REPORT OF PROCEEDINGS BEFORE

GENERAL PURPOSE STANDING COMMITTEE No. 5

INQUIRY INTO THE FORMER URANIUM SMELTER SITE AT HUNTERS HILL

Uncorrected transcript

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At Sydney on Friday 4 July 2008

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The Committee met at 9.15 a.m.

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PRESENT

Mr I. Cohen (Chair)

The Hon. R. L. Brown
The Hon. R. H. Colless
The Hon. A. Catanzariti
The Hon. K. F. Griffin
The Hon. C. J. S. Lynn
The Hon. L. J. Voltz
The Hon. H. M. Westwood

CHAIR: I welcome everyone to the second public hearing of General Purpose Standing Committee No. 5 inquiry into the former uranium smelter site at Hunters Hill. Today we will be hearing evidence from Dr Gavin Mudd from Monash University, representatives from the Australian Radiation Protection and Nuclear Safety Agency [ARPANSA], Dr Joe Young from Australian Radiation Services, Professor Tilman Ruff from the Medical Association for the Prevention of War and a former resident of Nelson Parade.

Before we commence I would like to make some comments about aspects of the hearing. The Committee has previously resolved to authorise the media to broadcast sound and video excerpts of its public proceedings. Copies of guidelines governing broadcast of the proceedings are available from the table by the door. In accordance with the guidelines, members of the Committee and witnesses may be filmed or recorded. However, people in the public gallery should not be the primary focus of any filming or photographs. In reporting the proceedings of this Committee the media must take responsibility for what they publish or what interpretation is placed on anything that is said before the Committee.

Witnesses, members and their staff are advised that any messages should be delivered through the attendants or the Committee clerks. I also advise that under the standing orders of the Legislative Council any documents presented to the Committee that have not yet been tabled in Parliament may not, except with the permission of the Committee, be disclosed or published by any member of such Committee or any other person. Committee hearings are not intended to provide a forum for people to make adverse reflections about others. The protection afforded to Committee witnesses under parliamentary privilege should not be abused during these hearings. I therefore request that witnesses avoid the mention of other individuals unless it is absolutely essential to address the terms of reference. Finally, could everyone please turn off their mobile phones for the duration of the hearing, including mobile phones on silent, as they interfere with Hansard's recording of the proceedings.

The Hon. LYNDA VOLTZ: I have a point of clarification. Did you say that someone was a former resident of Nelson Parade?

CHAIR: That is Mr Benjamin Nurse.

The Hon. LYNDA VOLTZ: So the guy from the medical association is not from Nelson Parade?

CHAIR: No.

GAVIN MARK MUDD, Lecturer, Department of Civil Engineering, Monash University, affirmed and examined:

CHAIR: Are you conversant with the terms of reference of this inquiry?

Dr MUDD: Indeed.

CHAIR: If you consider at any stage that any evidence you wish to give or documents you wish to tender should be seen or heard only by the Committee, please indicate that fact and the Committee will consider your request.

Dr MUDD: Yes.

CHAIR: Would you like to commence, in the time we have available, to address the Committee and we will follow that with questions?

Dr MUDD: Sure. There are a few points I would like to begin with following up from yesterday but also to start with. First of all, I congratulate the Committee on having an inquiry on this site. It is something that is well overdue. It is an issue that has been around for 30 or 40 years and probably almost 100 years. Understanding the nature of these types of problems, I would hate to think that on the 100-year anniversary of this site first being operated in 2011 we have still not solved this problem.

I urge this Committee and the New South Wales Government to be bold, to be brave and actually try to come up with solutions for this site once and for all that addresses all the issues. I would hate to think that we come back in 10 years time or 20 years time and the waste is still there. We need to solve this problem once and

for all. I have done a lot of work on understanding the history of uranium mining in Australia and understanding the nature of radioactive waste impacts associated with it and that was how I first got involved with this site. It was more of a professional and personal interest; my own interests in nuclear issues and uranium mining. I am not a Sydney resident; I am a Melbournian so in that regard I appreciate the Committee facilitating me being here.

The nature of this problem is not simple; it is not something that is black and white. It is something that is tricky to look at. It is something that needs a bit more lateral thinking. The problem at the moment is that there is no easy solution in terms of finding a permanent, long-term site for managing this waste. I am very carefully not using the word "disposal" because I do not believe that this type of waste in an urban area can ever really be disposed of. It is something that has to require permanent oversight and permanent management. When I have travelled around almost every other former and current uranium mine site in Australia, we come back 20 years later after rehabilitation was done and we find that the sites are not working that well. Whether that be Radium Hill—the actual mine site in South Australia—or Rum Jungle or following the literature on other places like Mary Kathleen or Nabarlek.

So for me, I always tend to get sceptical of solutions that involve engineering and that involve believing they are going to work forever, because when you look at existing sites we come back 20 years later and we realise they are not quite good enough. So for me, I always say when we look at a site like Hunters Hill we have to come up with a long-term manageable scenario, which is why I have argued in my submission very briefly that for me the best long-term scenario is to excavate the material, remove it from an urban area where clearly it would create a permanent risk in that area for ever, regardless of how good our engineering technology might be.

For me, I therefore believe the best long-term solution for management is for excavation and management at Lucas Heights—whether existing facilities, existing expertise—and it would only be a very small addition to the already large volume of radioactive waste there. I do not believe it would be an impost and I do understand the legalities of that as an approach as well as the actual political dilemma that that creates. For me, I am not fearful of that; I think the community has a right to believe that the solution should be found once and for all. That is basically where I am coming from. The only other last point I would like to reiterate is that radiation exposure is cumulative—something that I think was not emphasised strongly enough yesterday—and I urge you to talk to Associate Professor Tilman Ruff this afternoon about radiation exposure.

Additional radiation exposure from a site like this—to background—adds to that cumulative risk. We know from a multitude of international studies that all the models accepted for radiation are still the linear no-threshold hypothesis for radiation exposure. That is, any additional increase in radiation exposure—remembering that radiation exposure is cumulative—over a lifetime increases your chance of radiation health effects. I do not believe Hunters Hill is a site that is probably as bad as some of the earlier years of uranium mining; I do not believe it is perfectly safe either. It is probably somewhere in the middle. As was highlighted yesterday, we really do not know where it is in the middle there because there is no good data on some of the key pathways for radiation, that is, radon gas and dust on uptake and so on. One of the key things I would like to support from yesterday's hearing is that I think there does need to be a much broader survey and retesting done, and that should be on the public record.

CHAIR: I am sorry to interrupt you, but when you say that, are you saying a more intense survey of the site or to look at different aspects of radiation there; for example, radon?

Dr MUDD: Absolutely. Because I think one of the things we need to be absolutely sure of is although it was pretty clear from the various witnesses yesterday that in the seventies when this site was first really investigated and dealt with as a contaminated site we thought we had identified all the right properties in terms of hot spots, leftover contaminations and so on. I think it is pretty clear from yesterday that there are sites still on Nelson Parade, especially No. 11 and possibly others, that still have some degree of contamination there.

So I think we need to be bold: we need to make sure that we look at the whole area and address the concerns from residents and therefore get a survey, put it on the public record, get accurate data for all aspects of radiation exposure pathways—not just gamma—and therefore we can get a good, transparent, confident process that the public can have confidence in and that we can find a legitimate solution from. That, to me, is how I approach the problem. I will leave it there and I will open it up for questions.

CHAIR: At one stage in your material you said that you thought the material should be packaged or contained in some way and transferred to Lucas Heights, is that correct? You are quite clear in stating that?

Dr MUDD: Yes.

CHAIR: The Department of Health, if I have it correct there, has said that the level of buried contamination at Nelson Parade is below the regulatory limit that defines a radioactive substance that would be regulated under the New South Wales Radiation Control Act. My understanding is that this material, if shipped off site, would be most likely sent to a landfill area such as Castlereagh tip, but I do not know that that has necessarily been resolved in any way. Could you perhaps comment on that? Is there a disagreement there? Is there a disagreement with the relative levels and what is the categorisation of the material, from your perspective?

The Hon. HELEN WESTWOOD: Just for clarification, two things: Firstly, no longer can toxic waste be taken at the Castlereagh site—that does not happen. Secondly, when we talk about Lucas Heights we should clarify whether we are talking about the ANSTO site or the landfill site. Dr Mudd may be referring to the ANSTO site rather than the waste transfer/landfill site.

CHAIR: Thank you for that. With the Castlereagh site, depending on the classification, perhaps you could clarify whether it would be suitable to go to a landfill site, perhaps would be the best way of stating it.

That is good to clarify, thank you. One of the issues in terms of the classification of the waste is that some of the data on which we are classifying and understanding the Hunters Hill site was old and not very extensive. When I published my paper a few years ago the data I was able to see on the public record was very sparse. I understand there are a lot of other commercial-in-confidence reports, some of which have been submitted to the committee. There are probably still more out there. Again, I encourage the committee to ensure we can compile all of those reports and that data on the public record. One of the issues in terms of classifying is the high degree of variability in the nature of this waste. It depends on whether you look at the average for the whole volume or the peaks. At the moment I believe that there needs to be a more comprehensive survey that goes deeper in terms of the soil profile to get a good handle on the total waste that is contaminated.

One of the other issues raised yesterday is the whether it will become more radioactive over time. When you look at what was done in the 1910s, it was a radium refinery. Uranium decays through various stages from uranium through to thorium, through to radium, through to radon and so on through to polonium, bismuth and lead and eventually to a stable lead isotope. They removed some of that radium. In technical terms there is what we call disequilibrium. The rate at which the uranium and then the radium decay and so on is the half life or how long it takes for that process to happen. If you remove one of those things, it is like moving along a highway. Everyone is travelling at 100 kilometres an hour. If you remove the first car, which is travelling at 100 kilometres and hour, and the second car is capable of travelling at 1,000 kilometres an hour, all of a sudden everything can speed up. It is the reverse for Hunters Hill.

The analogy for understanding the radiation issue at Hunters Hill is that if there are 10 cars travelling along the decay chain from uranium through to lead, at 100 kilometres an hour, everyone is travelling at the same speed. We call that equilibrium. So all of the radioactive isotopes are travelling at the same speed. Some can travel a lot faster and some can only travel more slowly. When you interrupt that process and remove the first car—so the second car can now go a lot faster—everything can speed up, if that is possible. The reverse occurs if you take one out. The next one only goes as fast as the one that is there. If you have taken out 80 per cent of the radium, the radon gas can occur at only 20 per cent of that speed.

Over time, because the uranium is still there, eventually that radium will come back again. So over time the radium will be greater. As pointed out by the Department of Environment and Climate Change representatives yesterday, that rate of increase is slow. It is not something that occurs in months; it will occur over hundreds to thousands of years. However, the radium will come back. I am happy to provide much more material if that would help the committee. One of the other things that might be helpful is a current extensive journal paper on radon issue I have under review. I am happy to provide it to help in the committee's understanding of radon and the decay process. It is still under review and it has not been published, but if it helps the committee in understanding, that is fine..

CHAIR: Is there a necessity, given that people are living in these areas, to undertake radon testing? Has there been enough assessment of radon present in houses and so on and around that site? Can you comment on that regarding radon?

Dr MUDD: I do not think there has been anywhere near enough testing. We know from the journal paper that I have under review and from international literature that where there is an elevated uranium concentration, sometimes in natural rocks—whether that be granite, shale in Sweden or elsewhere—sometimes you can get uranium that is normally present at, say, two parts per million or five parts per million. It might also be present at 10 or 20 parts per million in natural soils or rock formations. In parts of the world that can lead to a situation where radon generated from that uranium can accumulate in house. That can lead to significant radiation exposure. Radon exposure is a lot more biologically damaging than gamma.

I defer to my colleague Associate Professor Tilman Ruff in terms of expertise on the health effects. My expertise is in understanding the waste and the pathways. That is a lot of what I have done over the years. Radon is a much more powerful radiation exposure pathway. From my point of view that is something we need good testing for. It can vary on a daily cycle or a seasonal cycle. It also varies on the nature of the soils, the types of buildings and the way that houses are used. Sydney has a warmer climate than Melbourne. All of those things can either mitigate or enhance radon accumulation in buildings. It is not a simple process; many factors can be involved in whether there is radon accumulation in buildings. Therefore, you cannot just take a one-off sample and then use that as a basis for everything.

You can get peaks, and those peaks reach very high levels—especially if you get cold periods when the houses are closed up and there is a waste source. The way you can get radon varies, sometimes a thousandfold. That is on sites that are not contaminated with uranium tailings. That is often on sites with natural background concentrations that are slightly elevated. There are sites that have had uranium tailings used in the construction or houses built over the top. Unfortunately, as much as it is hard to believe, some parts of the world are a lot worse than Hunters Hill because houses were built using uranium tailings and over extensive amounts of uranium tailings in places such as Grand Junction in Colorado, Canonsburg in the United States, Germany and elsewhere in the world.

When you look at the data from those sites and understand the level of radon and the decay products—and they are extremely biologically damaging in terms of the polonium, bismuth and lead, what we call the progeny or the radon daughters—radon can give rise to very significant radiation exposures. We need to have good testing on that. If we want to understand the true nature of exposure at Hunters Hill we need good testing to prove that. If there is good data that can prove that radon is not an issue, that test will show that. That is something we need. From a public point of view, it is not fair to not have any data on something that has a critical exposure pathway. The history of how this site has been dealt with is very unfair.

The Hon. LYNDA VOLTZ: When you are talking about radon accumulation, are you talking about sites where there are houses, not open spaces?

Dr MUDD: The exposure would be occurring under both scenarios. Now, in open space, you would get dispersion of that radon. Understanding the site, there would be some dispersion, but the radon exposure would not be zero and it would be elevated over background compared to, say, other sites around Woolwich or other sites around Sydney.

The Hon. LYNDA VOLTZ: But you get radon naturally anyway as background, do you not?

Dr MUDD: There is radon in background, but when you have an active source term there, that does lead to additional radon, which is over the top and additional to background.

The Hon. LYNDA VOLTZ: What is the radon measurement over the top of the ground?

Dr MUDD: Well, we do not know because there has never been good data published on that.

The Hon. LYNDA VOLTZ: No. Given that radon occurs naturally in the background, what other safe levels, or what levels are considered safe under the Australian standards above background?

Dr MUDD: The Australian standards are not measured in terms of activity of radon. They are measured in terms of biological exposure. When you know the source term and you know how much radon is

present and how much progeny are present, you can then calculate what the exposure is and those that meet the standard. One of the things also that does require clarification, and hopefully colleagues either from the Australian Nuclear Science and Technology Organisation [ANSTO] or the Australian Radiation Protection on Nuclear Safety Agency [ARPANSA] can provide further clarification on this later on, is the public exposure limit is 1 millisievert per year. That is a calculated exposure. That has to include gamma, that has to include radon, that has to include radon progeny, that has to include any dust intake, any uptake through vegetables that may be ground on the site—all exposure pathways. That is additional to background. Very small amounts of radon can give rise to a significant dose in terms of millisieverts.

The Hon. LYNDA VOLTZ: When the radon testing was previously done on the site and was identified on No. 7, what were the readings at that point when they removed the soil because of the radon?

Dr MUDD: I cannot remember the numbers off the top of my head. I do not believe there has been a lot of data published on that.

The Hon. LYNDA VOLTZ: Was it significantly above the one above background?

Dr MUDD: Certainly my understanding is that the testing was done in the late seventies, and it was very extensive. The limited amount of data that I have seen suggest that at No. 7, because it was built over the top of part of the main waste at Hunters Hill, there was a very significant radon exposure there.

CHAIR: Dr Mudd, in that respect, you are saying that the testing is for gamma, et cetera, but the radon has not been necessary properly tested.

The Hon. LYNDA VOLTZ: No. Radon was tested in the seventies and that was why No. 7 was removed, and then it was retested in 1992, according to the records we have.

Dr MUDD: The '92 data, I have never seen.

The Hon. LYNDA VOLTZ: It was only on No. 7, which is where the soil was removed from. That was in the report yesterday that we spoke about.

Dr MUDD: I have not seen the report.

The Hon. LYNDA VOLTZ: It was with the Department of Environment and Climate Change [DEC] when we were talking about radon testing specifically during questions. What I am trying to ascertain is the levels of radon. There has been experience of radon testing on this site. I want to know how they related in terms of the range. You have stated that the risk at the Hunters Hill site, you think, is significant, or moderate?

Dr MUDD: I think, given the source term and the fact that you have potentially up to a few thousand tonnes of material there that is contaminated, either as direct tailings from the material or from the site itself or from waste that was contaminated by a lot of liquid wastes and a lot of mixing of wastes on the site, the radon issues have very little data. I have not seen the '92 report. I think that is one of the things that needs to be rectified. A lot of the data needs to be put on the public record properly so that we can look at a lot of the data accurately and not talk about ideas or concepts without the actual data.

One of the things I always believe in, and that I am always emphasising to a lot of my students when I am teaching, is that I do not like hope, I do not like just "Trust us", I do not like optimism on a lot of these things, and I do not like "We don't believe that's an issue." I think you need good data on the public record to prove one claim or another. Now I think there is not enough data on Hunters Hill to do that.

The Hon. LYNDA VOLTZ: I guess the point is in '92 the reason that there is no data is that the house was pulled down and the soil was removed, so obviously they retested, just to ensure that what they had done in relation to the radon on that site was successful.

Dr MUDD: I have not seen the '92 report, but I looked for it several years ago when I was finishing off the research behind the paper that was published in the historical records. I was not able to find that report, and the editor of that journal was extremely thorough and was extremely careful about checking everything in that paper.

The Hon. LYNDA VOLTZ: But you would accept that if they removed the soil and they did pull the house down, because of dispersion, that would probably be the case?

Dr MUDD: If the source term is still there, there would still be an elevated radon exposure that is additional to background, that is cumulative to the existing exposure there. Now if there is good data to show what those levels are, fine—put it on the public record. And if there is good data there that shows that it is low, fine—I will recognise that. But I do not like accepting just "Trust us". I do not believe that is a good public policy.

The Hon. LYNDA VOLTZ: I am not asking for trust. What I am saying is that if you identify radon, which is obviously what happened in the seventies report on site No. 7, the appropriate action would be to remove that soil, and then once the house is pulled down, that would help with the dispersion of it, yes?

Dr MUDD: I have not seen the details of the '92 report in terms of what was done, how that relates to the soil site—

CHAIR: I think we have covered that. I do not think we will go further with that. Dr Mudd, in the written submission by the government agencies, they simply say that, according to surveys reviewed from 1992 to 2008, they generally indicate that, given the current range of problems, the exposure of residents would not be expected to exceed 1 millisievert per year above normal background levels for members of the public. Would you agree with that?

Dr MUDD: Without seeing data on the public record, I would find that that is a hard statement to prove. I think one of the issues that does need to be rectified, and that I hope this inquiry can help to rectify, is that data for that can actually be put on the public record—good data, not once-off data, not data that is limited to only a small part of the site. I think one of the things that came through in yesterday's hearing is that when we are missing some of these exposure pathways, such as radon—and we know from literature I have reviewed, such as the journal paper that is under review at the moment, that radon can vary enormously in this type of context—we cannot just use one-off data for that. We need good data, long-term monitoring data, that addresses the nature of the problem. In that sense, if that data shows that all pathways add up to less than 1 millisievert, fine. Put that data on the public record. Do not leave it buried in commercial-in-confidence reports inside government departments where it is not public and is not transparent.

The Hon. ROBERT BROWN: I note you have a civil engineering background, do you?

Dr MUDD: Environmental engineering, yes. It is very close to civil engineering, but yes.

The Hon. ROBERT BROWN: You are aware of the nature of the site, the steep terrain difficulty?

Dr MUDD: Yes.

The Hon. ROBERT BROWN: Do you have any experience, or would you have an opinion, on the methodology of removing the material from the site? Would you have any opinion on that, on how it should be done, et cetera?

Dr MUDD: I think in a lot of ways, that is a question I have asked myself before. I think one of the ideas that came out in yesterday's hearing was using a barge-type system and taking it out by the harbour. I partially agree with some of the Department of Environment and Climate Change [DEC] comments in terms of when you look at risk management and the virtue of risks in the barge-and-harbour approach versus the trucks-and-shovel approach and so on, but at the end of the day, that would not be my decision to make. That would be a decision that would have to be made by the government, by the regulators, and the agencies in conjunction with what the community prefers as well.

