairly friendly information-gathering session, so feel free to add anything if you wish. We have about 45 minutes, so I may have to hurry things along if I think we are getting behind. May I begin by asking what advantages you think nuclear power has over other energy sources?

Professor Allison: Well, it does not involve carbon at all, and it is dense. I do not know how many windmills you would need to run electric furnaces for Port Talbot if it takes on melting down steel. You need dense sources of energy that will run round the clock; otherwise, we cannot do the things we need to do. Nuclear is about the only answer to that. I am not against wind power in the right places, or solar power in the right places, but nuclear is unique. It is also unique because people do not understand how beneficial it is.

Q112 Chair: We will come on to safety in a minute, but to set the scene, a typical nuclear power station would probably generate about 1,000 MW of electricity—the newer ones may generate more, but for round figures that is not an unreasonable supposition—and they can be on for about 80% of the time, so they are 80% efficient. Some would argue about this, but you are nodding, so I will suggest that that is reasonable. In terms of how much space they take up, do you know how they compare with a wind farm or a solar farm?

Professor Allison: It is very interesting, because the Americans, who have plenty of land to use, state that you need a very large space to put in a nuclear power station, but I have been round a 1,000 MW nuclear power station in Switzerland that I think I am right in saying was on 14 hectares of land, with one cooling tower, and which used water from a river. It did not seem to me that its footprint was significantly large at all.

Q113 Chair: I am afraid I think in acres, but I think that is about 42 acres. I wonder how many wind farms you get on 42 acres of land.

Professor Allison: Yes, you cannot have the turbines that close together because they need to be separated, but I am not an expert on that.

Chair: Thank you very much indeed for that.

Q114 Dr James Davies: Do you feel that nuclear power should form a large proportion of UK electricity generation, or should it be in addition to renewables or other sources of power?

Professor Allison: Yes, I think it should be a very large proportion. In fact, I think, in simple terms, it should replace coal. In windy places and sunny places where there is not the need for an enormous amount of electricity—in Cornwall, or the north-west of Scotland or something—renewables are obviously extremely valuable, and I am not against them, but for somewhere like Port Talbot or conurbations we need nuclear power. Although I have not had this conversation with all the people I should have it with, I do not understand why it is really necessary for them to be spaced round the coast in remote places. We just recently lost a coal-fired power station at Didcot, and I would have thought that was a very good place to put a nuclear power station, but I have only had that conversation with one person, I will admit.

Q115 Liz Saville Roberts: We have been led to understand that the costs in the nuclear sector of reflecting safety requirements are an issue in large developments. You have suggested that it is possible to cut back on some safety measures, and that in itself could reduce some of the costs. Could you quantify that? What degree of costs could be reduced? Also, what areas of safety would you consider it possible to address?

Professor Allison: I wish I could answer your question more fully, but I have discussions with people working at Sellafield, and I have said, “How much of your time do you spend checking in and checking out, and doing things to do with safety, rather than getting on with your work?” and the answer seemed quite a significant amount, so the whole business of working practices on nuclear projects and exposing workers to minuscule amounts of radiation—all of this must feed into the cost. I am not an engineer, in the sense of having built a nuclear power station, so I cannot turn this into the number that you and I would like to hear, but it must be tens of percentage points on the cost—30% or maybe even 50%, depending on how far we are prepared to go on changing the safety philosophy.

Q116 Chair: If I can play devil’s advocate with you, the brunt of the cost is in the building of the power station, not in the staff salaries, so even if staff spend quite a lot of time checking in and out and doing paperwork on safety, that is still likely to be a fairly small percentage of the overall cost of building and developing a nuclear power plant, is it not?

Professor Allison: Yes, but an awful lot of the building is concrete, and an awful lot of the concrete is there for safety. Again, I can’t begin to do the engineering of what could be saved there. If I can make a slightly different point, when one is considering nuclear safety, rather like the safety of a car, there are two separate things. One is the safety of the nuclear power station itself: like the car, it should not destroy itself and write itself off. The other is the effect on human beings, and it is the effect on human beings that I think has been grossly over-egged.