The Hon. ROBERT BROWN: Right.

Dr MUDD: I think that whichever solution is chosen, there will be risks. I do not think we can avoid that. My point of view is short-term pain for long-term gains—that is to say, deal with the problem. There are dust issues, there are other issues around whatever technology or technique is used to excavate the sites: remove the material and get it off the site. That has to happen. That, to me, is not the question. The question is where the material goes after that.

The Hon. ROBERT BROWN: Okay.

Dr MUDD: For me, by acknowledging some short-term risks, you remove that as a long-term risk, and that means that there are no restrictions or no issues in the long term for those residents and those properties.

The Hon. ROBERT BROWN: My second question relates to when you split out the parts of the ore and you take parts away and you get different acceleration rates for concentrate—in other words, the stuff that would have been bought there from South Australia in the first place.

Dr MUDD: Yes.

The Hon. ROBERT BROWN: One of the Committee members postulated that there were records showing that there may be material on the bay floor under water that has not been processed as the dry material on the site would have been. Would that material be any more dangerous or less dangerous than the material that has had the radium removed? What pathways would you measure to measure that stuff in the marine environment? I guess you cannot measure radon gas in the marine environment, can you?

Dr MUDD: Yes, you can.

The Hon. ROBERT BROWN: You can. And if so, is that material any more dangerous than, say, material that has been partially processed for radium?

Dr MUDD: Yes. The relative risks between, say, aboveground material in terms of the site and the below water material, I would tend to treat them in the same category. I do not think they should be treated very differently at all. They should both be treated as radioactive waste, and their low level in terms of the way you might consider radioactive waste, but because of the fact that both wastes can generate radon. In a marine environment the amount of radon that would get out would be relatively low, but there are other issues in terms of leaching of uranium that might get out, and there might be a small degree of bioaccumulation from that if there is uranium leaching out of the material in the sediments.

If that has not been tested before, if you do the testing, you can show that there is no problem there, fine. I will always accept good scientific data to argue a point. I do not believe if there is no data there is no problem. Too often a lot of regulators are captured in that sense, they are not prepared to be brave and say, "Okay, we know it is going to cost money, but from the public health point or view, or from an environmental health point of view, we need to address these things properly. We cannot just go off on a lot of these things when we just believe it is going to be okay." That is not good enough. We need good data to argue all of those things.

In that sense, when you look at the fact that we do believe there is material beneath the foreshore, based on some of the testing that has come to light because of this inquiry—and that is pretty clear—I would use the same approach. If there is any degree of excavation, removal of that material, it is short-term pain and issues around that for a longer-term gain.

The Hon. ROBERT BROWN: How should that data be collected? Do you think there should be soil tests?

Dr MUDD: A bunch of things can be done. Soil tests can be done, and we need to make sure that there is deep enough testing done so that you are not taking samples just at the very surface. Maybe given accumulation of sediment or silt and clay over the top of that over time, maybe go several metres deep. That can be easily done. There are various techniques that can be used to do that. Also, you need to test the water quality as well. In that way you test water quality at the surface and get a vertical profile. So you test down the column of the water. If that result shows that there is no leaching of the material of any sort of contaminants, whether that be uranium, radium or any other metals that may be in that concentrate, or the ore that is sitting at the bottom of the foreshore there, if there is good data that proves there is no leaching at the moment, fine.

Good data proves a point, but we need data to approve that. We cannot just believe that there is no problem. That is often what I find is a real problem. I do not believe it is a problem unique to environmental problems, I think it is a problem that is more fundamental across a whole range of areas.

The Hon. RICK COLLESS: Dr Mudd, in your submission you stated that about 2,150 tonnes of uranium ore was processed, or shipped to the site. How much of that would have been processed in order to produce the two grams of radium that supposedly came out of there?

Dr MUDD: We do not know exactly, to be honest. There is not a complete set of records. One of the things I have done over the past few years is pretty much check all of the records for all mining. As part of the research for the historical records paper on radium mining, I went through all of the annual reports for the South Australian Department of Mines, all of the annual reports for the New South Wales Department of Mines, as it used to be called. The New South Wales Department of Mines never mentioned Hunters Hill, which I often found very curious, given the high profile that radium had back in the 1910s as a wonder element for medical uses and the fact that it was 100,000-fold more valuable than gold.

South Australia was very prominent in promoting radium, so a lot of the records that are available are only available from the South Australian Department of Mines publications. Not every report of theirs had data on it, so we do not have a good, 100 per cent accurate record of exactly how much was spent, exactly how much was processed, or exactly how much was produced. A lot of it adds up what we do know and fills in the gaps a bit and saying, therefore, that is probably about the best we can come up with, based on grade, based on tonnage and based on what we believe the amount of radium they had to produce. There are not 100 per cent records on that.

The Hon. RICK COLLESS: So the 2,159 tonnes of ore was concentrated ore, as I understand it, came from the Radium Hill?

Dr MUDD: That is the best estimate that I can produce, yes.

The Hon. RICK COLLESS: In your submission you state that was about 0.5 to 2 per cent uranium oxide?

Dr MUDD: We believe that, yes.

The Hon. RICK COLLESS: Realistically, there could still be somewhere between 10 and 50 tonnes, say, of uranium oxide on that site?

Dr MUDD: Contained within minerals, yes, absolutely.

The Hon. RICK COLLESS: The breakdown of that material, and I think you more or less confirmed this, is going to provide a source of radium for many years to come. Is that correct?

Dr MUDD: The half-life of uranium you are aiming to create, to be specific in terms of the isotope, gives rise to the radium and radon in our isotopes itself. Uranium has a half-life of 4.5 billion years. That means it has a very low, I suppose in technical jargon, specific radioactivity. That means, how much radioactive decay per unit of mass. It is 4.5 billion years, that means it has a very low radioactivity per unit of mass.

CHAIR: When you give technical information, could you please slow down a little, we want to get the details in *Hansard*.

Dr MUDD: This is a really important point and I am trying to get to the detail on that. Therefore if you look at one radioactive decay, what we call a becquerel, one becquerel would be one radioactive decay per second. If you look at uranium, because it has a very, very long half-life, the amount of becquerels per gram is exceedingly low. If you look at radium, it has a half-life of 1,600 years. It has very, very high becquerels per gram. If you had a kilogram of radium versus a pure gram of uranium 238, the amount of becquerels would see in the radium would be exceedingly high. Therefore, because the uranium has such a long half-life—4.5 billion years—it will be there, it will generate radium.

If you look at it, 50 per cent of uranium would decay in 4.5 billion years, that is what half-life means. In 45 billion years we would be down from 1 per cent of that uranium. We can do some of these numbers. The uranium itself has a very low radioactivity per unit mass, radioactive decay. Radium does not, radium is very intense radioactive decay per mass. Radon is even more intent, it has a half-life of 3.8 days. The progeny of the decay product from that radon, in terms of the polonium, the bismuth and the lead—and there are a few stages

within that—ranges from fractions of a second through to minutes to years. They are intensely radioactive per unit time.

Because you have uranium there you will always have the generation of that whole decay chain, always. At the moment we have removed some of that radium, so the radon is slightly lower. Over time, and it is a slow time, as was pointed out by the Department of Environment and Climate Change yesterday and as I have highlighted earlier, over thousands of years you will get that radium build back up again, because the uranium is still there. In that sense that is the nature of the problem and that is why, understanding that, in 100 years time I would hope that Sydney is still here, but we still have that source term there. I think engineering technology changes and people build bigger houses, we want to dig up the site and redevelop it. It is a permanent risk that creates a problem for that site forever.

That is why I argue, based on the understanding of the nature of that radioactivity, understanding that decay chain and the fact that it will be there forever, as an engineer I still find that hard to accept. My parents just came back from six weeks in Europe and they visited Egypt. When you see the pyramids there that may be 5,000 years old, or less than 10,000 years old, we do not have a human analogue for things at last that long or longer. For me that is why I always argue that we need to come up with a management scenario, not a disposal scenario and get the material out of that site. That is the only way you will really remove the long-term risk at the site.

The Hon. RICK COLLESS: Very interesting stuff! Is it fair to say that if the radon emanating from that site is not an issue at present, it could become an issue down the track, as this process proceeds?

Dr MUDD: Absolutely. I think it could become an issue probably in two principal ways. One is through disturbance to the site or failure of the engineering measures that may be put on site in terms of any remediation strategy. The other is through ingrowth, which is the technical term, the increase in the radium content based on the decay from the uranium. Those two problems will always create an issue when it comes to radon. Therefore, we always have to monitor it. I was talking with Dr Young yesterday about the site that he remediated in Barnsdale, and I encourage the Committee to ask him about this. It is his area, not mine. They go back and monitor that site every two years. If you do that forever, that is a pretty big impost on governmet. I do not think that is said to have that sort site like that in a residential area. That site was Barnsdale. It was where they did the original pilot processing of Radium Hill ore in 1910, 1911, and that only involved about 40 to 50 tonnes of material.

I believe the volume of radioactive waste that was put into concrete bunkers, sealed in containers and so on and isolated in that fashion, like a good engineering approach—it is the type of approach that I would encourage to be considered for Hunters Hill in terms of storage at the Lucas Heights facility from ANSTO—that to me is the right approach. From 50 tonnes they generated hundreds of cubic metres of radioactive waste. Given that we believe there are probably at least a few thousand odd tonnes contaminated either as directly residual tailings from the site or from material that was contaminated by liquid waste disposal practices at the site, I think we can start to get an idea that we are dealing with something that is probably at least a few thousand cubic metres or more. That is probably a realistic number in terms of addressing the site once and for all, including all potential parts that are contaminated, not just 7 and 9.

The Hon. RICK COLLESS: In your submission you make the point that it should be excavated and transported to Lucas Heights. Do you believe that it is feasible to completely remove that radioactive threat that is there and all the material so that the radioactivity returns to ambient levels?

Dr MUDD: Absolutely. The trick and I suppose the caveat on that is to get a good characterisation of the material in the first place. That is why I heartily agreed with Mr Smith yesterday that there needs to be a broader test, there needs to be deeper testing done, there needs to be testing that includes all potential exposure pathways, not just gamma but looking at radionuclide uptake but also looking at radon and things like that. If the material is going to be excavated, then largely you can just use things such as gamma. It is not too expensive. It can be done. I think from a reward for effort ratio, if you look at it in that way, the depth you would need to drill might be, say, 10 metres at most. They can be drilled with hand over holes or you can get a rig mounted on the back of a ute or something like that, which a lot of consultants would have.

This type of investigation is not unique. It is something that is done quite commonly for former petrol stations and a lot of former industrial sites that have a legacy of contamination. So the characterisation can be

done very easily. It requires effort, it requires thoroughness and it requires good sampling techniques and so on, but that should be routine to any good consultant. As long as the characterisation is done quite well and we actually looked broader than just 7 and 9 and deal with the whole region, including property 11 and maybe 5, and just verifying that they are the only sites that have any residual issue, and if we can do some simple testing, maybe not the same frequency, the same depth or the same area, but you can do some testing that would add value to the process, give confidence to the community and therefore really make sure that we have got all the material. Once you have identified where all the material is, it should be a relatively easy exercise.

CHAIR: So you are suggesting less intensive testing over how big an area?

Dr MUDD: I think some of the maps, for example that were shown yesterday by Mr Smith—I have not seen that map myself—but certainly the immediate properties in the vicinity. There may be a radius of one or two properties, but also I think there is probably I guess a public issue here as well in order to demonstrate that there is no more residual contamination elsewhere. The other complicating factor is the tin smelter that used to be in that area, so of that sort of magnitude, certainly not for five kilometres around but somewhere of the order of maybe a few properties radius from 7 and 9.

The Hon. ROBERT BROWN: Just on a point of clarification, the residents who were here also expressed concern about surrounding streets, and it was mentioned about the tin smelter which was only just on the other side of Kellys Bush. Would it be prudent to do some non-obtrusive type testing in some of those areas perhaps, just as a bit of background?

Dr MUDD: Yes. One of the things you could do, I mean, you could do some surface gamma counts—

The Hon. ROBERT BROWN: That is just with a machine?

Dr MUDD: That is just with a proper environmental radiation detector. I will pass to Dr Young to talk about that more.

The Hon. ROBERT BROWN: Would that pick up things like where, say, during the building phase of some of the neighbourhoods things like retaining walls and fill? Would one of those machines pick up where fill had been dumped?

Dr MUDD: It should. Gamma is good at detecting different types of materials and even materials that are ostensibly natural materials that do not have any active source in them from uranium or from lithoriam wastes derived from the tin ore in terms of the monocyte and so on. That can be used as a first path. Certainly, if it is based on background gamma radiation of about .1 micrograys per hour would be the standard unit for that. Anything above that can be used as an indicator.

The Hon. RICK COLLESS: I found your paragraph on radium uptake through the garden vegetables and so on extremely concerning, given that radium is perceived by the body as a calcium.

Dr MUDD: That is right.

The Hon. RICK COLLESS: What are the ramifications of that in terms of garden things that may not be vegetables but cut flowers and cuttings coming into the house? Is it possible to get elevated levels of radiation from that aspect as well that would be dangerous?

Dr MUDD: Radium uptake in that sense, external to the body, would probably present a low radiation exposure pathway. In terms of uptake in vegetables, that is actually more significant internal radiation. If you ingest radium then that can be a much more significant biological exposure pathway. The health effects of that, I defer to my colleague Associate Professor Ruff. But certainly I think if you have radium uptake occurring, then it means that you have material right at the surface, and if you have material at the surface such that roots are within that material that is causing radium uptake, that is a real issue and I think it means you have a problem there. You would have elevated gamma radiation as well. You would have elevated radium. Certainly, I would never want my niece or nephews playing anywhere near materials like that. If you have people playing in the back yard, whether it is dust or soil getting under your fingernails, it is just abhorrent to think that kids could be playing in that sort of scenario. So it is an issue. We need to get good data on demonstrating all of those issues. That is one of the things we need to go through.

The Hon. RICK COLLESS: When you were doing your research on this did you come across any publicity articles about the dangers of eating vegetables grown on some of those sites?

Dr MUDD: Certainly my understanding of the history of the site is that when the tin smelter closed down in the early 1960s and that whole peninsular was looked at being redeveloped for residential, the Australian Atomic Energy Commission [AAEC]—the forerunner to the current ANSTO—did some testing on the site. They ignored radon and just looked at gamma radiation levels and also radium uptake in terms of soils. It was understood at the time that there was some radium uptake but it is below the health levels and exposure levels at that time. Since then radiation exposure standards have dropped significantly.

CHAIR: When was that?

Dr MUDD: That was about 1964, I believe that work was done. On that basis the AAEC—I think I always believed that they tend to underestimate the nature of these radiation risks. I think in some ways it is probably not necessarily hard to understand. They are used to dealing with reactive scenarios where the radiation levels are much higher. More environmental levels are probably something that they are less concerned about. I am not sure; they can speak for themselves, I guess. But certainly in my view when I look at the published literature that scenario was something that was recognised back in the 1960s when it was first approved to be residential and then in the 1970s someone obviously realised that that is not acceptable.

Since then in 1991 the radiation exposure standards for members of the public have come down a lot. It was the International Commission on Radiological Protection [ICRP], which is where Australia gets its national standards from, and that is now 1 millisievert a year. So I think if you have got a situation where there is radium uptake, to me it suggests there is a source term at the surface, and that raises not just radium uptake but a range of other issues, which means that would be a real problem.

The Hon. LYNDA VOLTZ: Is that the 1965 Department of Health report where they controlled the growing of beans, vegetables and parsley on No. 11?

Dr MUDD: I could not find actual reports at that time. The only papers I was able to find on the public record at the time, and I have searched extensively, and from many years in academia and research I have ultimate faith in librarians: they have never failed me yet. On the public record I was not able to find the original 1960s report.

The Hon. LYNDA VOLTZ: This one was provided to the committee by the solicitors for No. 11.

Dr MUDD: It may have come to light since but when I searched many years ago I was not able to find the original 1960s report. I was able to find a paper that was published in 1982 which was presented at the Australian Protection Society's annual conference in 1978, and it sighted some of the data from that report but I was not able to sight the actual report itself.

The Hon. HELEN WESTWOOD: Does the geology of the site present any additional risk in terms of radiation exposure? I am thinking specifically of the sandstone bed there. Is there a risk of leaching into the sandstone? If so, do we know what that risk will be and what are the options for managing it?

Dr MUDD: Understanding the nature of the process that was used in the 1910s, it was a very aggressive, very intensive chemical process and Radium Hill ore was, right from the first time it was discovered, always recognised as a very difficult ore to process and it required that level of aggressive chemical treatment to be able to extract the radium and uranium from it which of course was the problem they had in the 1950s when they went back to mine it for the nuclear weapons of the day. Given that, understanding what that means, there is potential for leaching and so on. Now I do not know, I mean, the residents can speak for themselves, if there are any groundwater bores or so on in the area, I am not quite sure. I certainly have not seen any data on groundwater in the area and the sandstones. But there are issues. I tend to think the greater risk is the fact that material is at the surface and I think that is where probably the greater pathways exist for exposure, both radiation as well as chemical.

The Hon. HELEN WESTWOOD: Yesterday the committee heard evidence that suggested that some surveying was being done inside the property at No. 11. The suggestion was, although the results are not in, that there is an increase of radon, or higher levels of radon inside that building than you would normally expect. Given that there was extensive excavation of No. 11 immediately under the building, or where the house was

constructed, what is the likely cause of increased radon inside that building if, as I say, it is demonstrated and I think if you had been to the site you will have seen, that it has been excavated right back to the rock?

Dr MUDD: One of the things in terms of trying to classify and actually identify where the source terms are that can give rise to that radon, gamma radiation cannot give you an idea where radon is coming from. Radon, because it is a gas, can diffuse through soil from a much deeper source than just at the surface. So if you have got material that was excavated, and material was removed all the way right down to bedrock or the sandstone, and there is no source term there, the only radon would be what is naturally coming out of the sandstone which would be a very low level.

So if there is waste there, and even if it was covered over with other sediment or other soil that was not contaminated, there would still be a degree of radon that could diffuse through that soil up into the surface environment. Now it depends on where that source term is; it depends on the building structure and things like that. I have not seen the detail on exactly how No. 11 is laid out with respect to where the waste is, how deep it is, how strong that waste term is there and things like that. I think, being an engineer I love detail, and I love data, and I like actually having real numbers to work with so I think we need a lot more data on that answer.

The Hon. HELEN WESTWOOD: Your conclusion to the committee is that the source of the contamination needs to be removed and then managed in a site that is not in an urban area such as the one that it is in. How easy it to define just what needs to be removed? Is there an agreed method for defining that amongst the experts in your field?

Dr MUDD: There are two different answers for that. One is the regulatory answer. What is the current regulatory standards and use those as a basis to set what the levels are or the levels are already set in terms of either public exposure, such as the 1 millisievert per year, or the way I tend to approach these things is looking at it from a risk-base point of view. That is why I tend to say, "It is always going to be a risk at that site". If we leave the material there there is always going to be some form of residual risk. It is hard to quantify. It is easy to qualify and understand the nature and the type of risk. It is hard to quantify exactly for the regulatory criteria of 1 millisievert per year. If you extrapolate not just in five years' time, but if you extrapolate 100 years or 1,000 years into the future I think to me the nature of that risk means that is why I advocate excavating all that material.

Consultants or others, and the regulators and the community can come up with a process to say, based on either soil tests, on how much radium is in the soil, based on either the gamma radiation levels, and we can say, well, if we have got a really good characterisation of the site we know that if we set the number—let us just use the number of, say, 0.5 micro grays per hour as a randomly chosen number, that gives us 2,000 tonnes of material to excavate. We know exactly where that is because we have extensively characterised vertically, horizontally and spatially across the whole site, the whole region. Now if we choose, say, 0.2 micro grays per hour as our number, maybe that means we excavate 7,000 tonnes. So I think a lot of that sort of approach depends on, well, we have characterised the site and which approach you are using in terms of the solutions. So I think there is a regulatory approach and then what I would call my more public approach.

I do not shy away from the fact I tend to make more public environmental approach and sometimes I would prefer to see regulators go a lot further than just the raw numbers that are involved in regulation. I happily admit that I get that from having visited similar sites where they are older mine sites—and other mine sites that are non-uranium, and you come back later on—having talked to actual uranium miners in Germany where their radon exposure led to about a one in four chance of lung cancer. That is again one of the studies that has been done on radon exposure and things like that. So when I look at these problems, and I have spoken to people and I have visited sites, and things like that, I tend to take a much more environmental and public approach to that, rather just looking at the raw numbers.

The Hon. HELEN WESTWOOD: I ask a question that is perhaps not so technical but I seek your opinion on it. In the work that you have done in your many pieces of research both here in Australia and across the world, are there many examples where it is actually the polluter that pays for the cleanup or is it invariably the taxpayer that ends up footing the bill for the pollution?

Dr MUDD: I cannot think of an example where the polluter pays. I will qualify that. In America the biggest site worldwide where we know that this type of problem occurs was Grand Junction where they had literally about 4,000 houses that had this problem and often a lot worse because of the uranium component that

was used to build the houses or it was excavated; it was used for fill material and houses were built over the top of that. That sort of scenario is worse than at Hunters Hill.

The period when that was done was the 1950s and in the 1950s all uranium in the United States was bought by the United States government and it was bought for nuclear weapons and in that way the contractor, even though the company operating the uranium mine, the Climax Uranium mill bought uranium for a number of different mines in the region, a private company operated the mill but the contract was with government and they believed that therefore they were responsible for that. It was done under government policy at the time and therefore government was responsible and government had to spend many, many millions on cleaning all those sites up. In that sense the polluter per se was the government indirectly. It was basically very similar in Pennsylvania in the United States of America.

You can get background raid on problems in indoor settings. Sometimes it can be the residents that have to pay because it is a natural problem and if the standards are there to look at the construction to mitigate against that, the residents have to pay for that. Other times it is a problem that was not recognised scientifically until the 1970s and the houses predated that and the government has stepped in and facilitated that. As a Melbournian I would not pretend to understand the nature of Sydney property prices but I do understand that the properties are valuable.

I reiterate some of the comments made by various people yesterday that this is something we need to be brave on. I do not think it should just be a simple matter of cost. It is a problem that is a century old. There is no way we could argue that the polluter should pay. They went out of business in 1915. It is part of our industrial heritage and legacy that we are dealing with. The Government should just say, "Okay, let's be brave and deal with the problem once and for all."

CHAIR: One issue that comes to mind for me when talking about excavation and removal, et cetera, my hometown of Byron Bay had a legacy of sandmining with a lot of fill under houses. I know it is a different product and process, but what was set up there was a plant to reprocess that material, removing and reusing the radioactive content to resolve the problem to a reasonable degree. Is that something that could occur in this instance or is that a totally inappropriate process to minimise the bulk?

Dr MUDD: If you look at the economics of trying to extract any residual value out of the material at Hunters Hill I cannot see how the economics would even remotely stack up. The way you would use a similar concept is some sort of entombment or some sort of reprocessing in order to improve the properties of the waste—as I said yesterday, maybe encasing it in cement to make it less susceptible to leaching, easier to manage and so on. That would be an approach that might be quite valuable.

Another idea that entered my mind, although I have not recommended it, is to excavate the material and send it to an existing tailing sand. Ideally it would be more appropriate to send to an existing uranium tailing sand such as Olympic dam and so on, but that is not something that would ever be really viable to be considered and the transport risks associated with that when you are talking 4,000 or 5,000 kilometres to get to South Australia—I suppose if you went inland it would probably only be a couple of thousand kilometres, but with the risk of that approach I would say, no. You want to minimise the amount of transport involved in this always and I think a site not that far away and I believe the Lucas Heights facility at ANSTO would be maybe 30 or 40 kilometres at most; if there is some capacity there, that could be done.

I do not believe you would be able to carry out that sort of process to en case it in concrete easily at the site. I do not know. I have a lot of faith in my engineers. We are good at coming up with ingenious solutions; whether it is to develop a mine, whether it is to build a tunnel or to do all sorts of infrastructure or other projects that we are asked to do. Maybe engineers and other consultants can come up with an even better solution than what we are talking about now, I am not sure, but certainly I have faith that we could come up with something like that.

CHAIR: There was another inquiry in this Parliament involved with the actual transport of nuclear waste. We discussed at that time low, medium and high-level nuclear waste. The material on the site, given that it is mixed with quite a volume of fill, natural and imported sands occurring on the site, what level of waste would you consider this to be?

Dr MUDD: I consider it to be low-level waste. If you use a framework of nuclear waste classification, intermediate and high-level waste is generally material associated with spent fuel or reprocessed materials that

are derived from spent fuel. Low-level waste are things like uranium tailings and a whole range of other things. I would set the classified as low-level waste. Other colleagues of mine perceive that the transport is such a great risk that they believed that the material should be kept at Hunters Hill. I do not agree with that. I think the context in an urban area where you have that type of material of low-level waste it is not appropriate to leave it there permanently. I think it needs to be excavated and we have to accept the risk, that short-term risk of transport and the remediation and excavation process in order to get a greater public good in the long term.

CHAIR: With that the low level waste in situ, is there any danger of theft and use in seriously antisocial activities? If that totally unrealistic or is that an issue that needs to be addressed?

Dr MUDD: Australia is required under the international obligations to safeguard all sites where we know uranium is in a form that could be an issue and the current legacy at Radium Hill itself in terms of the mine that was developed in the 1950s for the nuclear weapons program, which we invited the British to test at Maralinga, we still have to go back and monitor those sites. We have international obligations to protect those sites.

I have to double check, and I am happy to take that on notice if the Committee wants me to check on whether Hunters Hill would be considered significant enough under that sort of regime or not. I am not sure. Certainly the effort involved in getting it out would be a highly public exercise and not something that they could do very easily. It is not like the Radium Hill site where it is 30 kilometres off the highway; it is very remote and very awkward to get to. It is a high-profile area and something that the residents are ringing up about, so I do not think that it would be easily done in that sense. Given the nature of how hard it is to get uranium out of the material; we know that from the processing at the time in 1910 and also the processing that was done in the 1950s, it is not the easiest uranium to get out. It is very difficult.

CHAIR: The dispersal of it, not windblown, but I know in the case of my hometown Byron, a lot of people got some fill in their backyards and it was all over the town. It has been an ongoing process to remediate. Would a couple of cubic metres placed in backyards represent a significant problem?

Dr MUDD: It depends on how strong the source is? If that is right at the surface and you have radionuclides or uranium and radium in there, potentially that could be a real issue. We need to characterise that first and we need to make sure that is done properly.

CHAIR: Local residents dispute that photo as being the original mine, saying that, because of the geography of the area, it was most likely the tin processing plant further around the bay. You supplied that photo, did you not?

Dr MUDD: Yes, and all I can say is if it is wrong, then the South Australian Department of Mines have it wrong. It was sited as Woolwich, the radium refinery, and if it is wrong then the South Australian Department of Mines got it wrong in 1912. I do not know, I am not a local from the site. All I can go on is the public literature. When you look at the material that is there, and understanding how a tin smelter works, from my opinion it looks like it would be more likely to be the radium refinery. The radium refinery was not a very big process. You are only dealing with tens tonnes of material whereas the tin smelter would be dealing with hundreds of thousands of tonnes.

But again, I would defer to the locals on that; they are more likely to be accurate on that than me. All I can say is that I know the photo was published in the South Australian Department of Mines Mining Review in 1912—that is where I sourced it from—and it was cited as the Woolwich/Hunters Hill Radium Refinery.

CHAIR: You had a paper under review. Perhaps you could table that?

Dr MUDD: The radon paper? Yes, I am happy to.

CHAIR: Thank you very much. I am sure you would be happy to be available because we may, through the secretariat, ask you some further questions.

Dr MUDD: I am happy to help, whether on some of the technical aspects, whether there is more data you would like me to review. I am happy to help in whatever capacity the Committee feels appropriate.

CHAIR: Thank you for coming here from a long way away and for the time you have given.

(The witness withdrew)

PETER ANTHONY BURNS, Physicist, Australian Radiation Protection and Nuclear Safety Agency, 619 Lower Plenty Road, Yallambie, Victoria, affirmed and examined:

CHAIR: In what capacity are you appearing before the Committee, as an individual or as a representative of an organisation?

Mr BURNS: I am a representative of the Australian Radiation Protection and Nuclear Safety Agency [ARPANSA].

CHAIR: Are you conversant with the terms of reference of this inquiry?

Mr BURNS: I am.

CHAIR: Should you consider at any stage that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee please indicate that fact and the Committee will consider your request. Before questions do you have any statements or points you would like to make to the Committee?

Mr BURNS: I would like to make a brief summary of the submission that ARPANSA has put. The Australian Radiation Protection and Nuclear Safety Agency is a Commonwealth Government agency and it was formed in 1998 under the ARPANS Act. Among its functions is to promote uniformity of radiation protection and nuclear safety in Australia across the various jurisdictions of the Commonwealth States and Territories, all who have responsibilities in this area. The agency also provides advice on radiation protection and nuclear safety and it is actually the regulator of the Commonwealth Government agencies who use radiation sources.

In the agency we have three committees: the Radiation Health and Safety Advisory Council and underneath that a Nuclear Safety Committee and a Radiation Health Committee. The Radiation Health Committee is a committee that is the vehicle for promulgating national uniformity in Australia and has representatives of all the States and Territories regulatory authorities on that committee. The mechanism for making uniform recommendations is a national directory of radiation protection, which it has been agreed through all the States and Territories legislative bodies that those recommendations would then be adopted into their regulatory framework.

The work of the Radiation Health Committee is to produce standards, codes of practice and recommendations that fit in with the national directory, and this provides the basis for national uniform radiation protection arrangements in Australia. Prior to the establishment of ARPANSA the Radiation Health Standing Committee of the National Health and Medical Research Council promulgated standards and recommendations for the previous 50 years, and we have subsumed that function from the National Health and Medical Research Council now. The purpose of ARPANSA's submission is to provide information to the Committee relating to ARPANSA's understanding about ionising radiation, its health effects and a contemporary national and international framework for radiation protection.

ARPANSA carried out an assessment of the Hunters Hill site in 1999, or Egis Consulting Pty Ltd, who had been contracted by the New South Wales Department of Health to do a report on the site. So, we did radiation measurements on the site at that time. The submission aims to assist the Committee to address its terms of reference, but we do not intend to make recommendations as to what should be done on the site. You are probably all familiar with the site—Gavin Mudd has been talking to you for the last few hours about that—so there is not much need to go into detail there. But approximately 500 tonnes of uranium concentrate was processed on the site, producing 1.8 grams, and this give you an idea of the total amount of radioactivity that went through the site and what may be left behind.

The survey that we did seems to be compatible with all the surveys that I have seen—and I have not seen all the surveys—that levels of radiation exposure on the site vary from background to about 1.5 microSieverts per hour, which is about 10 to 20 times the normal background level, and that the activity concentrations of the soil is in the range of 1 to 10 Becquerels per gram. That is our understanding of the contamination of the site.

CHAIR: In Becquerels what is the normal background or what is the accepted background?

Mr BURNS: For uranium and thorium it is about 0.03, 0.04 Becquerels per gram in ordinary soil. So this is about 100 times what you would find in ordinary soil. That said, it varies quite a lot throughout the world, and there are plenty of places with 10 times the normal level and obviously there are places with hundreds of times the normal level—and you call those uranium mines. But it is a very variable quantity. The average background throughout the world is about 0.03, 0.04 for both uranium and thorium, radium being a part of the uranium decay series.

The system of radiation protection currently applied in Australia is based on a system set out by the International Commission on Radiological Protection in its 1990 recommendation. At that time the public dose limit was lowered from 5 milliSieverts per year to 1 milliSievert per year. This was as a result of studies in the 1980s that had shown that the effects of radiation were more serious than had previously been thought, and because of the increased risk that was perceived then the dose limits were lowered. At that time the commission also changed its recommendations about this type of situation where you have an existing exposure situation and it called those interventions where you might want to intervene into an existing situation and that they should be treated differently to planned exposures where somebody wants to do something in the future and there is no radiation exists at the moment.

So, it felt that it was inappropriate to actually apply strict dose limits to that situation because the situation already exists and the situation should be used following its optimisation approach where doses should be optimised so that the doses on such a site are controlled after doing a proper costs benefit analysis of how much good you are doing and how much time you are doing.

This comes down to the basis that we do not think there is a threshold for radiation health effects for these long-term chronic exposures and induction of cancer. We do not believe there is threshold, so there is no clearly defined boundary between what is safe and what is unsafe. Before the 1950s it was believed that the radiation effects were reddening of the skin and other severe effects and that they had a threshold. So, by staying below a limit, you could ensure that the effects did not occur. However, with this sort of exposure there is no clear boundary, so it is always a cost-benefit judgement of where you are going to stop doing more good and start doing more harm by intervening.

These recommendations have been reinforced by the International Commission on Radiological Protection in its 2007 recommendations, where it more explicitly makes recommendations for existing exposure situations and defines a range of dose constraints in a band of 1 to 20 millisieverts that should be applied in these types of situations. They are saying that for these situations, based on a cost-benefit analysis, you should select a dose criterion in the range of 1 to 20 millisieverts to assess whether the situation is safe. It is a reemphasis of the way in which radiation protection has been practised over the past 20 years, but it is a change from how things were done 40 or 50 years ago.

CHAIR: At one point you said that there is no safe level, that there is a varying natural background level and that we receive that radiation throughout our lives. Therefore, a cleanup operation could occur that would still not render that site to a level that your organisation would consider to be acceptable to live on. Is that a reasonable assessment?

Mr BURNS: I am saying that you really have to assess the cost of any cleanup and the impact on the site against the benefit you will achieve by doing that. It really depends on the dose assessed for people who might live on the site. There really needs to be a comprehensive assessment of what doses someone living on those sites might receive. To date a lot of work has been done measuring radiation levels on the site and activities of radium in the soil. But you need to translate those in terms of the dose to people on the site. Everyone on earth is exposed to background radiation. That comes from cosmic rays from outer space and radioactive materials in soil and rocks. There are pathways for soil and rocks. It can be direct external exposure.

We get about one-third of a millisievert a year from that source and one-third from cosmic rays from outer space on average at sea level. We all get about one-third of a millisievert from ingesting food that contains radioactive material. A normal diet will give people about 0.3 millisieverts from the radioactive materials in the food that we all ingest. Inhalation of radon gas is the biggest variable in the world. In Australia it is quite low at about 10 or 11 becquerels per cubic metre, whereas worldwide it is about 40 or 45 becquerels. In Australia it is about one-quarter of the worldwide average.

That said, there are plenty of homes in Australia in which the levels are several hundred becquerels per cubic metre and people get 10 millisieverts a year living in their own home from background radiation. There

are also places in Australia where the background radiation is 3 millisieverts and the background is normally about 1 millisievert per year from external radiation. The 2000 report of the United Nations Scientific Committee on the Effects of Atomic Radiation estimated that the worldwide average background is 2.4 millisieverts per year, which is 1.2 millisieverts from radon.

More importantly, the background level commonly varies throughout the world between 1 and 10 millisieverts a year. There are certain more isolated places where tens of millisieverts a year is known and the highest places on earth where the background radiation levels are 100 millisieverts a year. Against that background, the International Commission on Radiological Protection main commission ameliorated some of its recommendations. If you were to apply some of these measures to many existing homes, people would not be able to stay if it was determined that they could not receive more than 1 millisievert a year. We all get more than 1 millisievert a year from background radiation, but that needs to be put in the context of the added burden of some operation you are doing on people.

I will conclude by dealing with waste disposal remediation. If a decision were taken to remove the contaminated material from the site, it could be disposed of in compliance with the code of practice for near-surface disposal of radioactive waste in Australia, which was promulgated by the National Health and Medical Research Council in 1992. It is a code that we have not rewritten yet as part of the Australian Radiation Protection and Nuclear Safety Agency process because we still consider that most of it is relevant today. In 1999 the International Atomic Energy Agency published a safety requirements document dealing with the near-surface disposal of radioactive waste. That document has much the same obligations and requirements as the Australian code. The International Atomic Energy Agency has also recently published a safety guide on the clearance of bulk amounts of radioactive material from the regulatory system. For radium it considers that a level of 1 becquerel per gram is appropriate to allow bulk materials to be cleared from the regulatory system.

The Australian near-surface code defines the level that can be buried in a near-surface repository, which means within 10 to 20 metres from the surface. From 10 to 30 metres is considered to be near surface. It is then covered with five metres of clean fill. The level for radium for that sort of the area recommended in the code is 500 becquerels per gram, which is about 100 times the average concentration of material on the Hunters Hill site as far as I understand it from the measurements I have seen. That is a brief summary of the main points that we would like to make to the committee. I am happy to answer any questions.

CHAIR: You mentioned burial under five metres of clean fill. If the radon gas emanating from this type of site were buried in clean fill would that entrap it?

Mr BURNS: Yes, and that is the reason for the five metres. Radon will emanate through soils at one or two metres. However, the analysis done to determine those levels in that code said that five metres was sufficient to keep radon at that sort of activity concentration. So, if you built a house on top of the surface you would not get more than 1 millisievert a year. That was the criterion used in determining that level.

CHAIR: Similarly, cement capping of some sort would achieve the same.

Mr BURNS: Yes.

CHAIR: Page 4 of your submission refers to the extraction of radium from uranium ore on the site. It states that approximately 67 gigabecquerels—

Mr BURNS: One billion becquerels. It is a big number.

CHAIR: That was extracted from the 74 gigabecquerels of radium in the concentrate. This implies that up to 7 gigabecquerels was left on site. Can you explain that?

Mr BURNS: That is based on the work done by Gavin Mudd and the 1982 paper written by George Gandhi. That is the source of those numbers. If you have 500 tonnes of uranium concentrate and it is about 1.4 per cent average ore, that is about 7 tonnes of uranium, which is about 80 gigabecquerels of uranium. The radium would be in equilibrium after being there for millions of years. You would have 80 or 85 gigabecquerels of radium.

The evidence seems to be that 1.8 grams of radium was taken and processed from the site. A gram of radium is 37 gigabecquerels, so 1.8 grams is about 66 gigabecquerels. So you have a net shortfall of about 10

gigabecquerels of radium on the site. I did that estimate to give myself an idea of the total inventory we might be talking about on the site now. Obviously, if more material was processed or in larger volumes, given that radium was such a valuable material, one could be assured that they would have had reasonable inventories of what was coming on and going off.

CHAIR: In your submission on page 5 you state, "The dose is rather likely to be in an area where the scientific knowledge is still uncertain and uncontested." Could you elaborate on that?

Mr BURNS: Yes. We know the effects of radiation. As I say, before the 1950s, it was only then that we became aware that radiation, the long-term low level exposure to radiation, can cause cancer and hereditary effects. One of the first cancers that was observed was leukaemia. Doctors and radiologists who used X-ray equipment were showing increased leukaemia by the 1950s. Also, obviously in 1945, with the atomic bombings on Japan in Hiroshima and Nagasaki, by the mid-1950s the first evidence was coming of leukaemia among the survivors of that population. It is really the study of that population over the past 50 years that has provided the best evidence of the effects of radiation.

The Japanese survivors in the study—there were approximately 100,000 people in the study—received an average dose of approximately 240 millisieverts. That gives very good evidence of exposure at that level, hundreds of millisieverts. There is no controversy about those studies and the level of risk. From animal studies and biological studies on cells, it looks as though the damage that is caused to produce those cancers is produced all the way down to low doses. The theory was adopted that there is no threshold and that the response is linear right down to zero dose. It really comes down to an argument of: one radiation particle striking one cell can make that cell go cancerous, and therefore there is no threshold, and the risk goes all the way down.

Since that time there have been other epidemiological studies, which are tens of millisieverts, say, 50 millisieverts to 100 millisieverts, that show the effects of radiation and seem to be consistent with the Japanese bomb survivor data. However, you will never have an epidemiological study of 1 to 10 millisieverts because the number of cancers you are expecting to produce is so small against the background of cancer—20 per cent of all people die of cancer—that you will never be able to see it statistically. If you have got people with 10 millisieverts, you would need to study millions of people over 50 years, and you probably still would not be able to see the effect because the risk is so small. We estimate that the risk is about 1 in 20,000 for a millisievert or a few millisieverts. For a millisievert dose, the estimate is about 1 in 20,000 at producing a fatal cancer from that exposure. As I say, because 20 per cent of all people die of cancer, you will never see that small increase in a large population.