Q117 Chair: If I can pursue that a bit further, in your written evidence you talked about—I’m no expert—200 mSv. I’m looking at Dr James, because he might be the only other person here who understands what impact that would have on human health. You suggested in your written evidence that the amount of radiation that a worker in a nuclear power station gets is only a fraction of what they would get if they had an X-ray. Is that correct?

Professor Allison: That is certainly true. I have got my submission here. An X-ray for a tooth or something is very small. A CT scan, for instance—that is quite a big scan—is about 10 mSv. That is typically 100 or 1,000 times smaller than what the public accepts if they have radiotherapy. What you get from a safety point of view is often 1,000 times smaller than the scan. There are very many powers of 10 involved, which is why you do not really have to go into the minutiae of the question to get sensible answers.

Q118 Chair: Obviously, you wouldn’t get a CAT scan every day.

Professor Allison: No.

Q119 Chair: You wouldn't want people to be exposed to those sorts of levels of radiation on a daily basis.

Professor Allison: Oh, no; that's right. What one has to do is to look at the radiation per month, for example. I have suggested in this book that, on medical grounds, an exposure per month is a sensible thing to be looking at. This business of adding up all the radiation that you have ever had in your life makes no biological sense.

Q120 Chair: I understood that principle in your written evidence, but even so, it seemed to me that there is no reason to take any chance here. I could not really understand why the costs of protecting somebody from any radiation at all would be that much greater than allowing them to have only small doses of radiation. I guess you either stop the radiation leaking out or you don't.

Professor Allison: But we have radiation inside us anyway, so you can't protect people from all radiation. We are radioactive. This gives you one level to work from, and that is the level that the international community works on, but that is very low.

Q121 Dr James Davies: Expanding on that, could you run through the linear no-threshold hypothesis and why you disagree with it?

Professor Allison: It is like trying to explain alchemy, but instead of being based on bad science and avarice, it is based on bad science and fear. Life, in evolving itself in the past billions of years—has provided mechanisms for repairing things. In fact, the Nobel prize for chemistry last year was given for somebody who had elucidated one of the repair mechanisms for the radioactive effect on DNA. We know a lot about these things now.

Things only go wrong when there is too much, because like any safeties, you can have too much radiation, and then everything comes to a grinding halt. Of course, in radiotherapy, where the name of the game is to kill the tumour, doctors work very close to that boundary. We know all about that, and members of the public know all about that because they have the experience of it.

The LNT model says, "No, no, no. We don't know anything. Let's suppose that the amount of damage from radiation just increases in proportion to the amount of radiation that you receive." That is the way that a lot of things work in physics, which is my subject; it is not the way that things work in medicine and biology, because biology is an evolved system that has been designed so that, up to a certain level, things do not get damaged.

Q122 Dr James Davies: So it is more of a J-shaped curve, perhaps.

Professor Allison: Yes—I always get a bit unhappy about J-shaped curves, but I will not get involved in that sort of detail. Yes, it is not a straight line.

Q123 Dr James Davies: You are saying that there is, therefore, a threshold.

Professor Allison: There is a threshold. The question is: what is that threshold? That is what I attempted to conclude when I wrote my first book. In my second book, there is a lot more evidence, including everything that happened at Fukushima, and I have had no reason to change that view of what that threshold should be.

Q124 Gerald Jones: Please accept my apologies for coming late. Unfortunately, I was delayed elsewhere. What do you think a safe level of radiation would be? Is there such a thing?