Then there is still uncertainty at the low levels. Some people will argue that there is a threshold and that there ought to be these protective mechanisms occurring at the cellular level, and you certainly can see those. But for radiation protection purposes, for pragmatic application of these and to be cautious, it is assumed that there is no threshold and there is an effect and these are the sorts of risks that apply. You can look at epidemiological studies of background radiation in areas where there is higher background, but nobody has yet shown an increased incidence of cancer in those areas. That is to be expected from what I explained before: that there is such a small increase that you probably would not be able to see it. But it does give comfort the other way—that the radiation risks are probably not a lot greater than what we think. We are in about the right ballpark.

CHAIR: Just on that general aspect, you mentioned one contact with one cell, potentially.

Mr BURNS: Yes.

CHAIR: Is radon a much greater danger in that respect in inhalation?

Mr BURNS: It is because radon emits alpha particles. When you breathe it into the lungs, the lungs receive the dose of alpha particles and it is one of the few areas of occupation exposure—uranium miners—where there is good epidemiological evidence of lung cancer being produced by radon exposure. These studies have been followed for the last 50 years of these miners. Recently there have been full studies of 13 countries in Europe for residential radon levels of hundreds of becquerels per cubic metre. Those studies show an excess relative risk of cancer among those populations. Again, the relative risk is similar to that which you get from the uranium miners.

But an alpha particle has a lot more energy than most gamma rays or beta particles. It loses its energy in a very short distance compared to the dimensions of the cell. Because an alpha particle creates more damage in the cell, it has a high radiation weighting factor, as we call it, and it is given a radiation weighting factor of 20. If you are measuring the dose to these people's lungs from alpha particles, you need to multiply by 20 to get the relative effect by exposing the lungs to gamma rays. Radon inhalation is a significant problem and a very variable problem.

CHAIR: Thank you for that information.

The Hon. RICK COLLESS: Mr Burns, are you aware of the Australian Radiation Service [ARS] methodology that was used to assess some of the sites in Nelson Parade?

Mr BURNS: No, I have not seen them. Presumably they have only been done in the last few months, have they?

The Hon. RICK COLLESS: Yes.

Mr BURNS: No, I have not seen those reports.

The Hon. RICK COLLESS: What about the Australian Nuclear Science and Technology Organisation [ANSTO] methodology? Are you aware of that?

Mr BURNS: No, I have not seen any of that either.

The Hon. RICK COLLESS: In your view, is it important to assess the risk of people living at No. 11 from things such as dust and particles? How would you assess the internal exposure from those things?

Mr BURNS: Yes, the question at the moment would be: What is the dose? What would be the dose to people living in No. 11? You need to do those sorts of assessments and measure the radon levels. I think that would be the most unknown question—what are the radon levels at No. 11? You need to measure those over a long period of time. Doing the particular measurement at a particular time will not necessarily answer that question because of the seasonal or diurnal fluctuations in the level of radon. It would be necessary to do long-term measurements by leaving it to the type of integrating radiation monitors that would give that answer.

The Hon. ROBERT BROWN: I have a layman's question on the effect of radon. I understand that radon gas is heavier than air. Is that so?

Mr BURNS: Yes.

The Hon. ROBERT BROWN: If you had radon present in an enclosure, such as a house, is radon capable of or can it be absorbed by things like carpets and soft furnishings or other fabrics in the building?

Mr BURNS: No.

The Hon. ROBERT BROWN: It has to be a free gas?

Mr BURNS: It is an inert gas. That is why it diffuses. It will not stick to anything.

The Hon. ROBERT BROWN: Okay.

Mr BURNS: It has a three-day half-life. It decays through various daughters, as we call them, in the chain, notably lead-214 and bismuth-214, which have half-lives of 26 minutes and 19 minutes. If you have a high ventilation rate, which most Australian homes have—

The Hon. ROBERT BROWN: Right.

Mr BURNS: That is why I say that the average levels in Australian homes are about 11 becquerels per cubic metre. That is because we can build our homes on stilts and there is an area below the floor space so that the radon does not come up into the home, and we can build homes with high ventilation rates with four or five air changes an hour. In northern Europe, you do not want to do that because you are losing all your valuable heat

and they have much lower air changes. Because of those reasons, because it is well ventilated, the radon coming into the building is ventilated out and does not build up whereas if you enclose the radon, you get a build-up of its daughter products, which are the main of vehicles transmitting a dose to a person breathing the air.

The Hon. ROBERT BROWN: If the radon gas is produced from the soil or is coming out of the soil, it has to then be transported into the enclosure, if it is not being produced from the fabric of the enclosure.

Mr BURNS: Yes, but it can emanate through the flooring, even if the floor is concrete.

The Hon. ROBERT BROWN: It can permeate through concrete?

Mr BURNS: Yes, it can. My home is built on a concrete slab. I know the levels of radiation in my home are about six or seven times the Australian average, but only twice the world average. There is radon in this room now. We are all breathing radon. You cannot avoid it.

The Hon. ROBERT BROWN: We have had statements that if it is under two metres of soil, radon can permeate through the soil.

Mr BURNS: Yes.

The Hon. ROBERT BROWN: If radon is heavier than air, radon would tend to stay on the ground when it came from under the ground, would it not, or flow across the ground?

Mr BURNS: Again, it depends on weather conditions, if there is a breeze it will blow away. It is usually in the morning, when the air is very still, inversion conditions often apply and that keeps the radon on the ground, like in open-cut uranium mines that is a problem at those times.

The Hon. ROBERT BROWN: In housing, in the home situation, in Australia would you be more likely to get a radon build-up in winter, because houses are enclosed?

Mr BURNS: Yes, more likely. But it is so variable it is very hard to say for any one house or situation what is going to happen.

The Hon. LYNDA VOLTZ: You mentioned seasonal changes and how they affect radon. Could you expand on that?

Mr BURNS: Because of the different weather patterns, whether an inversion layer is operating or whether it is very windy, and all those sorts of things.

The Hon. LYNDA VOLTZ: It is not a head-cold thing?

Mr BURNS: No.

The Hon. LYNDA VOLTZ: Earlier you said that 1.8 grams of radium was produced at the site.

Mr BURNS: That was from one of the Department of Health reports of 1978.

The Hon. LYNDA VOLTZ: Is that the 1.8 produced that may still be on the site?

Mr BURNS: No, that is what was sold, the product that was being produced for sale. At that time it was much more valuable than gold. Even though it was only 1.8 grams it was a very valuable commodity.

The Hon. LYNDA VOLTZ: The Department of Health estimated that there maybe up to half a gram on the site. Would that be possible?

Mr BURNS: Yes, that is quite possible, because 10 gigabecquerels is about a third of a gram or a quarter of a gram. Within the uncertainties of the historical record, yes, that is about the amount.

The Hon. LYNDA VOLTZ: It is more likely to be in that range rather than the two or three grams, because of the value of the radium?

Mr BURNS: I would have thought so.

The Hon. HELEN WESTWOOD: One of the key aspects of the evidence before the Committee is remediation of the site and the recommendations that the material should be removed and taken from the site. Given your knowledge of the site and the levels there, do you think that is an appropriate course of action?

Mr BURNS: I would not like to comment. It is for the New South Wales authorities to determine that.

The Hon. HELEN WESTWOOD: With your work with ARPANSA have you come across similar situations to this one?

Mr BURNS: Yes, someone referred to the Bairnsdale situation that was cleaned up. Also at Fishermans Bend in Melbourne, Victoria, the CSIRO had pilot plants for studying extracting methods for uranium from the 1940s and 1950s, they did a lot of uranium extraction. That resulted in contamination of that site. In the late 1970s and early 1980s the same sort of era we are talking about here. That site was cleaned up by the CSIRO and 10,000 tonnes of soil were removed from the site and they are currently stored at Woomera awaiting the establishment of the new surface disposal facility by the Commonwealth.

The Hon. LYNDA VOLTZ: The site now has a mandatory order under the Contaminated Land Management Act. Under that Act they will use the Radiation Control Act and its Regulation 1990. Do you think that is appropriate within the framework of the planning? Is it acceptable that they are the standards upon which they manage removal of contaminated lands?

Mr BURNS: The Radiation Control Act and Regulations in New South Wales have a system of licensing. In New South Wales, the same as the other States and Territories of Australia, they follow the codes, standards and recommendations of the Radiation Health Committee of ARPANSA. The code of practice for disposal of radioactive material by mere surface disposal would be applied as a result of that process to control the disposal of that sort of material.

CHAIR: In your opinion, given your knowledge of the levels and amount of contamination, is there a guideline or any regulation for protection, delineation, fencing, and signage on that site in its present condition?

Mr BURNS: Are there requirements to do that?

CHAIR: Yes.

Mr BURNS: I am not sure exactly what would apply in New South Wales, but there is no general requirement or general code of practice for the control of such a site that would delineate that by signs. Given the levels that are there you would have to see what level of regulation it came under.

The Hon. RICK COLLESS: Page 2 of your submission mentions the Radiation Health Committee and its functions. Does not that include setting threshold levels for cleanup, when cleanup should commence, and those sorts of things?

Mr BURNS: It has a variety of codes ostensibly being produced. It has not as much threshold levels as criteria, more within terms of those. But there is not a clear level at which it must be cleaned up. It is really like any site like this you would want to assess the doses that people might receive as a result of exposure to the site. Then you work it out in terms of the dose criteria.

The Hon. RICK COLLESS: Is the ARPANSA guideline for radiation exposure after a site has been remediated background plus 1 millisievert per year?

Mr BURNS: That is the present system, which goes back to the RCRP 1990 recommendations that 1 millisievert per year for members of the public is a target does. Often you would clean up to less than that, depending on how much cost would be involved. Again, it comes back to a cost effectiveness study. If you can reduce doses below that at very little cost, the present optimisation process recommends that that is what you

should do. It would be inordinately expensive to do that and create other risks, that may not be appropriate given the level of risk that you would be exposed to for some fraction of a millisievert per year.

The Hon. RICK COLLESS: What is your view on lots Nos. 7 and 9 in that regard?

Mr BURNS: I have not seen a comprehensive study that would tell me what the does would be in those properties. That is what you would need to know to be able to make that decision.

The Hon. RICK COLLESS: The Egis remediation plan that was drawn up in June 2000 claims that background is 2.25 millisieverts per year. What should the post-remediation level be there in that regard?

Mr BURNS: Sorry?

The Hon. RICK COLLESS: The 2.25 millisieverts per year in its current situation?

Mr BURNS: That presumes you are spending so much time in the contaminated area. The highest level on the site that I can recall is about1.5 microsieverts per hour. Given that there are 8,760 hours in a year, if you stood on top of that every year you would get about 10 millisieverts. To calculate the number of 2.4, presumes if you are in a house, what is the dose level in a house, how much time your going to spend there, what are the radon levels that you might breathe while you are there. You need to do all those calculations to get a proper estimate of does. But 2.5 millisieverts per year would not generally be seen as acceptable except in relatively extraordinary circumstances to allow people to get that dose.

The Hon. ROBERT BROWN: So that is a relatively high dose?

Mr BURNS: Yes. It is not a high dose in that it is a highly dangerous dose but it is an unacceptable risk to put on people for no reason if you can remove that risk at a relatively small cost.

CHAIR: How many, say, chest x-rays is that?

Mr BURNS: The chest x-ray does not actually give a big dose. It is about 50 or 60 microsieverts. The real problem in Australia at the moment is CT scans. CT scans give 10 to 20 millisieverts per scan. The dose to the Australian public will double this decade because of CT scans.

The Hon. ROBERT BROWN: Can you repeat that?

Mr BURNS: The average dose of a CT scan is 100 times a chest x-ray. A chest x-ray is only 50 to 100 microsieverts. A CT scan is 10 millisieverts to 20 millisieverts. If you have a CT scan of your head down to any large portion of your torso you will be getting that sort of dose. So it puts it in context.

The Hon. CHARLIE LYNN: You will die one way or another.

Mr BURNS: Obviously people can be very sick and it is important for their medical management to know what is wrong. There needs to be a careful cost-benefit judgment made with those people.

The Hon. HELEN WESTWOOD: One of the issues that has been brought up by a number of witnesses has been about the background levels and where they have been taken in terms of various surveys that have been done to determine levels. Can you explain to the Committee the relevance of background levels to health effects of radiation?

Mr BURNS: The background level in Australia, we would estimate, is about 1.5 millisieverts per year on average to people but there are plenty of people in Australia getting less than that and there are plenty of people getting more than that. There are areas of Australia in capital cities where the background radiation level is 3 millisieverts per year. At one millisievert a year, if you do a crude estimate, you could estimate that for the hundreds of Australians who die from cancer their cancer has been induced by background radiation. As I say, there is no real certainty at those levels of exposure that that is what will happen but background radiation is significant but it is variable. It is something we have grown up and live with, and we accept as a relatively low level of risk compared to the other risks that we normally are subjected to in everyday life.

The Hon. ROBERT BROWN: If checking was done on the sites and then relative sites were checked for background—it was stated here that the virgin bush areas in Kellys Bush adjacent to these sites was checked and a certain level of background was evident; I think I asked the witness at the time why it was necessarily relevant as people do not live in bushland, they live in the built environment, houses. In a suburban environment if you are doing background checks would you not check the built environment as a background?

Mr BURNS: Yes. I presume they went to the bushland to try to get away from any footprint from either the tin smelting or—

The Hon. ROBERT BROWN: The bushland is between the two.

Mr BURNS: —to try to get what the real background is. Normally in Australia the background level is .05 to .1 microsieverts per hour but it is quite likely, because it is a rocky, cliffy area, that the levels there could be higher, depending on what the natural level of radium and uranium is in the rocks there.

The Hon. ROBERT BROWN: Because of the geology.

Mr BURNS: Because of the geology. There are plenty of places in Australia where it will be two or three times higher. You would go to measure it in the bushland to find out what the real background is. You will never get down to .1 microsieverts per hour; it is always .2 or .3 microsieverts per hour because of the natural level that is in the rocks there.

(The witness withdrew)

(Short adjournment)

ANDREW HUMPERSON, General Manager, Government and Public Affairs, Australian Nuclear Science and Technology Organisation [ANSTO], New Illawarra Road, Lucas Heights, sworn and examined:

CATRIONA MARY MALONEY, General Manager, Safety and Radiation Services, Australian Nuclear Science and Technology Organisation, New Illawarra Road, Lucas Heights, and

STEVEN McINTOSH, Senior Adviser, Government Liaison, Australian Nuclear Science and Technology Organisation, New Illawarra Road, Lucas Heights, affirmed and examined:

CHAIR: In what capacity do you appear before the committee today?

Mrs MALONEY: In my capacity as general manager of radiation safety at ANSTO

Mr HUMPHERSON: In that capacity and on behalf of the organisation.

Mr McINTOSH: In that capacity.

CHAIR: Are you conversant with the terms of reference of this inquiry?

Mrs MALONEY: Yes, I am.

Mr HUMPHERSON: I am.

Mr McINTOSH: Yes.

CHAIR: If at any stage you consider that certain evidence you wish to give, or documents you may wish to tender, should be heard or seen only by the committee please indicate that fact and we will consider that request.

Mrs MALONEY: Thank you.

Mr HUMPHERSON: Thank you.

Mr McINTOSH: Thank you.

CHAIR: Do you want to make a statement?

Mr HUMPHERSON: If I could make a brief opening statement, I would appreciate the opportunity. Thank you for the opportunity to appear before the inquiry this morning to explain ANSTO's involvement with Nelson Parade, Hunters Hill. The Australian Nuclear Science and Technology Organisation [ANSTO] is the Australian Government's centre of expertise in nuclear science. As part of its functions, ANSTO provides various commercial radiation protection services, including site surveys and radiation measurements. ANSTO and its predecessor, the Australian Atomic Energy Commission [AAEC], have provided technical services in support of assessments of the Hunters Hill site on several occasions.

In 1977 staff of the then AAEC analysed soil samples from various locations in Nelson Parade. Dr B. W. Scott, a consultant physicist, performed the work as part of an assessment by the then New South Wales Health Commission. I understand Dr Scott's report has been provided to the committee. In 1987 ANSTO's staff analysed more than 250 soil samples from Nelson Parade at the request of a consultant company, Sinclair Knight and Partners, who had been contracted to submit a report to the New South Wales Department of Health. I understand that the ANSTO report has also been made available to the committee. In 2000, at the request of a private company, ANSTO conducted a field survey on No. 13 Nelson Parade. I understand this work was done as the site was under consideration for development.

In February 2008, ANSTO undertook testing on behalf of the New South Wales Department of Health. The scope of the request of work was to conduct indicative broad-scale radiation level measurements at various locations on Nelson Parade to compare with previous data that the department had. ANSTO was not requested to undertake soil tests or provide remediation advice. The work was conducted by ANSTO personnel, accompanied by representatives from the New South Wales Department of Environment and Climate Change

[DECC] and the Department of Health over two days using hand-held instruments. Results of the radiation surveys were documented and provided to NSW Health. This report also was commercial-in-confidence.

However, we understand that the Department of Health yesterday provided a copy to this inquiry. The results of ANSTO's analyses indicate the presence of radioactive material of the type used in the radium extraction operations that were carried out at the site in the early part of the last century. ANSTO's role in this matter has been limited to the provision of technical information. With the exception of the 2000 study, that information was provided for the purpose of enabling competent authorities to make informed decisions as to the future of the site. That concludes our opening statement, and we would be pleased to take questions.

The Hon. RICK COLLESS: Mr Humpherson, were the terms of reference for the Department of Health report to which you referred given to you by the Department of Health?

Mr HUMPHERSON: On that study?

The Hon. RICK COLLESS: Yes.

Mr HUMPHERSON: Can I ask Mrs Maloney to answer?

Mrs MALONEY: You are referring to the February 2008 study?

The Hon. RICK COLLESS: Yes.

Mrs MALONEY: The work was carried out consistent with a scope of documentation that we got from them. It was a documented request.

The Hon. RICK COLLESS: Was there any negotiation with NSW Health about the scope or terms?

Mrs MALONEY: There was, as there would be with any request, some clarification about what the expectation was before we got the documented request.

The Hon. RICK COLLESS: When I looked at it yesterday it struck me that the scope was entirely inadequate for what NSW Health was looking at, given the seriousness of the situation and the publicity it had been given. I am trying to determine whether NSW Health took advice from ANSTO or whether what was contained in that report was all its own work.

Mrs MALONEY: In other words, did they establish the scope?

The Hon. RICK COLLESS: Yes.

Mrs MALONEY: What they were looking for was an indication whether there had been changes from previous levels that had been measured and the like so there was some back and forth about how to do that. They also wanted results just in several days, and that is why we said that doing an indicative survey with gamma was the way to go. So there was back and forth on that.

The Hon. RICK COLLESS: Do you consider, given the complexity of the deposits of radioactive material on at least three, and possibly four blocks—I gather you walked around with a Geiger counter a metre off the ground?

Mrs MALONEY: That is right.

The Hon. RICK COLLESS: Do you think that was comprehensive enough given the situation there?

Mrs MALONEY: It certainly was not a comprehensive study. It was not intended to be. The request we had was to do some measurements to see if there had been changes from the work that had been done in 1999 and earlier work that had been done. It was a rough and ready indication.

CHAIR: Did you use the same process for assessment as the 1999 study?

Mrs MALONEY: The 1999 study was not carried out by us, that was one that Mr Burns referred to earlier; it was done by ARPANSA. The more detailed work we did was in 1987 and then we did a lot of soil samples. In fact, that was all the work we did then was soil sampling.

CHAIR: Can you compare those studies? The idea was to get some assessment in line with what had already been assessed in the past.

Mrs MALONEY: That was what the department wanted to do. They had the studies, they wanted new results to see how they compared back with the earlier data they had. So we did not do the comparison but that was what the department was wanting to do.

The Hon. RICK COLLESS: In the tests in February 2008 was there a reading of 0.46 micro sieverts per hour in a bedroom on the third level of No. 11?

Mrs MALONEY: May I check the report? I have it with me.

CHAIR: Yes. Yesterday the results made available to the committee related to No. 11, and not other areas. Is that correct?

The Hon. HELEN WESTWOOD: Yes.

Mrs MALONEY: Sorry, you were saying 0.46 for the bedroom?

The Hon. RICK COLLESS: Bedroom on the third level, yes.

Mrs MALONEY: That is correct.

The Hon. RICK COLLESS: Did you comment at all on that relatively high level at the time?

Mrs MALONEY: We provided the results as they were, that was it. There were no comments made about results. The department was provided with the data for all those spots.

The Hon. RICK COLLESS: Is the level that you found within the ARPANSA guidelines?

Mrs MALONEY: There are no specific guidelines per se. Mr Burns made reference earlier that one would need to know occupancy factors and the like. They are certainly well above background.

The Hon. RICK COLLESS: The Government now says that the ANSTO test proves that No. 11 is below the ARPANSA guidelines. Would you agree with that?

Mrs MALONEY: I do not believe there are appropriate guidelines against which one could make a statement. In other words, the hourly rate depends on the occupancy factor and I would also need to know what the radon was and the like. I do not believe we would have made such an assumption.

The Hon. RICK COLLESS: Can I ask your professional opinion now? Would you consider the level of 0.46 microseconds per hour to be too high in a residential situation for permanent occupants?

Mrs MALONEY: It is certainly something I will do further investigation to find out what was going on there.

The Hon. RICK COLLESS: What sort of further investigation would that entail?

Mrs MALONEY: I would do further characterisation of the site. It could be a very localised hot spot; it could be a more generalised area. There could be radon there. I would be doing more but it would certainly be at a level that I would want to investigate.

The Hon. RICK COLLESS: Did you make any recommendations back to NSW Health that further studies should be done to determine the cause?

Mrs MALONEY: No, we did not. That was not part of what we would have done. We knew we were providing information to the Health Department.

The Hon. RICK COLLESS: So you do not consider that, given your expert knowledge of these things as a member of ANSTO, you should be making some sort of comment on that?

Mrs MALONEY: When we are dealing with knowledgeable clients, as we were in this case, we are also aware that there is a State regulator who is going to be involved in the work there as well, it is appropriate that they do that work. If they come to us to get specific expertise and advice, we will give it, but otherwise it is not appropriate for us to do that. I would liken it to a physician seeking advice on blood tests or a laboratory that will do the work for the blood test and get the information back to the physician. They then make the diagnosis and decide on the treatment. That is a relationship that we had in this situation.

The Hon. HELEN WESTWOOD: In your submission I note that you state that ANSTO would not accept the contaminated soil or waste from the site at Hunters Hill for storage if the course of action were to remove that soil and then dispose of it. Can you tell the Committee why that is the case?

Mr McINTOSH: We did not say we would not accept; we said we cannot legally accept. I will give some background to that. Mr Burns mentioned the situation at the Fishermens Bend site in Victoria and the soil that was cleaned out. Once the soil was removed from Fishermens Bend, it was initially sent to ANSTO for storage. This was around 1990. Sutherland council brought an action in the New South Wales Land and Environment Court saying that the soil did not originate from ANSTO's activities and therefore it should be removed from the site.

They succeeded in their action in the Land and Environment Court. Our Act was then subsequently amended to come into line with that Land and Environment decision to restrict, not the type of waste that could be stored but the origin of the waste that could be stored at the site. Attachment A to our submission sets out the sort of waste we can store on the site and the waste that is currently at Hunters Hill does not fall within those categories of waste that we are allow to store so we could not legally do so.

The Hon. RICK COLLESS: Why was that the case? Was it outside the radioactive guidelines that you can store there?

Mr McINTOSH: No. We operate under legislation and the ANSTO Act was amended in the early 1990s to prevent us storing waste that did not originate from our own activities. There were some minor amendments a couple of years ago but that did not change that basic picture and that is where we still are today.

CHAIR: Did ANSTO or the Lucas Heights facility store medical waste from the Sydney area?

Mr McINTOSH: No, we store waste from the production of radio pharmaceuticals on our site but waste that is produced at a hospital, we do not.

CHAIR: So you have no facility for the storage of any waste other than what you have produced in your facility?

Mr McINTOSH: That is correct.

CHAIR: We have discussed the transport of nuclear waste in the past?

Mr McINTOSH: We have.

CHAIR: What do you see as a reasonable resolution to the material on site that we are discussing? How do we deal with it? A former witness has suggested an appropriate and adequate facility may be the ANSTO facility. You have ruled that out quite conclusively with the information that you have currently. What is the resolution?

Mr McINTOSH: The waste from Fishermens Bend which the New South Wales Land and Environment Court ordered be removed was then trucked to Woomera and sits in an aircraft hangar at Woomera today awaiting the availability of a Commonwealth facility. I am not sure exactly what the quantities are but I think we are roughly in the same ballpark, so the shipping of that sort of level and quantity of waste occurred

around 1990-91 from ANSTO to Woomera with no issues, so it seems to me that you could do the same sort of exercise again.

CHAIR: Essentially you would see if the waste is disposed of off-site, it would have to be taken to some facility similar to Woomera or the South Australian facility rather than something that could act as a local storage area like the presumption that others have given evidence that Lucas Heights would be a short trip and relatively safe?

Mr McINTOSH: Lucas Heights is legally unavailable. That legal problem applies specifically to Lucas Heights. It is possible, I guess, that you could drum it up and store it somewhere closer than Woomera. The material was trucked to Woomera for two reasons. The main reason is that it was trucked to defence land; it was Commonwealth land because it was Commonwealth waste. You do not face that issue with this waste because it is waste under the responsibility of the New South Wales Government.

CHAIR: You said "drum it up". I refer to Mrs Maloney on that. Given that your organisation has done testing on the site and you have a fairly good idea of the volume and radioactive levels of the material, what form would the storage have to take on a site, in your opinion and what sort of site could receive that sort of waste in Sydney, for example?

Mrs MALONEY: I would suggest that it could certainly be stored in an industrial type landfill but it would need to have some special characteristics, as Mr Burns talked about earlier. In other words, you would need to put a good depth of soil over it or some concrete cover. From a dust prevention point of view, it would be sensible to drum it to take it away rather than bulk it away. However, we need to bear in mind that we do not have good characterisation of the actual size of the hot spots; whether you are going to go in and do bulk removal or just go in and take out a few square metres at a time. That gets back to doing a much more detailed characterisation of the site to see what needs to be done.

CHAIR: Would you expect your organisation to be called on if there is subsequent action for remediation? Would you be called on to take on those more detailed assessments?

Mrs MALONEY: We have the capacity to do so but there are other organisations that could do it as well. We have certainly got the expertise to do the work.

Mr McINTOSH: Just to add: Ms Maloney has correctly stated that it depends upon the characterisation of the site for the volume of waste that you are talking about. I was talking about the volume in comparing it to the Fisherman's Bend waste. I was doing so on the basis of Dr Mudd's proposal this morning that the entire site should be cleared. As I say, it may be possible, depending upon the characterisation of the site. We are talking a smaller amount.

The Hon. ROBERT BROWN: Ms Maloney, you mentioned that there are other organisations who have a similar skill set to ANSTO in terms of monitoring and/or testing. Are there any other organisations that would have had the experience that ANSTO has had in things like methodologies of transportation and transportation?

Mrs MALONEY: You have to bear with me. As you probably guess by my accent, I am not an Australian; I have only been here a few years. I will defer to Steve in terms of other groups that have been involved in that.

Mr McINTOSH: As I say, there was that transportation of the Fisherman's Bend waste, which was transportation of large quantities of low-activity material.

The Hon. ROBERT BROWN: Managed by ANSTO?

Mr McINTOSH: Yes.

Mrs MALONEY: There are certainly companies here that deal with contaminated soil—reference was made earlier to petroleum sites and the like—and if you deem this to be just another contaminant then there are people who could do that. But there is certainly need for expertise and also regulatory oversight of what is going on. That is the international practice that there would be a regulator involved in setting the criteria.

The Hon. ROBERT BROWN: We have had evidence from the Department of Health that it is not just radioactive waste on the site that needs to be dealt with but that there is hydrocarbon waste.

Mrs MALONEY: It is mixed waste, yes.

The Hon. ROBERT BROWN: Normally are those other types of wastes stored with radioactive waste? For example, what I am trying to say is, if you recommended that the stuff be drummed to be taken off site, is there any issue with corrosive wastes mixed in with it that would prevent you from doing that?

Mrs MALONEY: That would be part of the characterisation to do that. If you look at any of the mixed wastes challenges that have been faced—I am more aware of the ones in North America—you do the characterisation, and then you set your strategy. Because it may be if you have got Mercury or something, that is much more important than the radioactives, or maybe vice versa: it depends on the characterisation.

The Hon. ROBERT BROWN: And if you do the characterisation—I assume characterisation, from what I have heard other witnesses describe, means that you actually have to sample down through the soil profile?

Mrs MALONEY: Yes.

The Hon. ROBERT BROWN: Is there any high danger level in carrying out those sorts of processes; in other words, auguring and handling the material and bringing the material to the surface? There are protocols for doing it?

Mrs MALONEY: The levels of radiation that we have seen—these are not ones that would be of concern for workers—we would certainly look at sanitary measures; in other words, making sure there is not inhalation of dust and the like, because that is going to be an issue. That is the type of thing. But it is not dangerous work if it is planned and overseen properly.

The Hon. ROBERT BROWN: Has ANSTO had any experience with either testing or handling of wastes in the maritime environment, underwater sediments?

Mrs MALONEY: The handling of waste, no, not that I am aware of. But we do a lot of characterisation of that type. We do experiments in those sorts of areas.

Mr McINTOSH: For instance, we did work on non-radioactive contaminants in Homebush Bay some years ago. So we do have experience in sampling sediments and telling you what is there.

Mrs MALONEY: If I could just add: There is international experience in doing clean-ups in the marine environment.

CHAIR: The upper levels of gamma radiation, which you would have measured, I understand you were measuring basic gamma radiation on the site. You are saying there that the upper levels that you found on site were not sufficiently high to do, in your expectation, any more than have workers on site that would need respiratory protection rather than actual protection from the radiation itself?

Mrs MALONEY: That is correct.

CHAIR: So there is no danger, in your opinion? Perhaps you could explain to the Committee what you see as the levels on site and the length of exposure before it becomes an issue—perhaps in this case gamma radiation?

Mrs MALONEY: Some of the levels we found there are ones that if they were to occur in Lucas Heights we would have people on restricted hours going into those areas. That would mean that they would not be working there for 2,000 hours a year, which is the restriction. It is highly unlikely that any one person would be in that type of situation with what we are dealing with here. As I say, to me, it is more of a sanitary issue of ensuring that, in other words, there is not ingestion; that the gamma itself for workers I do not think is a major issue. But since we do not know what is down there that is just the ambient gamma at surface. So obviously when you are starting to clean up, not necessarily when you characterise it, when you are cleaning up you would

have people monitoring what was going on to make sure that there was no hotspot there that was significantly higher.

CHAIR: There is a hotspot that we found, and the map showed, very close to the border of No. 11 and there are elevated radiation levels detected on the corner of a platform area, if you like, that has been built up on No. 11. Have you made any assessment of where that would have come from? Is it migrating just as the natural consequence of radiation on the adjoining lot? What would be the assessment of those levels on that particular site?

Mrs MALONEY: What it looks like is that the pattern of radiation there is consistent with material having been moved to be fill and things like that. There is little evidence of migration of radioactive material—in other words, not leaching from the soil. It looks like there has been ore transfer or it has been used for fill or somebody has chucked it from one area to another. I am not quite sure what has gone on.

CHAIR: So it is actual radioactive material on the site of 11, as far as you can see?

Mrs MALONEY: That is right. Obviously if there were a source—and this is speculatively—on No. 9, right on the edge, certainly you are going to get some radiation into No. 11. That is a possibility as well.

CHAIR: In your investigations doing what was required of you, which was a limited monitoring and looking at mainly the gamma radiation, in your experience did you have any questions about radon and the implications of radon gas?

Mrs MALONEY: Did we have any questions?

CHAIR: About radon gas—

Mrs MALONEY: Do you mean did people ask us about it or was it an issue for us?

CHAIR: I am just asking in your opinion would this have been an issue? With your experience is this not perhaps an even more significant issue for neighbouring properties?

Mrs MALONEY: It is certainly an issue, but, as I say, that was not the context for this study; this was just to see if there was a change in conditions from the last study that had been done. If we were setting up a characterisation study, radon would be one of the first things we would be looking at.

CHAIR: Did you make known to the other departments any concern about the lack of investigation into radon dispersal?

Mrs MALONEY: If I go back and say what we were looking at was an indicative study: if you see the gamma, knowing what the source is, you know you are going to have radon issues around.

CHAIR: Was that issue discussed at all? Because my understanding is the potential for radon contamination is perhaps a significantly greater issue than the potential for problems from the gamma radiation. Would you agree with that?

Mrs MALONEY: Radon is certainly more of a health implication than gamma. But the gamma is an indicator that you will get radon because of the material.

The Hon. LYNDA VOLTZ: I refer to the reports you did on No. 11. Are the figures you are using millisieverts or microsieverts?

Mrs MALONEY: Our version says microsieverts per hour.

The Hon. LYNDA VOLTZ: I am looking at the reports from both the Department of Health and from the Australian Radiation Services where they refer to effective dose limits of one millisievert.

Mrs MALONEY: It is one thousand times the microsievert.

The Hon. LYNDA VOLTZ: I am looking at that 46 figure on the first bedroom—and I understand that they are per hour. How does that relate?

Mrs MALONEY: With full occupancy, there are 8,000 hours in a year. You take that to 10,000. That would say that you have 4.6 millisieverts per year in that bedroom.

The Hon. LYNDA VOLTZ: So that is 0.46 as opposed to 1 millisievert being acceptable.

Mrs MALONEY: This is 0.46 microsieverts per hour. If you multiply that by 8,000, it is about 4 millisieverts a year. That is four times the limit.

Mr McINTOSH: That is assuming that someone was in the room 24 hours a day.

Mrs MALONEY: That is only if someone is getting it. But that is the dose being delivered over the year. Whether someone gets it is a different question.

The Hon. LYNDA VOLTZ: So when they have assumed United Nations Science Committee on the effects of Atomic Radiation occupancy factors, the calculated annual effective dose to an individual is in the range of 0.7 to 2.5 millisieverts above background. Is that right?

Mrs MALONEY: I do not understand.

The Hon. LYNDA VOLTZ: This is the Australian Radiation Services report.

Mrs MALONEY: I have not seen that report.

The Hon. LYNDA VOLTZ: It states that, considering the absorbed dose rates measured by Australian Radiation Services and those reported inside the house by the Australian Nuclear Science and Technology Organisation and assumed United Nations Science Committee on the Effects of Atomic Radiation occupancy factors, and so on. I assume that you know what they are. I do not.

Mrs MALONEY: I do not know the numbers, but I do know the concept.

The Hon. LYNDA VOLTZ: The calculated annual effective dose to an individual is in the range of 0.7 to 2.5 millisieverts. Is that right?

Mrs MALONEY: The uncertainty would be right. You will assume that people will be in a bedroom for no more than eight hours a day. That is the type of thing they would be—

The Hon. LYNDA VOLTZ: They are bringing that 4.6 back down based on occupancy rates.

Mrs MALONEY: Yes. Dr Young will be here this afternoon—

The Hon. LYNDA VOLTZ: And then they factor in on top of that the naturally occurring background. Is that correct?

Mrs MALONEY: That is in there.

The Hon. LYNDA VOLTZ: So you factored in the background?

Mrs MALONEY: Yes.

The Hon. LYNDA VOLTZ: I understand there are two different readings on background. One was taken at Kelly's Bush at about one point something and another came in at about 3.5. Is that correct?

Mrs MALONEY: As the committee was told earlier, background levels will vary. If you get natural background with very low levels of human intervention—in other words, no buildings and the like—you can get fairly consistent background readings unless you have rocks that contain uranium or deposits. You start getting variations in that case. However, our standard methodology is that we will try to go to an undisturbed area. That

is why we go into the bush to get a background. We will then do backgrounds in the local area. We did backgrounds on another road above where we knew the contamination was, because you get differences there.

The Hon. LYNDA VOLTZ: So your readings factored in the different geological factors in the area.

Mrs MALONEY: That is ambient. It is a measure—

The Hon. LYNDA VOLTZ: Is that standard practice for that kind of background reading?

Mrs MALONEY: Yes.

The Hon. LYNDA VOLTZ: So you would read over a number of different places.

Mrs MALONEY: Correct. If I were doing a survey in this room, for example, I would do a survey outside first. I would also look at who had undergone a nuclear medicine study or something else, and we would pick that up as a hotspot. We check the background.

The Hon. ROBERT BROWN: We have had evidence from the local residents' groups and from a number of scientists. The consensus appears to be that a broader area needs to be checked, even if it is only screening.

Mrs MALONEY: Yes.

The Hon. ROBERT BROWN: If that is to be recommended, what level of analysis should be done? I understand basic screening means walking around with a machine. Would that be a good enough indicator of whether material has been deposited on other properties?

Mrs MALONEY: That is certainly the first thing to do. That is the screening. You walk around with a meter and if it goes off you investigate further. You would also look at the historic records to see whether the company had a practice of burying things or if work had been done later. If you knew they had dumped material, you would try to find out where that had been done. You may find that people had buried things. Again, that is speculation, but it has happened in other places I have dealt with.

The Hon. ROBERT BROWN: The background checks that Ms Voltz was talking about were done at Kelly's Bush, which is virgin bush. There was a radium site and a tin smelter on the other side. It probably would not hurt to do broadscale checking in that area.

Mrs MALONEY: Given the possibility of contamination even from the tin smelter, it certainly would be a standard.

The Hon. ROBERT BROWN: Is it a fairly easy study to do?

Mrs MALONEY: I do not know the topography. If it is a cliff it gets dodgy.

The Hon. ROBERT BROWN: I realise that. I am talking about testing in the built environment—

Mrs MALONEY: It can be done.

The Hon. ROBERT BROWN: —as well as the bush.

CHAIR: Areas where there is likely to be human usage at varied levels.

Mrs MALONEY: I am aware of the practice in other contaminant situations. They will have done broad surveys like that. If the land has remained undisturbed they will go no further if they have not found anything. However, there will be notes on land deed or something that will say, "If you decide to build there or something else is going on you need to do further characterisation". From a cost-benefit point of view, that is seen as an appropriate thing to do.

CHAIR: I know that in other areas—and you have mentioned this—often with a major hotspot like this historically material has been moved to fill under a wall, fill a hole in a garden or moved to other areas.

Would it be reasonable to transfer the level of investigation you have done so far on the site to other sites in the area?

Mrs MALONEY: Yes.

CHAIR: Would that be something within the boundaries of the Department of Health? Would it be doable, understanding that it has certain budgetary constraints?

Mrs MALONEY: One would certainly need to consider the probability of contamination at some sites. You may well want to do soil characterisation, not necessarily because of radiation but because of chemical contaminants. The advantage of radiation is that you can find it walking around with a meter. It is not necessarily as easy with some of the other contaminants.

CHAIR: You mentioned the tables and what you figured in the background.

Mrs MALONEY: We did not figure in.

Mr McINTOSH: We did not figure it out.

Mrs MALONEY: God figures it in.

CHAIR: Are they above background or do they include the background?

Mrs MALONEY: It is including.

CHAIR: And in addition to the background.

CHAIR: In terms of the difficulties of assessment, the assessments you have made have been taken from walking over the surface of the ground. I understand that others have made more detailed assessments by actually digging into the ground. In terms of cost or difficulty of radon gas assessments, is this a more difficult and detailed process compared to what your organisation has done so far on the sites?

Mrs MALONEY: Radon measurements are quite feasible. They are very difficult to do in the open air, obviously, as we have talked about, with gas coming up and you have to trap things. Certainly indoors, in basements and inside buildings, they are very simple to do, and that methodology is standard.