Professor Allison: I think the safe limit should be the threshold. The dose or dose rate that is the highest that has never been seen to cause anybody any ill health effect is something like 100 mSv a month or 1,000 a year. Now, I came to that conclusion, roughly, before I learnt that, in 1934—the year that Marie Curie died—it was 734 mSv a year. So there seems to be reasonable agreement among people who are prepared to look at things in this way, as to what that threshold should be. Of course, if you give someone a large blast of radiation, all at once, the repair mechanisms are knocked off their perch before they have had time to act, and that is what happened at Hiroshima and Nagasaki. There was essentially a flash of radiation from the exploding bombs—that is the worst kind of situation. But that is taken into account in what I said.

Q125 Gerald Jones: In terms of the safe limit, how does that relate to people who are nuclear workers or to people living around the plants?

Professor Allison: People who are living around it can have it all the year—every day.

Q126 Chair: From the plant?

Professor Allison: No, but you could imagine that they might have it every day. They do not get flashes. If they do, people's exposure has to be monitored. But of course there are many cases where some glass was broken or something, and people got a dose of radiation and their health had to be watched for the years afterwards. And it is very surprising how, in fact, their health was not affected nearly as much as people expected. Of course, Mr Litvinenko was given so much that his health did fail, so there are cases that we know about and those cases are also described in my book, and compared.

What you can do, for instance, is you can take dogs. They use dogs in particular because the lifetime of a dog is a reasonable fraction of a human life and so it is better



than mice. You can take dogs and feed them radiation every day of their lives. How much can they have before their lifespan is affected by early cancer, heart disease or something that is induced by the radiation? We know the answer to that, and in fact there is some evidence of that in my book.

Q127 Liz Saville Roberts: I understand that you have said that there is no reason to treat nuclear power, as an industry, in any way particularly differently from any other industry in regards to safety risks. The one question I would really like to ask you is: why do you feel that we treat nuclear as so much more of a concern than other industries that have risks implicit in them?

Professor Allison: If it hadn't been for Hiroshima and Nagasaki I do not think that we would have done. There is a chapter in my book where I have tried to look back at the situation in 1945, and at how the world reacted to fear of nuclear weapons as a result of the detonation of this new kind of energy. It is a very bad way to learn about things, all in a big bang like that. One needs time to learn about things.

There was a lot of political intrigue going on in the United States. When a lot of this went wrong it was the time of the un-American activities and spies and so on, and I have attempted to unpick some of that, but I do not pretend that history is like physics—you can write more than one history based on the same events.

Q128 Liz Saville Roberts: That was very interesting. It is interesting the way that we treat what is evidently a potentially dangerous industry—but there are many potentially dangerous industries out there and there are different approaches. Do you think that Governments should therefore be changing their approach towards safety in this industry and radiation per se?

Professor Allison: Yes, I do. But this is very difficult because they were so frightened—there was so much concern about nuclear in the past that it has all been set in concrete at the level of the United Nations. Somehow that has got to be unpicked.

I make the case that the effect of ultraviolet light in sunshine is just next to X-rays in the spectrum of radiation; that causes cancer and cell death and so on. We have learnt how to cope with that kind of threat and teach our children—we don't need a United Nations committee on sunbathing. Yet 9,000 people a year in the US die from cancer caused by too much sunshine. But we don't let it turn the world upside down.

Q129 Chair: I am quite sympathetic to nuclear power, and I appreciate that you are a scientist, but I cannot see this argument flying politically, if I am honest with you. The idea that we could cut back a bit on the safety measures because it is not quite as dangerous as we think it is, is one that is just not going to wash. Isn't the danger that, if you propagate this idea, it is going to make it even harder to get a viable nuclear industry off the ground?

Professor Allison: It cannot be done just like that; it has to be done starting in schools and teaching people. It is amazing how much more receptive young people are to

what I am saying than my generation, who are more or less a lost cause. If children have learnt about things and go back and tell their parents what they learnt in school today, the parents will listen in a way that they don't listen to politicians on TV. And it's doctors. On Friday, I was speaking in the Churchill hospital in Oxford on this subject and I was emphasising that there is tremendous responsibility on the medical profession, probably more than on anybody else, to explain what is and is not dangerous.