CHAIR: It has been mentioned that there is really no safe lower level of irradiation, and that things like radon gas can be just a particle that is breathed in, and that can have a detrimental effect. Given your experience in the area of dealing with radiation levels from low to quite high, could you comment to the Committee how you deal with that situation and how you can assess the dangers of exposure to perhaps levels around what we are dealing with here, both with the radiation from uranium, the gamma radiation, and also from radon gas and the danger to workers or people living in those areas?

Mrs MALONEY: As you have been made aware, the public dose limit is 1 millisievert per year.

CHAIR: Of anything?

Mrs MALONEY: Of anything, yes. The dose limit is actually based in sieverts. I will go back. You measure the radiation, the energy, as Gray's. I think this may have come up yesterday because people are using different units.

CHAIR: It does not mean that we are wiser.

Mrs MALONEY: If you say it often enough, sometimes it clicks. I will try to do this. You measure that in Gray's, but since the alpha particles of radon are more detrimental than gamma, if you like, you have a weighting factor, as Mr Burns talked about earlier. When you translate from Gray to the seivert, the seivert is the unit of damage, if you like—potential damage. When we talk about a dose limit being in microsieverts, that does not matter whether it is radon, uranium, tritium or anything; that is the unit of damage; that is how you do the control for health. So, yes, it is from anything.

The public dose limit is 1 millisievert per year. For a worker, the limits are actually 20 times that. That is established on the assumption that it would be safe for a worker to be exposed to 20 millisieverts per year for the whole of his or her working life, but the public dose limit is set significantly below that because it is deemed to be unnecessary that the public would be exposed at that level, so that is what the control is.

CHAIR: Are you measuring the radon in terms of your precautionary position on it?

Mrs MALONEY: I am sorry, do we factor that in for worker doses?

CHAIR: If you are measuring radon gas and the potential issues that might arise in your area of expertise, in your institution, when dealing with these things on a regular basis.

Mrs MALONEY: Yes. The 1 millisievert would be from whatever source of radiation you are dealing with in that area.

The Hon. HELEN WESTWOOD: What I am not clear about in relation to the levels of background is that the evidence we have been given so far talks about levels of safety as though it is on top of background. I thought if the level was 1, whatever it is, if the ground is 0.25, it does not become a 1.25, does it? It is still 1.

Mrs MALONEY: The 1 relates to a man-made situation arising. It is on top of background, but remember, as we said earlier, background varies all over the place anyway.

The Hon. HELEN WESTWOOD: Yes.

Mrs MALONEY: It is a regulatory control, if you like. It is what is reasonable to look at.

The Hon. HELEN WESTWOOD: I am just not clear what its role is in terms of safety, such as absorption. If we are talking about its being unsafe at 1, whatever the background is, even if it is 0.9, it is not that 1 is unsafe, or that exceeding 1 is unsafe.

Mrs MALONEY: The irony is that 1 is not unsafe per se. It is just deemed to be unacceptable.

The Hon. HELEN WESTWOOD: Okay.

Mrs MALONEY: I think it is the same if you look at the risk of driving a car. There is a risk; we all know that, but if you stay within the speed limit and you keep awake and the like, it is safe. But is it absolutely safe? No. That is what we are talking about here with the radiation.

The Hon. LYNDA VOLTZ: So it is all about reducing as much as possible any external factor that has an impact on radiation.

Mrs MALONEY: That is right. It is having a reasonable risk-benefit.

CHAIR: Thank you very much for your attendance today.

The Hon. ROBERT BROWN: Your evidence has been very enlightening, Ms Maloney—very enlightening.

(The witnesses withdrew)

(Luncheon adjournment)

JOSEPH GLADMAN YOUNG, Principal Consultant Health Physicist, Australian Radiation Services Pty Ltd, Post Office Box 3103, Nunawading, Victoria, affirmed and examined:

CHAIR: In what capacity do you appear before the Committee, as an individual or a representative of an organisation?

Dr YOUNG: Representing Australian Radiation Services.

CHAIR: Are you conversant with the terms of reference of this inquiry?

Dr YOUNG: I am.

CHAIR: If you should consider at any stage that certain evidence you wish to give or documents you wish to tender should be heard or seen only by the Committee please indicate that and the Committee will consider your request.

Dr YOUNG: Thank you.

CHAIR: Would you like to give any information or make an opening statement?

Dr YOUNG: I would like to table two documents. The first is "Preliminary Assessment of 11 Nelson Parade, Hunters Hill", and the second is "A Background of Radiation Assessment of the Area" conducted this week at No. 11 Nelson Parade, Hunters Hill.

Documents tabled.

Also, I would like to make a statement. The following is a brief summary of the work undertaken by Australian Radiation Services Pty Ltd [ARS] in carrying out a preliminary radiation survey of No. 11 Nelson Parade, Hunters Hill in New South Wales. In March 2008, ARS was approached and asked if it was interested in undertaking an external gamma radiation survey of the site and how it would undertake such a survey. ARS set up a team comprising Dr Malcolm Cooper, a Consultant Environmental Scientist with ARS, Mr Darren Billingsley, Senior Health Physicist with ARS, and myself to work on the project.

We advised our client, Environmental Resources Management Australia Pty Ltd [ERM], that we would undertake an external gamma radiation survey of the site and, depending on the results of the radiation survey, we would decide if we needed to undertake a radionucleide assessment of the soil at the site. On 9 April 2008, Mr Billingsley visited the site with a contamination monitor, an ultrasensitive GR-135 minispectrometer and a mini 6-80/MC-71 environmental survey monitor. All the equipment that was used to undertake the radiation survey had current calibration stickers.

Mr Billingsley commenced his external gamma radiation survey of the site at around 11.30 a.m. on 9 April 2008. It was evident after a short time on site that he was identifying elevated external gamma radiation levels using the GR-135 hand-held minispectrometer. He then set up the environmental survey monitor on a stand and proceeded to undertake a three-metre by three-metre grid survey of the external gamma radiation level at one metre above the ground. So, 128 measurements were taken at 27 locations across the accessible sections of the backyard of No. 11. Because levels of gamma radiation can vary over short time periods, the measurements were undertaken with the environmental survey monitor and recorded in the intergrade mode over a long time to ensure that reliable and statistically valid data was collected.

The data was collected at some locations for over one hour with the environmental survey monitor. The environmental monitor has a linear response to dose rate over a wide dynamic range. The external dose rates for No. 11 Nelson parade varied from approximately .2 to 1.6 microgray per hour. The natural background radiation level measured by ARS, approximately 250 metres from No. 11, was found to be approximately .12 microgray per hour. The average external gamma radiation level across No. 11 was approximately .52 microgray per hour, approximately four times that of the background measured at Kellys Bush. The natural background radiation measures were recorded at the nearby Kellys Bush Reserve.

We later found out that that location possibly may have been contaminated with residue from a tin processing plant. Since we had measured elevated gamma radiation levels on No. 11 Nelson Parade, soil

samples were also taken. ERM took seven soil samples, some at surface level and some at depth, in order for ARS to assess the levels of radioactive material in the soil; or, more precisely, the activity concentration of the radionuclides in the soil. The soil samples taken along the boundary of No. 11, adjacent to No. 9 Nelson Parade, were the highest gamma dose rates recorded.

Each soil sample was prepared by drying, grinding and homogenising. A portion of each sample was transferred to its own standard plastic container and analysed using high-resolution gamma ray spectroscopy at the ARS laboratory. Three duplicate samples were sent to the National Radiation Laboratory [NRL] of New Zealand for independent assessment and quality control checks. Good agreement was obtained between ARS and NRL. The activity concentrations in the soil samples taken by ERM from No. 11, when compared to the soil sample taken from Kellys Bush, were between 50 and 350 times greater, depending on the type of radioactive material or radionuclide.

Based on our measurements and those of ANSTO, we estimated that the potential annual effective dose from external gamma radiation that someone could receive by residing at No. 11 Nelson Parade was approximately between .7 and 2.5 millisieverts above natural background radiation levels, based on assumptions listed in our report of May 2008, which we tender today.

I stated earlier that we were advised that Kellys Bush may have been contaminated with residue from a tin processing plant so we returned to Sydney this week and undertook a comprehensive series of background measurements with another highly sensitive environmental monitor, namely, a health physics instrument model 1010 iron chamber monitor. All measurements were taken over a lengthy period of time to ensure accurate dose rate measurements were obtained. Data collected from five locations showed that the typical background radiation levels in the area varied from approximately .02 to approximately .1 microgray per hour, as was expected, and an agreement with the published data for Australia and reported by the United Nations Committee on the Effects of Atomic Radiation [UNCEAR]. These measurements confirmed our original finding of .12 micrograys per hour in Kellys Bush in April 2008.

In addition, we also used a Rotem R200 hand-held protection monitor identical to the one used by ANSTO in the survey they conducted in February 2008. It was noted that at low dose rates near typical background radiation levels, the R200 underestimated the dose rate by approximately a factor of 2. However, when measuring dose rates such as those found at 11 Nelson Parade, the instrument performed to the manufacturer's design specification and good agreement was obtained between the health physics 1010 environmental monitor and the R200 monitor. As stated in our report of May 2008, to properly assess the potential effective dose to someone living at No. 11 Nelson Parade, it is important to estimate the dose that may be received from other sources and pathways of exposure. These include radon gas that may enter the dwelling from contaminated soil through the floor, inhalation and ingestion of dust particles, eating of vegetables and herbs grown in contaminated soil and physical contact with soil during residential use, for example, gardening, children playing, et cetera. That is the end of the statement, and I would like to tender the statement to the Committee.

CHAIR: Thank you. You are saying that at one stage of your investigation you used a machine that was the same as the equipment used by ANSTO, is that correct?

Dr YOUNG: That is correct.

CHAIR: Did you draw similar conclusions? If I understood it correctly, there was a certain level where there was differentiation between the surveys and another level where the equipment coincided in terms of the results that you found and that were previously found by ANSTO investigations. Can you explain the differences and then the similarities a little more?

Dr YOUNG: We placed the environmental monitor at one metre above the ground on a stable support and we started to integrate the radiation measurement at that point. I then placed the Rotem R200 beside the instrument and took a series of measurements with the Rotem R200. That was a natural background radiation level. The radiation level that was reported by the ANSTO monitor over-read by a factor of 2. We then took the two pieces of equipment to another site where there were elevated levels on Nelson Parade and we set them up against side by side and they both gave good agreement. The Rotem R200 monitor is a protection level instrument. If you use it at the .1, .2 microsieverts per hour level you are pushing it to its absolute maximum limit. It is not designed for doing environmental radiation surveys. It is a protection level instrument for use in elevated radiation levels. It is not suitable for background measurements.

CHAIR: In this monitoring process that you have done, exactly what types of radiation was your equipment able to measure?

Dr YOUNG: Both pieces of equipment, the Rotem R200 and the health physics environmental monitor, measure penetrating external gamma radiation. It does not measure radon. It does not measure radioactivity. It measures external penetrating gamma radiation.

CHAIR: Are you doing any radon testing as a separate effort to the gamma radiation testing?

Dr YOUNG: This was a preliminary study. When we were asked if we would do the work I set the boundaries of what I would do, and I said I would do the external gamma radiation measurements first. If the levels were elevated I would then do the activity concentrations or take soil samples. Once we got the results we then decide what is the next step after that, and the obvious step after that is to fully characterise the site and measure radon levels and do a complete analysis of the site.

CHAIR: At what we might term the filled or banked area near the boundary to lot 9, there is a recognised hotspot on the site. Can you give an opinion as to whether that is irradiated material in situ in the earth at that point on the site or is there a possibility that there is some sort of migration of radiation emissions from the next door site?

Dr YOUNG: I cannot comment on how the hotspot got there. There may be some small contribution from No. 9 towards it, but I suggest that a fuller assessment of the soil in that area would indicate that maybe it was just lifted up and placed there when it was spread.

The Hon. RICK COLLESS: Does the presence of the radioactive contamination of No. 11 present any danger to the human beings who may live on that property, in your opinion?

Dr YOUNG: The contamination level on No. 11 results in a chronic, long-term lasting exposure that gives no benefit to the residents of No. 11. They can contrast—if you have a medical exposure, for example, you receive a dose of radiation but because you are going to receive benefits from it then the risks of the radiation exposure are far outweighed from the benefits of having that procedure but there is no benefit to someone on that property receiving this additional exposure.

The Hon. RICK COLLESS: So the fact that it is there all the time is a chronic, long-term exposure rather than a short, sharp exposure.

Dr YOUNG: It is a long-term, lasting chronic exposure. It will be there for many, many thousands of years.

Dr YOUNG: Will that cause medical issues for the people living in that residence in the long term?

Dr YOUNG: I am not a general practitioner; I am a health physicist. I leave that to other more knowledgeable people.

The Hon. RICK COLLESS: Your results any different to the previous studies that were done on No. 11, in particular the ANSTO report of 1987?

Dr YOUNG: I have only looked at some of the results over the years and all the results are similar. They are measuring similar activity concentrations in the soil. They are measuring similar dose rates, external gamma radiation dose rates. So I do not see how our results vary much from the previous studies.

The Hon. RICK COLLESS: Have you assessed the risk from exposure to dust and particles to an occupier of No. 11?

Dr YOUNG: No, this was not part of this initial investigation because, as I said in my report, this is a preliminary investigation to look at it. Once we now know that there is a significantly elevated contamination level on the site, the next obvious part of the process would be to do a full characterisation of the site of No. 11 because we were not asked to look at Nos 7 or 9.

The Hon. RICK COLLESS: I think the point made by a number of witnesses is that there needs to be a full characterisation of the whole area. If this committee recommended a wider survey how would you go about it?

Dr YOUNG: Basically, I would organise a thorough investigation using the correct radiation monitoring equipment of the external gamma radiation across the entire site. I would then arrange to have detailed sampling of the site because it has been many years since the original survey was done. Once you have got the activity concentration from the soil, and the external background gamma radiation at the site, you can then start to make some decisions based on this information. Because you need that data before you can actually draw some conclusions of what you are going to do.

The Hon. RICK COLLESS: Are there any instruments that you would or would not use?

Dr YOUNG: If I was measuring the external gamma radiation level I would prefer to use very sensitive equipment, like the environmental ones that we use, which have a large and dynamic energy range. In other words, it will respond to radiation from a really broad spectrum and in that way you will get a much more accurate assessment of the radiation level at one metre above ground. That is for doing the external radiation site, you then have to use special equipment to measure the activity concentrations. Then when you come to do the radon measurements they can be done by several methods, but the three standards is using track H detectors, you can use a sniffer, a real time instrument, or you can use activity charcoal and do a grab sample. But I would prefer long-term measurements because it gives you a better average of what it is on the site.

The Hon. RICK COLLESS: In that regard is it the Rotem R200?

Dr YOUNG: The Rotem R200 is a protection level instrument. It is used in facilities where you are known to get radiation levels above 0.5 microsieverts per hour.

The Hon. RICK COLLESS: That instrument is not sufficiently sensitive enough of those lower readings—

Dr YOUNG: That is correct. It is not sensitive enough at the lower levels. However, the minute you get above 0.5 1 microsievert per hour it is more than adequate for the job.

The Hon. RICK COLLESS: The Bern Scott report recommended that when material is removed from this site that it should be tested with a Geiger counter or some appropriate instrument and separated into what we could loosely call hot and cold whites. Would you support that view? It needs to be treated and shipped out separately so that we get the hot stuff together.

Dr YOUNG: Waste minimisation is one of the most important parts of any radiation safety program. You have to minimise the amount of waste you are creating because it just causes a headache. When I cleaned up the Bairnsdale site a number of years ago which, funnily enough is residue from the Radium Hill smelter or mine, I instigated a system where we defined with one of our instruments—and I would not use a Geiger counter because it is not suitable—for this instrument I would use a highly sensitive sodium iodide detector. I then defined with this instrument what level of radiation corresponded to an activity concentration in a bulldozer's bucket because that is how much it was. What I did was, the bulldozer came in, dug up the soil, and took it to another part of the site where there was no activity concentration of elevated levels. I then measured the bucket and if it was radioactive it was stored. If it was below the level that we were looking at it was cleared from the site as non-radioactive. It took us several weeks to do it, but it was successfully done and noone was put at risk.

The Hon. RICK COLLESS: Did you supervise the process at Bairnsdale?

Dr YOUNG: My company carried out the remediation of the Bairnsdale site which was in the middle of the town of Bairnsdale in Victoria.

The Hon. RICK COLLESS: Are you confident that that same process could be applied at Hunters Hill?

Dr YOUNG: If the correct precautions are taken and the health physicists involved in the project know what they are doing, it should not cause an issue.

The Hon. HELEN WESTWOOD: If I can follow on that question on the Bairnsdale site, are we talking about similar levels of contamination that are at the Hunters Hill site?

Dr YOUNG: From memory, the radiation levels were higher than what was at Hunters Hill. At Bairnsdale in the TAFE college when the crusher was working, they would crush the ore, the stuff they did not want it was just thrown out the door and it accumulated outside the building so, therefore, you had different activity concentrations at different depths in the area. We went down to a depth of about three, four or five metres to remove the elevated contaminated soil.

The Hon. HELEN WESTWOOD: Following that remediation is the site now acceptable? Does it still present health risks?

Dr YOUNG: No, it does not present a health risk at the moment. On that site we segregated the hot stuff from the cold stuff and put it to one side. The cold stuff was taken away and put in normal landfill. The hot or contaminated soil was then placed in approximately six bunkers—because it has been a few years—on the site. The bunkers were capped with a concrete lid that was 150 millimetres thick of concrete. Then a large metal label was put on top saying that the bunker contained contaminated soil so that any future generations, if they ever stumbled across it, they would find it. We also placed it at several metres below the ground. We covered it with topsoil and we put a car park on top of it so it would have a very low occupancy. Then at the back part of the property, because we did it in two parts of the property, it was placed in an open parkland area off the TAFE college and again it was covered with several metres of, I cannot remember the exact thickness of covering, but it was covered with soil and then vegetated.

The Hon. HELEN WESTWOOD: Was any of it removed from the site?

Dr YOUNG: Yes, the only thing that was removed from the site was the radioactive materials that were below regulatory control. Because in Victoria, as in every State of Australia, there is a certain level of activity concentration that is regulated. The minute you get below that level then it is beyond regulated control and it can be disposed of as normal landfill.

The Hon. HELEN WESTWOOD: The analysis you did of the soils on this site, I understand from your evidence that someone else actually took those samples and sent them to your laboratory. Is that correct?

Dr YOUNG: No, what happened, and I will have to confirm this, Mr Billingsley who was on site doing the measurements with Environmental Resources Management, he observed them taking the samples from the ground. He observed the samples. We then sealed them in plastic containers, put a security seal on them, and we brought them back to Melbourne because we had a chain of custody so that noone could say that the samples had been tampered with from the time we took them to the time they were analysed. The samples that we had, as I said, we prepared the samples and then we took duplicate samples and sent them to the National Radiation Laboratory of New Zealand which is a worldwide expert in the management of this type of radioactive contamination.

It was just to confirm other measurements and also to give us quality control checks.

The Hon. HELEN WESTWOOD: So you know whereabouts on the site they are in terms of identifying those locations?

Dr YOUNG: We know exactly, yes, and that is why we know they were from the hot spots that we measured and we know it was directly adjacent from No. 9. We did not go on No. 9. We just took it purely from No. 11.

The Hon. HELEN WESTWOOD: Your clients, Environmental Resources Management, what is their interest in No. 11?

Dr YOUNG: I do not know. We were asked to carry out some measurements. If an organisation wants us to do measurements and they do it according to my criteria, I will do it. If they do not do it according to my criteria, I am not interested because then the survey would be flawed.

The Hon. LYNDA VOLTZ: On page 7 of your report there is a map which shows where you have taken testing from?

Dr YOUNG: Yes.

The Hon. LYNDA VOLTZ: If you go to the next page you have the normalised absorbed dose rate there?

Dr YOUNG: Yes.

The Hon. LYNDA VOLTZ: There it has "P and X reasonable high as is G and L". Have you seen the maps council provided yesterday based on the 1987 Scott Taylor report?

Dr YOUNG: We have not seen that report.

The Hon. LYNDA VOLTZ: Those overlays are consistent with another report provided by the Department of Health that also has the kind of hot spot radiation overlaid onto the sites?

Dr YOUNG: I am not familiar with that either.

The Hon. LYNDA VOLTZ: We would expect that where we are seeing these higher doses, where the bright reds are on those, to be the areas where you are going to get the higher radiation above ground?

Dr YOUNG: Assuming that background shows that red is hot and green is cold, then that would be correct.

The Hon. LYNDA VOLTZ: There is the scale there.

Dr YOUNG: The caption says that, yes.

The Hon. LYNDA VOLTZ: So when we overlay those, they will be pretty consistent with your findings, which were X and P, which are the really bright red spots that we are getting around the wall face there, and along the side of the house, and K and L. so we could probably say that there is some consistency about where there has been identification over a period of years about where the higher levels are. Would that be consistent, if your figures repeat what we have been shown somewhere else?

Dr YOUNG: That would be a fair assessment.

The Hon. LYNDA VOLTZ: There has been discussion and I still do not have it clear in my head. It is about the background readings and how you do them. I am not going to go into the technicalities because my brain will explode, but there has been evidence that in particular where there is bush rock and cliff face you will get higher levels of background reading—we have been to the site so we know it is a steep site with a lot of bush rock and sandstone—than in another area. I understand why you are getting the no impact background radiation, but how do we then translate that into the fact that we know there is that bush rock and that geological type view to that site?

Dr YOUNG: I will try and précis your question. Are you saying that the rock face may have elevated levels of naturally occurring radioactive materials and how do I know that my measurements are not picking it up?

The Hon. LYNDA VOLTZ: No. We have been told in this inquiry that quite often when you get that type of geology you do get higher background levels. The average may be about 1.2 to whatever, but in those instances it can be a lot higher because of the bush rock. I am looking at your report that we have only just been handed where you have taken readings. The only one on Nelson Parade is No. 11?

Dr YOUNG: Yes.

The Hon. LYNDA VOLTZ: Then you have gone to the street with a higher elevation at the back, the next street that runs parallel. You have gone to Nelson Parade and then you have gone up to the top of Wall Park?

Dr YOUNG: This is in the second?

The Hon. LYNDA VOLTZ: It says that No. 7 is actually the top of Nelson Parade but it looks to me like it is Prince Edward Parade up the top?

Dr YOUNG: It is an intersection.

The Hon. LYNDA VOLTZ: Yes, which is a much higher elevation. I am trying to ascertain why there are different background readings for different organisations. One explanation has been that you may get elevated levels in Nelson Parade, although I am not saying that is a fact in science, because of the type of geology and bush rock there?

Dr YOUNG: The main reason that different organisations measure different levels of natural background radiation level is that they have to use the right equipment. The equipment we used to measure the natural background radiation levels at the sites shown in this graph has been specially designed to measure natural background radiation levels.

The Hon. LYNDA VOLTZ: I understand that, but instead of standing at the front of 7 and 11, why not move up to the other end of Nelson Parade and take a reading?

Dr YOUNG: We could take the samples anywhere. We just decided that these places were suitable. You could do measurements until you are blue in the face. Our results have shown that at all of these sites we got a similar background radiation level at every one of the sites that we checked. I would like to tender these documents.

The Hon. LYNDA VOLTZ: Except on Nelson Parade though?

Dr YOUNG: Nelson Parade is different and in our report at Nelson Parade we did some measurements in the street of Nelson Parade, at street level, but you cannot use street level as giving a proper indication of the natural background radiation level because the actual materials used to construct a road may have been taken from the tin smelter or from Nelson Parade itself. You cannot measure natural background radiation level on a man-made construction.

The Hon. LYNDA VOLTZ: Do you look for similar urban and geological backgrounds to get an alternative background reading for that site? Different sites are always going to have different background levels.

Dr YOUNG: Yes, but it is not going to change within a few hundred metres all the time. You normally look at the sites and if you look at the photographs I have given you, we looked at natural scrub bushland, we looked at trees that looked as if they had been disturbed.

The Hon. LYNDA VOLTZ: What about the evidence that the bush rock that the houses were built on can make a difference to background reading levels?

Dr YOUNG: I do not deny that. I am not saying they do not but we took a survey across the entire area there. We did not measure every single square metre of it but we took a good representative sample from the natural bushland. That is what we tried to do. We were only a few hundred metres from some of these from Nelson Parade.

The Hon. LYNDA VOLTZ: But on an urbanised bush rock environment or—

The Hon. RICK COLLESS: On a point of clarification: Maybe you could clarify for the Committee the difference in the geological type in relation to background radiation, sandstone compared to granite compared to basalts and so on?

Dr YOUNG: I am not an expert in that area but granite will have a higher level of naturally occurring radioactive materials in it than sandstone and some other materials.

The Hon. LYNDA VOLTZ: That is not the question I am asking.

The Hon. RICK COLLESS: That is what was referred to earlier. Previous witnesses were referring to the higher levels that came out of the ground.

The Hon. LYNDA VOLTZ: They did talk about bush rock as well.

CHAIR: Perhaps for the benefit of the Committee you could explain what you are trying to prove here.

The Hon. LYNDA VOLTZ: I am not trying to prove anything. I am asking when you are measuring a background or something, what you want is a naturally occurring background to the area to which you are testing for radiation.

If I wanted to get the background for this room I would find a similar room in a similar circumstance. If someone is saying there is something special about this room what I would try and do is find a similar room in a similar circumstance and measure that.

Dr YOUNG: No, that is not correct.

The Hon. LYNDA VOLTZ: That is what I am asking you. Do you or do you not do that?

Dr YOUNG: What you do is move away from the area and try and find a natural situation that has not been disturbed by man; you do not want to look at anything that has been disturbed by man. If you find something that has not been disturbed by man you then take it there. We have monitored seven sites across the area and the background radiation level is between approximately 0.07 and 0.1 microsievert per hour, and that is consistent with numerous measurements done across Australia and reported by AINSE.

The Hon. LYNDA VOLTZ: So what you do not do is look for something that is urban and built-up, you look for the basic background one?

Dr YOUNG: Yes.

CHAIR: I think that was clear. You are looking for a natural background in that locale and you have proven that; you have got what you consider to be reasonable, natural background radiation levels?

Dr YOUNG: Yes.

CHAIR: And then you have assessed that and then you are looking at the site and you are able to say at that point the levels you are finding are additional to the natural background that you would expect to find in that area undisturbed?

Dr YOUNG: Correct.

CHAIR: Perhaps we can continue from that point. That is pretty clear what you are intending to do. Is that not clear to you?

The Hon. LYNDA VOLTZ: Yes, it is clear to me that that is what they have done. I was trying to relate it to some earlier evidence. We will move along.

The Hon. ROBERT BROWN: If we were to recommend that the Department of Health or EPA do some testing in the area of Nelson Parade and the surrounding areas just as a precaution in case any materials may have been removed from that site for garden fill, what sort of level of instrumentation would you use for that? Would you use the type of instrument that you referred to when you did your background checks or would you use a lower sensitivity instrument? In other words, if you are walking around the streets checking the built environment just to see if you could find any higher levels of radiation.

Dr YOUNG: What I would do is use a piece of equipment, a GR130 or GR135. This is an ultra sensitive handheld environmental monitor because that is the one that ANSTO has got and ARPANSA has got: it is a standard instrument.

The Hon. ROBERT BROWN: So everybody uses that type of instrument?

Dr YOUNG: It is a standard instrument, and everyone uses it to walk around and it can pick up very, very small changes in the natural background radiation level.

The Hon. ROBERT BROWN: We have heard lots of evidence to say that there will be varying levels because there was this particular industrial site and there was also another site on the other side of Kelly's Bush, a tin smelter, so there could be varying levels in the built environment. What we probably may be interested in doing is just as a precautionary principle seeing whether there are any other elevated areas around the neighbouring properties or properties a couple of streets away just to see if there was any movement of material. You could do that with those sorts of instruments?

Dr YOUNG: Yes. That is the standard way that we operate. If we are commissioned to do a job we go in, we then do a review of the site, we wander across the site with these instruments; if you find an elevated spot you move away from it; you check other areas; you come back to that spot. If it keeps giving an elevated reading you then come over and place your environmental monitor there and take absolute measurements.

The Hon. ROBERT BROWN: So you do not have to go digging holes and taking samples and all that sort of stuff?

Dr YOUNG: No. The GR130 and GR135 instruments are suitable for detecting radioactive samples or radiation sources between 10 and 50 centimetres below the ground.

The Hon. ROBERT BROWN: If you walk down a street and there is a retaining wall you would probably pick up radiation on the other side of the retaining wall?

Dr YOUNG: Correct. I could actually wander through this building and go near the brickwork and find elevated levels with that instrument. It is a highly sensitive, state-of-the art environmental monitor. It does not give you absolute measurements—you leave that to other devices—but it is ultra sensitive and it is ideal for picking up low levels, and that is what I would have used at No. 11 and that is what we did use. Any organisation who is asked to do an environmental survey of a site would use that type of instrument; they would not use a protection level instrument.

CHAIR: I understand you are currently or are going to do radon assessments of No. 11?

Dr YOUNG: We have not been asked to do radon measurements.

CHAIR: Are there any other further investigations you are doing on No. 11?

Dr YOUNG: We have not been asked to do any more work on it. We were asked to tender this to this Committee.

CHAIR: In terms of the Bairnsdale site you said the actual levels of radiation were higher than this site at Hunters Hill, or in parts—it was a hotter site. I appreciate you actually then opted or the authorities opted to encapsulate the hottest radiation on site. That sort of treatment, was it just a cement capping? I understand they put a car park over it. Was that a sort of an entombment under, over and around, so to speak?

Dr YOUNG: It was actually a concrete bunker with a base, four sides and a top. Each side and the base were 150 millimetres thick of reinforced concrete. The inside surface of the bunker was given a very, very thick coating of absorbent material so that nothing could leach out of it, and then the concrete lead was put on top and it was then screwed with massive bolts and then there was a big sign put on top of it to warn future generations that there is naturally occurring radioactive material contained in the bunker.

CHAIR: In terms of that process at Bairnsdale, I understand it was done in the town itself, in the central area, how does that rate with what is a rather difficult site, you might say, at Hunters Hill, given the topography, the rock formations, the slope of the ground and suchlike, and the area that you have actually got to work on if you are looking at 7 and 9 as the subject sites? If you were to be given that particular exercise would you be able to move around, separate and divide up between the hot and the cold materials and actually separate that on site? Would that be a feasible activity on that type of site?

Dr YOUNG: Personally I have never physically seen the site. My staff have told me it is very, very steep. According to Dr Mudd's presentation this morning, he said that he felt the engineering fraternity should be able to remediate the site. I would have to physically see the site myself and then make a decision if I would like to actually wander across the site and try and separate it, because I have never seen the site.

The Hon. ROBERT BROWN: Point of clarification. The evidence we heard this morning was he said yes, engineers could remediate the site but he also said that his recommendation would be to remove all the material off the site. Whether that means separating it or not I do not know, but it is an extremely steep site with a lot of terraces and native rock outcrops on it, and right at the back end of the site, down near the water, it is probably half the size again of this ceiling. So it is a very steep site.

The Hon. LYNDA VOLTZ: I am not sure if you can answer this question. I maybe should have asked the ANSTO representatives. They say radon gas seeps up from the ground—it is a very heavy gas that sets there—but would it pull out? For example, here where you have got the hot spots next to the house, if you were picking up radon, if you put a tester there and tested it, could it likely be that if you remediated these sites you would remove that problem—you tested it and that would be indicative? Or is it something that goes straight up and down? Is it something that would pull out from something that was up against a wall to you?

Dr YOUNG: As Mr Burns said this morning, as radon gas permeates the ground it can be blown in any direction depending on weather conditions. Once you remove the contaminated soils you would then remove that introduced hazard.

The Hon. LYNDA VOLTZ: If it was being picked up inside the house then it would have to be coming from something contaminated under the house as opposed to something bordering the house.

Dr YOUNG: That would be a fair assessment.

CHAIR: Dr Young, thank you very much. We may refer to you at a later stage if other questions arise. Thank you for your time and the material that you have given to the committee.

(The witness withdrew)

TILMAN ALFRED RUFF, Medical Association for Prevention of War, 52 Sussex Street, Brighton, affirmed and examined: the committee.

CHAIR: Thank you very much for appearing before the committee. Are you conversant with the terms of reference of this inquiry?

Professor RUFF: Yes.

CHAIR: Should you consider at any stage that certain evidence you wish to give or documents you wish to tender should be heard or seen only by the committee, please indicate that fact and the committee will consider your request.

Professor RUFF: I am sure that will not be necessary.

CHAIR: Before we proceed with questions, would you like to make a statement?

Professor RUFF: I am grateful for this opportunity particularly having been here for the day and having heard the other presentations and discussions. It might be most helpful as a public health physician to try to wrap up some of the concepts about radiation and the numbers and what that means in terms of human health consequences. I will proceed with a power-point presentation that covers those issues in brief. I would be pleased to provide it to the committee.

This is a brief overview of sources of environmental radiation, and I will focus particularly on health effects. Radiation is essentially moving energy and it comes in two forms, either as part of the electromagnetic spectrum in which we are all immersed every day, or as high-speed subatomic particles. Alpha is the most relevant in this context being the primary emission from some of the significant uranium decay products. It is called ionising radiation because it is able to knock off the electrons around atoms and cause charging of atoms and biological damage.

If you look at the spectrum of radiation from long waves and radio waves at one end, the ionising radiation is the high-energy radiation and x-rays and gamma rays are at the other end. They are very high-frequency, short wavelengths. It is part of the whole spectrum of electromagnetic radiation. These cause biological effects primarily via damage to the genetic blueprint of DNA by a variety of mechanisms. It is particularly efficient targeting of energy specifically at the macromolecules that are our genetic blueprint. Non-ionising radiation does not have the capacity to do that.

The different radiation types differ very much in their penetrating power. With an alpha particle, the key thing produced by the radon daughters is stopped by the few outer cells of our skin. So it is not an issue from an external point of view; it is an issue when you get it internally. Beta particles will pass through a modest amount of tissue. Gamma rays are similar to x-rays and will pass through substantial amounts of tissue and generally require shielding of substantial layers of concrete or metals such as lead to provide a reliable shield. Neutrons are even more highly penetrating. There are widely differing effects in terms of how far they will get into the body and how they will reach various organs.

I will provide a reminder about the sources of background radiation, which we are all immersed in. That is generally the bulk of the radiation we are exposed to. On average globally—although you have heard that it varies quite a lot—we get a couple of millisieverts per year. About half of the natural background radiation on average around the world comes from radon. It is a really important source of normal ubiquitous human radiation exposure.

As the committee has heard, the pathways are multiple. They may be external, and that is most easily measured. It is measured by the sort of monitors that Dr Young was talking about and the film badges that people who work with radiation wear. It can be via direct contact, inhaled or ingested via dust, food and environmental sources, particularly for children, or by breaks in the skin such as wounds. All of these things may be relevant to the doses that people get. It is very important to consider all of these possible pathways in their social context in terms of how people live and are exposed.

There are three ways that radiation is measured to recap some of the issues around the units. The becquerel is the radioactivity unit. It is essentially the amount of decay. It is how many atoms are disintegrating

per unit of time. It is a measure of how hot or how active the radioactive substance is in terms of decay. The energy absorbed by that radiation is measured in grays. That is the amount of energy that is absorbed per kilogram. The biological effect of the absorption of that energy is measured by sieverts. They measure not the energy but the biological damage it causes. It is the dose multiplied by a weighting factor that reflects the effectiveness of that particular type of radiation in causing biological damage. There are those three levels.

The different types of radiation differ significantly in how damaging they are biologically. So for gamma rays, the biologically effective dose is the same as the absorb dose, whereas for alpha particles it is a factor of 20. For the same dose of radiation in terms of absorbed energy there is 20 times as much biological damage. Again that is why—and I hope this is a recurring theme—radon is of such particular importance.

When uranium decays there is a long chain of substances that are produced starting from uranium 238.

You will see that what is emitted is also different from recent gamma that comes out at various stages, and that the half-lives are also very different. But the one that is of particular importance is radon with a relatively short half-life of just a couple of days. So it is pretty active, and its daughters have half-lives of minutes or days, a number of which produce alpha particles—these are a highly biologically damaging but not very penetrating form of radiation.

The half-lives vary enormously. But I think one very important point to make is that the half-life of the parent is so long that essentially you are talking about materials that, unless they are removed or managed and unless the source is eliminated, will be around and potentially expose people forever. They are not going to go away in any human time horizon.

This is a photomicrograph of an alpha particle in the lung of a dog, and these are the tracks of the alpha particles being emitted. You can see that they do not travel very far, but for the few cells that are immediately adjacent to that particle, they can get a very high radiation dose and the damage occurs when this material is inhaled when it enters the body.

Radon is produced in that decay chain from uranium. Its direct precursor is radium. It escapes into the air. Alpha particles are a key source of radioactivity from its progeny. Its progeny are more chemically active and so they stick to dust or aerosols in the air and are deposited in the lung when that is inhaled. They can deliver very high doses locally, but in a very localised area you will not be able to measure that externally. Globally it is the second most important cause of lung cancer next to tobacco smoking. It can get into houses by a variety of means—through the walls, through the floors, through gaps, through pipes and a whole variety of means.

The average outdoor levels are around 5 to 15 becquerels per cubic metre of air. The global indoor average, as you heard from Mr Burns, is about 40, and about half that in Australia. The action levels—the levels that are recommended by governments around the world that require remediation, and these are generally referring to indoor levels—are typically between 200 and 400 becquerels per cubic metre. Australia uses 200 as the action level. That is the kind of target that you really want to stay below. If you are getting up there, that certainly warrants remediation. As with radiation in general, there is a linear no threshold. There is no amount of radon, which has not been shown to cause some kind of biological effect. Simply, the more you get, the worse it is for you.

CHAIR: In terms of the "no safe level", it is a bit like a probability or Russian roulette. It is just a matter of a particle or particles lodged in a sensitive area, and that can cause a problem, even though it is a relatively low background level. Is that right?

Professor RUFF: That is right. It is essentially what is an acceptable, avoidable and manageable risk rather than some kind of cut-off, necessarily arbitrary, about what is safe or not safe.

CHAIR: What is safe or not safe?

Professor RUFF: Yes. So the risk is synergistic with smoking. It is much worse if you are exposed to high levels of radon and you smoke. There is some weak evidence that unlike for most other kinds of radiation with lower dose rates, when getting a smaller amount but the same total dose over a longer period, you may be worse off than getting the same dose over a shorter period, which is different for other forms of radiation exposure. The evidence for that is relatively weak, but some of the minor studies suggest that.

Thus to give you some sense of what sort of risk you are actually talking about, the issue with radon is lung cancer. For, say, a non-smoker or a smoker, your risk per 1,000 of getting lung cancer by age 75 if you are exposed essentially to no radon is about 4 in 1,000. For a smoker, it is about 100. That risk is increased significantly up near the recommended action level or limit level for radon exposure by roughly double from very low levels to the levels where it is recommended that remediation should occur. You can see that while the proportion is the same, in absolute risk terms, you are talking about a lot more lung cancers in smokers. Smokers are at particular heightened risk of adverse radiation effects from radon than are other people, but proportionally it is the same; it is just that these people are so much more at risk to start with. Radon does not add to that risk, but multiplies that risk.

Cells and tissues also vary in their sensitivity to radiation, and it is the cells, because when our DNA is most active is when the cell is dividing and is at its least robust, that are particularly susceptible. It is tissues that are rapidly dividing, such as the cells in the bone marrow that make blood, the gut-lining cells and foetal cells in young children, that are most susceptible to radiation. If you look at different tissues, there is a different weighting factor for the same amount of radiation in terms of the susceptibility of different tissues as well. It is the rapidly dividing tissues, such as the gonads that produce our reproductive cells, and the bone marrow and the gut—essentially the lining surfaces of the body and the lung—that have the highest radiation sensitivity. Your brain, where not much is happening in terms of cell division, is relatively radiation resistant.