Chair: Our eyes turn immediately to James.

Q130 Dr James Davies: Thinking of colleagues, to what degree do you find that there is consensus among the scientific community on what you are saying, and evidence for it?

Professor Allison: I don't get challenged—I haven't felt that I have been challenged on the evidence that I have been presenting. On the other hand, everybody has their own research to do and this subject is not something for which anybody is handing out research money or students. There are no Nobel prizes in this sub-field. It is a dirty bit of science and it's not something that causes people to get very excited. On the other hand, getting it right and getting nuclear power in north Wales and the like right could be the kind of decision that will determine whether life continues in this country and on the planet in the way that it has in the past. It's not exciting stuff.

Dr James Davies: The annual exposure of radiation in the UK that a person experiences is around 3 mSv, and you are saying that over 1,000 per year is probably safe. That is a huge difference.

Professor Allison: I didn't say over 1,000. I actually said 1,000, by which it could be 700, it could be 500—we can argue factors of two and three—and it is very important that it is squared more or less uniformly. If you have it all at once that is very bad.

Q131 Chair: This is new to me. I wondered if you knew how much would seriously damage your health? Also, the waste that gets buried—the high-level stuff that may or may not get buried one day in Sellafield and has to lie there for thousands of years—how many mSv—

Professor Allison: It doesn't have to lie there for thousands of years. The main constituents of the part of the nuclear of the waste—fission waste—that is not any use to anybody any more are caesium and strontium, and they have 30-year lifetimes. If you leave them for 20 lifetimes, which is 600 years, that is down by a factor of a million, so after 600 years the radioactivity has fallen by a factor of a million.

Q132 Chair: What level is it at that point?

Professor Allison: That depends on where you start from, but the point is, nobody has ever challenged who has ever died from nuclear waste.

Q133 Chair: I don't know; I am a layman, but I understand that, out of a nuclear power station, at some point comes some high-level waste, and nobody is sure what to do with it. This is one of the problems. I understand the idea is to bury it deep in the ground and leave it there for a while—for 1,000 years, I thought, but I may be wrong.

Professor Allison: You keep it at the nuclear power site. When I went to Sizewell, all the nuclear waste that Sizewell has ever produced is sitting in one building.

Q134 Chair: If we literally lifted the lid on the containers that keep it, how many millisieverts would come out?

Professor Allison: X-rays would come out of it, but it does not happen. Nobody has ever—

Q135 Chair: I am thinking worst case scenario here. When we were in Anglesey, they said it was all put into special, sealed flasks. I am a layman. You gave me some figures: 100 mSv per month is OK; 1,000 might be all right; 3 is what we normally pick up; 10 is what you get from a CAT scan. How many millisieverts are likely to come out of one of those flasks if it got damaged in some way?

Professor Allison: It depends whether you stay there. One of the problems with radioactivity is if you get it inside you. If you don't get it inside you, you can wash it off or move away and don't stand there, just as if there's a fire and you might overheat you move out of the way and you don't stand there. I always think, when I come up to London and I stand in the tube, there is an incredibly high-voltage electric rail in front of us. I might fall on the electric rail, but I don't, because I have been taught and I understand not to. It is all part of education that you don't do that sort of thing.

There isn't the same situation with nuclear waste, but it has not happened—that I am aware of—that anybody has really, on a large scale, had their health affected by nuclear waste, and yet we are prepared to consider bringing aspects of the whole economy to a grinding halt because we do not know what to do about this problem. I think it is a misunderstanding.

Q136 Chris Davies: First, sorry I'm late, Professor Allison. Several points came out of the evidence that you have just given. The first is to say congratulations. I am from Hay-on-Wye, the town of the Hay literary festival. I have never heard anybody market a book so well in all of my life, so well done on that.

Professor Allison: I'd like to take you up on that. It is very difficult to market books, and Hay-on-Wye is the place one would like to go.

Chris Davies: You've done it very well today, and I am dying to know the answer of the dog's life expectancy—but perhaps I had better buy your book for that.

As it happens, my wife is a therapeutic radiographer in a cancer hospital. I am interested to hear your views on why that form of radiation is treating cancer and is benefiting lives, whereas the type of radiation that we are talking about here—waste radiation from nuclear power—is bad for our lives. Perhaps you could just give a little explanation.

Professor Allison: The radiation is the same. In radiotherapy, the radiation is used very much beyond 1,000 mSv. Actually, 2,000 mSv a day are shone into the tumour; if you do that for 30 days or so, that is sufficient to kill the tumour. That is not the threshold, but the level that is fatal, and that is used in medicine. The tissue around the tumour also gets about half that dose, the hair falls out, the skin may be burnt and so on, but it usually recovers from these procedures. A factor of two is sufficient to make the difference, which means that radiographers have to be very careful not to give too much or too little radiation, because in the one case they will damage much more tissue than they meant to, and in the other they will not kill the cancer.

Q137 Chris Davies: Thank you for that explanation. Basically, radiation is radiation; it is just applied differently.

Professor Allison: That's right.

Q138 Chris Davies: Thank you. Again, I am slightly going off on a tangent here. We have talked a lot about the nuclear waste. Do you, as a physicist, ever see the day when that nuclear waste, other than by allowing 600 years or 1,000 years—we can argue about the “give or take 400 years”—can be dealt with and neutralised, in our lifetimes or in our children's lifetimes?

Professor Allison: I have not said anything today about reprocessing. I am assuming that, since only about 1% of the fuel—in normal fuel—is used up in a nuclear power station, the fuel should be reprocessed and the unused fuel should be used again. If you do that, and you use thorium and so on, then there is absolutely no shortage of fuel for nuclear power stations for many hundreds of years.

Q139 Chris Davies: That would be safe to do?

Professor Allison: That would be perfectly safe, but you do need a fast neutron reactor of the kind that has been developed in this country and was looked at in Scotland—sorry, I forget the name. We have to go back to that, as the Russians and the Chinese are doing. We are not doing this in an isolated situation: the Chinese, the Russians, the Japanese, when they are able to do it, and the South Koreans are getting on with developing sources of nuclear power. This is something I really wanted to say: if we want to be competitive in this country, we need to develop those sources without infringing safety problems.

Q140 Chris Davies: Thank you. May I just ask a final question, which is the question I should have come to straight away? Will the difficulties with the Hinkley Point project affect the prospect for nuclear at Wylfa, in your opinion?

Professor Allison: I suspect that that is a political and economic question. I do not understand why we pay what we pay for the utilities we use. Why can I get water and internet for almost nothing, when I have to pay a lot for electricity? I am not an expert on the costing of the agreement for Wylfa or Hinkley C. I think it is very important that Hinkley C is built, but I hope that the strange and probably unfortunate pricing arrangement that was entered into does not have consequences for everybody else.

Q141 Chair: Lastly, what do you think the potential benefits would be of small modular reactors?

Professor Allison: You won't be surprised to know that I am not impressed by the safety question, because I think most nuclear reactors—other than those like the Chernobyl one—are safe anyway. They are certainly more efficient if they are bigger. Nuclear reactors can be made small if you have very highly concentrated fuel, as you get in a nuclear reactor in a submarine, but we probably do not want to go in that direction, because that is beginning to use fuel which is too much like what is used in nuclear explosives. The main advantage of small modular reactors is not to do with that; it is to do with the workforce and the ability to build things many times over on the Henry Ford principle of production line techniques, building experience.

Talking about north Wales, it would be very good if in such a place in this country, there were groups of people who had experience because they had done it many times before, because of the export possibilities and so on. But, of course, there will be other people in the world thinking about doing the same thing, so it will be important to get on with it.

Chair: Thank you very much, Professor Allison.