What does this mean in terms of actual health risks? It is the capacity of radiation to damage this genetic blueprint that is the issue with the long term, particularly cancer effects and genetic effects. I think an important concept to get is that it is not a huge amount of energy that this involved: it is the packaging of that energy in a way to which our DNA is particularly susceptible that is the issue with ionising radiation. Different isotopes can behave differently biologically so that, for example, radium behaves like calcium, and so it is particularly deposited in teeth and bones and the consequence is high exposure, particularly as that relates to bone cancers and cancers of the blood-forming organs. Other radioisotopes behave differently. Many of them sort of mimic other normal naturally occurring substances and so are concentrated in different organs of the body and also are accumulated in the environment in different ways.

Then there are two different kinds of effects. There are effects that tend to occur acutely—so days, weeks, or months later—but generally occur at high doses for which there is a threshold, such as a burn on your skin or a cataract in your eye or sterility. Those sorts of things follow in high doses. If you get enough, everybody will get it. But that is not what we are talking about with the lower doses that we are talking about today. What we are talking about are the probabilistic effects whereby, if you get a cancer for which the risk is being increased by radiation, it is not different from a cancer that is caused by anything else, but it is the risk of getting that cancer that is increased by exposure to radiation. So there is no threshold for these effects.

The Hon. HELEN WESTWOOD: Professor Ruff, is that the same for everyone? Are there differences in individuals?

Professor RUFF: Yes. There are very significant differences. I will get to that.

The Hon. HELEN WESTWOOD: I do not mean environmental ones, such as smoking.

Professor RUFF: Yes. Definitely—genetic, and other. There is a long latency period involved in these effects. You do not expect to see effects from cancer production very quickly. For leukaemia it takes a minimum of five years before you would see any increase after exposure. For a solid cancer—so, that is, all the rest—you generally do not see any increase until about 10 years later. For the Hiroshima and Nagasaki survivors, the rates of cancer in those folk are still increasing more than 60 years after those exposures. There are some effects that are seen at high doses, that we do not have strong evidence for in terms of general degenerative disease, that make it clear that it is accelerated at high doses, but probably that does not happen at low doses. At least, the evidence is not there.

Cancer is really common. Approximately one in two men in Australia get cancer by 85 and about one in three women. Almost half of Australians will die with or because of cancer. So it is incredibly common. What you are looking at is an increase in something that is already fairly common.

Radiation risks are linear with no threshold. The increased risk of getting a cancer from 1 millisievert of radiation for solid cancers is approximately 1 in 10,000 and for leukaemia it is about one-tenth of that risk, so

about 1 in 100,000. About half of the patients overall, and this is excluding skin cancers, who get cancer can be expected to die from it. If you are looking at cancer death, then is about half that. These are the same figures that Mr Burns mentioned this morning. Increased risk of cancer death is about one in 20,000 per millisievert of exposure. Those are the sorts of numbers to remember.

Next slide: There are certain groups of people who are at particular risk and warrant particular attention. In infants it is clear that the risk is dramatically increased. Compared to young adults, infants are three or four times more sensitive to radiation damage than adults. Females, especially early in life, are at about twice the risk of males. Overall, the female risk of cancer, if you look at all ages, is almost 40 per cent greater for women than for men for the same dose of radiation.

The Hon. ROBERT BROWN: Point of clarification: Does the rate of probability increase linearly with the dosage from one millisievert up?

Professor RUFF: Yes.

The Hon. ROBERT BROWN: A straight line?

Professor RUFF: Yes, that is what all the radiation protection literature and standards are based on. Women are slightly at less risk of leukaemia, but significantly at greater risk of solid tumours. Though there are significant differences. The dosage levels that have been discussed are very much averages and there are particular groups in the population, especially young children, in utero and ex utero, who are particularly sensitive. If you multiply all of this you can have more than an order of magnitude, more than a 10-fold difference in susceptibility to a particular effect of radiation, depending on the age and sex of the person.

The Hon. HELEN WESTWOOD: Point of clarification: Is there any correlation in the greater risk for women of female-only cancers, such as breast, uterine, cervical or ovarian?

Professor RUFF: This is for all cancer. Clearly there are some that occur only in women, and some that occur only in men.

The Hon. HELEN WESTWOOD: It is not related to that?

Professor RUFF: This is not specific to a particular type; this is across the board. Obviously cervical cancer occurs only in women and prostate cancer occurs only in men.

The Hon. HELEN WESTWOOD: I wondered whether that was one of the factors in the greater risk.

Professor RUFF: It probably is, it may be. It is certainly not the only factor.

The Hon. HELEN WESTWOOD: Because of the organs and tissue involved?

Professor RUFF: Yes. Breast, uterine and cervical cancer feature prominently and that is probably part of the reason for that. The foetus is particularly vulnerable, especially in the early part, in the first trimester when nearly all of the organs are forming. At that time there is a very much greater sensitivity to risks of radiation. Next slide: For example, it has been shown from studies of when we used to do X-rays in pregnancy that a foetus getting a dose of 10 millisieverts increases the risk of leukaemia by about 40 per cent.

Next slide: This is putting it into a familiar medical context. You can apply this to any exposure and assess the risk. Basically, every doctor who orders imaging involving significant exposure should discuss these risks with their patients.

The Hon. ROBERT BROWN: Now you tell me.

Professor RUFF: A chest X-ray is only .02 of a millisievert, it is a tiny dose, it is really a negligible increase in the risk of getting a fatal cancer of about one in half a million. However, if you are talking about a CT scan that involves around 10 millisieverts, that will increase your risk of fatal cancer by about one in a thousand. That is related to the dose, it does not matter how you get it. Minimising radiation exposure from all sources is clearly highly desirable. You can see how those risks apply. One millisievert, one in 10,000 increases. Ten millisieverts, one in a thousand risk of fatal cancer.

Next slide: CT scan to increasing in getting ever more beautiful and more details, and that is a real problem in terms of increasing exposure of the population. Next slide: The same principles apply. One of the things I really want to convey to the Committee was that although there are very clear regulatory standards and a lot of science backing up the sort of levels and recommendations and risk estimates that you have seen, this is a highly contested area. Over the years, as we have learnt more, radio standards have never moved back up. It has never been less bad than we thought it was, as we learned more. The more we learn the worse it looks. Radiation protection standards have gone down below a factor of more than 20 in the last 50 years.

There are still significant new scientific findings that suggest that not all of the risks that may exist in calculated by these current risk estimates. As a public health physician, I say that a high level of caution is still required. I will show you a couple of bits of recent data that highlight that we do not yet know the whole story and there is some evidence that suggests that we still may not have discovered all of the risks that are radiation related. I will refer to two studies. One is the largest study that has ever been conducted of nuclear industry workers, including those at ANSTO, auspiced by the International Agency for Research on Cancer, the peak international body in this field. Almost half a million workers were involved, a very substantial study.

Next slide: They got an average of 19.4 millisieverts, pretty well monitored. If they were thought to has significant other exposures, non-photon or non-gamma exposures, they were excluded. Next slide: The estimates of cancer risk derived from this study, which is by far the biggest study of nuclear industry workers that has ever been undertaken, were several times higher than the risk estimates that were derived from the Hiroshima and Nagasaki data extrapolation from high doses. Normally, the thinking has been that if you get high doses acutely, the effect is greater than if you get the same dose staggered over a long time. This suggests that there may be an issue there. Those people had significantly higher rates of cancer than one would have predicted.

Next slide: There was a very important couple of studies done looking at residents in proximity to nuclear facilities, nuclear power plants, particularly childhood cancer, children obviously been most susceptible and childhood leukaemia being the most sensitive marker of radiation exposure. A larger study was done by some United States academics, sponsored by the US Department of Energy that reviewed all of the available data and was published last year. I will skip some of the detail in the next slide, but will leave the sides with the Committee.

Next slide: There were a number of statistically significant findings, especially for childhood leukaemia, for proximity of residence to nuclear power plants. Next slide: A study published a couple of months ago is the best study to date. In Germany, looking at the National Cancer Registry in Germany over a 23-year period, all of the cancer cases in kids under five found that for leukaemia and cancers overall there was a significant association, more than a doubling of leukaemia risks is a child live within five kilometres of a nuclear power plant.

Next slide: There is a very clear relationship between distance and risk. Next slide: The same sort of findings for cancer overall. The conventional science would tell us that that is not particularly plausible, because the measured doses involved are tiny—thousandths or hundredths of a millisievert. That is unexplained, but it is a very striking finding. I mention these not to create confusion, but because I really want to flag that radiation is a hazard and that the cut off between what you consider acceptable or unacceptable is based on a risk and a cost-benefit assessment. It is not safe or unsafe. The more we learn the worse it looks. There are some new findings that suggest that the effects of low-level radiation are still underestimated with these impressive recent signs. I am happy to answer any questions.

CHAIR: Thank you. If you could table that PowerPoint presentation, we would very much like to have that for our use.

The Hon. LYNDA VOLTZ: When you are talking about a millisievert, one of the things I want to understand is that when they measure in a gray as opposed to a millisievert, I am still trying to get the translation of these figures. If you have one millisievert, for example, and you are translating that to, say, one milligray, how do we perceive—because one is ionising radiation, is that right?

Professor RUFF: It is all talking about ionising radiation. You can talk about it essentially in three ways. As a measure of the activity, like how fast the thing is actually decaying, so a becquerel is one disintegration per second. How active is this decaying process that is going on? The second measure is in terms

of the radiation that it is producing, how much of it is there? That is measured by the amount of energy that radiation is deposited in the tissue, the unit of which is the gray. The sievert, what is the biological damage that correlates with that amount of dose of radiation delivered to the tissues? So it is moving from—

The Hon. LYNDA VOLTZ: How much is the gray?

Professor RUFF: —a level of radioactivity to an absorbed dose to the biological damage that correlates to that dose.

The Hon. LYNDA VOLTZ: So the one milligray of radiation does not equate to one millisievert, which is what you say is an acceptable level.

Professor RUFF: It does for gamma radiation.

The Hon. LYNDA VOLTZ: So milligray is almost the equivalent of a millisievert.

Professor RUFF: Yes. But for alpha particles, which are important in relation to radon, you need to multiply the gray by 20 to get the sievert. So for the same amount of energy delivered to the tissue, an alpha particle is 20 times as damaging as a gamma ray. That is why radon is such an issue.

CHAIR: In terms of radiation levels, looking at the land on Nelson Parade, for example, to say that there was an assessment done if February 2008 which indicated the exposure levels were within Australian radiation detected and nuclear safety agency recommendations for general public exposure. Am I correct in thinking you are saying that that is not really the way we should be looking at it?

Professor RUFF: No. I think in simple terms, .1 microsievert per hour or gray per hour for gamma radiation will correlate to about one millisievert per annum. So the levels that we have had presented today suggest significantly higher rates over a year than a millisievert. Of course, this is only one type of exposure. We are only talking about gamma radiation. We have not really seen anything in terms of radon measurements and I think those are important so there is clearly a lot of data that exists that has been collected in different ways by different groups at different times.

CHAIR: You are referring to this site here?

Professor RUFF: Yes. I certainly want to echo the need to fully characterise the site spatially and in terms of what is there, not just in terms of gamma radiation but also in terms of radon. That should ideally happen terrestrially, vertically and also into the marine environment, given the likelihood of significant volumes in the sediments close to shore but clearly pulling those data together and getting a comprehensive picture the gaps for what additional work might be required can then be identified. But it seems to me that what has been particularly missing is a comprehensive overview that puts all of this together and that maps the extent of this contamination. These were industrial facilities a century ago when there were no radiation protection standards. This stuff was moved and carted around and dumped freely, and people have moved around, I understand, as part of their landscaping works around their houses and sites. Who knows how far this might have gone? There are the additional issues related to the fact that there are two facilities, the radon facility and a tin smelter, both of which may involve both chemical and radioactive contamination.

CHAIR: Sorry, the tin smelter you are also saying could have a level of radioactive potential.

Professor RUFF: It may well, from uranium and thorium, which would commonly be in—

The Hon. LYNDA VOLTZ: I seek clarification on that. My understanding was that the State Government had purchased that site and remediated it and then had turned it into part of the bushlands. Is that not correct? The tin smelter may have been a remediated site.

CHAIR: I think that probably gets to another point where you remediate for a site to be lived on or remediate for a public space where there might be an average of an hour a day allowed for people to recreate on it but it does not necessarily mean that the material on the site is absolutely clean in terms of nuclear radiation.

The Hon. LYNDA VOLTZ: Yes but the point I am trying to make is that we are now talking about an alternative site. My understanding is that that site has already been the subject of remediation works and we do

not have anything for us to say anything other than it is a remediated site. So I am just wondering why we are raising it as an issue.

CHAIR: I was simply asking Professor Ruff—I would be a bit surprised if there was the potential for radiation materials from that other process.

Professor RUFF: I am not an expert on the details of the history of the site but I just wanted to make the point that both of those activities involve both chemical and radioactive risks and that in the context where these were activities that were conducted with thousands of tonnes of material a century ago at a time when there were no radiation protection or safety standards for workers or the public, with very poor documentation about the quantities involved and what was done. The full characterisation of what is there, which is essential, will not be able to rely very much on the historical record and will warrant a broader rather than a narrower assessment of the site in terms of the extent and the nature of the contamination, both radioactive and chemical.

CHAIR: That is all in line with the rapidly reducing safety levels for the whole industry that is being perceived with current or increasing knowledge of the issue.

Professor RUFF: That is right, and I think from the levels that have been presented today I would argue that it is very clear that those are unacceptable in an inhabited area and particularly in Australia's largest city and that full characterisation is necessary only as a prelude to full remediation of the site.

The Hon. HELEN WESTWOOD: That last research project you referred to, but the results around nuclear power stations, if we are to consider those in light of what we are studying here, which is the radiation at Hunters Hill, is it similar exposure? Does it compare to the situation we are dealing with in Hunters Hill, that is, living near or in close proximity to a nuclear power station such as that research project pointed to?

Professor RUFF: No, it is rather different. The nature of the exposure is rather different, but my point in presenting that was not to make a specific analogy of that kind but just to point out that if our knowledge about radiation and associated health risks is an evolving science and that it continues to evolve and that it continues to be rather controversial and that the historic tendency relentlessly and very consistently has been that the more we know the worse it looks. I do not think we still know the whole story because very well-designed and well-conducted studies such as these are providing findings that do not fit within the risk estimates that are the basis for our current regulatory guidelines.

Therefore I think a particular degree of caution is involved when you are discussing materials that are essentially permanently hazardous, particularly hazardous for vulnerable groups in the population, especially children. They are both more likely to be most highly exposed to dusts, to ingestion of soil, to wound exposures, as well as being inherently more susceptible to any radiation they absorb. The millisievert level exposures that are clearly going to be associated with the sort of contaminations levels that have been described are unacceptable in the short or the long-term.

The Hon. HELEN WESTWOOD: I know I did not frame my question very well. I was not suggesting they were the same levels, it is more are they same types of exposure that would be found around a nuclear power station as opposed to the sort of contamination we have got here. I am not talking about levels, I meant the same types of radiation?

Professor RUFF: No, they will be different. Here you are talking essentially about uranium decayed products and radon, and a whole mix of chemical toxins thrown in, heavy metals and solvents, and organics. In a nuclear power plant you are talking essentially about fishing products from the reactor. So the types of exposures to substances would be rather different.

CHAIR: So that radical exponential line would not apply in the case we are looking at?

Professor RUFF: That was in relation to distance from the facilities. So there is clearly something come out of the nuclear power plants that is more than we know about.

The Hon. HELEN WESTWOOD: Another thing that has been emphasised in the evidence the committee has received has been the issue of background levels. Given the linear threshold hypothesis how useful is the background levels in terms of assessing or measuring safety or risk? I still do not have a picture of that.

Professor RUFF: The background levels are important in the sense that we cannot do much about a lot of those. Clearly some we can, and whatever way we can minimise radiation exposures, whether it is by optimising use of medical x-rays, whether it is by reducing radon in dwellings, and a whole lot of other means, all of those are worth taking. But the point of measuring the background is so that you are able to discern what is the additional exposure that is related to the source term that is preventable or remedial that is of interest, in this case the contaminated soil from the radium smelter. So if you are measuring doses in a contaminated area you want to be able to compare them with something so that you can figure out what is attributable to the contamination, and what is natural background in that area.

The Hon. HELEN WESTWOOD: If you lived in an area that had an above normal background, is the risk of exposure the same as if you lived in an area with a lower background level? Alternatively, is it the level that is important, not the background?

Professor RUFF: Every little bit of exposure does a little bit of extra harm. It is not that background radiation is in some way intrinsically or biologically different from any other kind of radiation; it is all about the biologically effective dose that you get measured in sievert. It does not matter where it comes from or how you get it, every little bit affects.

The Hon. HELEN WESTWOOD: It just gives a measure to compare to?

Professor RUFF: Yes, so you can see what is the additional burden that is related to the source contamination.

The Hon. LYNDA VOLTZ: So it gives you your benchmark down to what you can remediate? So having the background level that is accurate for the site and the area that is what you want to bring it down to? It is what you can remediate?

Professor RUFF: Yes.

The Hon. ROBERT BROWN: The last graph you showed of the exponential curve in relation to distance from power stations, were you talking about the levels of dosage that were measured in the hundreds of microsievert?

Professor RUFF: These findings are unexplained but they are very consistent. My point was that on the basis of our current estimates of what we know is coming out of nuclear power plants and that populations in the vicinity are exposed to, we would not expect to see that.

The Hon. ROBERT BROWN: The level of sensitivity of the analysis was such that it was well below what background levels exist in urban Australia, was the purpose of that graph to demonstrate that you really cannot draw a line in the sand and say one millisievert is a level which is okay, and anything below that is not to be worried about? Is that what you are saying?

Professor RUFF: I think what I want to say is that we should minimise radiation exposures as much as we can.

The Hon. ROBERT BROWN: Above background?

Professor RUFF: Any radiation exposures—we should minimise them as much as we can wherever they come from. My point particularly was to inject a note of caution that this is not yet absolutely cut and dried, and that there may still be some surprises, and that this kind of evidence I showed you about the nuclear industry study and these childhood cancer studies suggest that low doses of radiation may be more injurious than is currently reflected in the regulatory guidelines, and that they might still move. So that there is an advantage in aiming for as low as achievable rather than to just get in below the cut off of one millisievert or any other defined level.

CHAIR: Thank you very much. It has been an excellent addition to the information the inquiry has and we will happily take the details. I think we might have been better off starting with those details. You have clarified a lot of problems I have had in understanding the dosage levels, the nuisances and the different types of grading. Your contribution has been invaluable. Thank you very much.

(The witness withdrew)

BENJAMIN SIDNEY NURSE, engineer, and

JULIENNE INGRID NURSE, tipstaff, 10/19 Queen Street, Newtown, affirmed and examined:

CHAIR: In what capacity do you appear before the committee?

Mr NURSE: As an individual.

Ms NURSE: As an individual.

CHAIR: Are you conversant with the terms of reference of this inquiry?

Mr NURSE: Yes.

Ms NURSE: Yes.

CHAIR: If you should consider at any stage that certain evidence you wish to give, or documents you may wish to tender should be heard or seen only by the committee, please indicate that fact and the committee will consider your request.

Mr NURSE: Yes.

Ms NURSE: Yes.

CHAIR: Would either or both of you like to make a statement or give information before we commence questions?

Ms NURSE: I would like to make the first statement. Firstly, the evidence that everyone is basing on the Scott report never indicated that radon testing was conducted within the house of 11 Nelson Parade. That should be clarified. It only ever refers to 7, 9 and 13. The evidence was supposed to come forward after that date and it was never provided, certainly not to us. Secondly, my issue with the inquiry would be if the Department of Health is going to make themselves available to residents and former residents, what form of testing are they going to provide and will it be transparent and will there be individual testers who we can trust? That is all I have to say.

CHAIR: Mr Nurse?

Mr NURSE: I did put in a submission that you probably all have. Being an engineer, I want to note a few things. The material delivered to the site was apparently 500 tonnes, which in layman's terms is 50, 10-tonne trucks, so that gives you a general indication of the amount of material that was delivered to the site. It might be on the site or it might be away from the site. In various things we were told there were no tests done to myself and the children, except the failed tests to Lucas Heights. We were to be given a series of tests done to test to see if there was any damage done. We were not given any tests other than to Lucas Heights.

Also, there was mention there were radon tests done in Hunters Hill. I do not remember them and I think the general theory is that if there is to be radon tests there has to be three months of tests to get absolute readings. I actually built the house and until such time as the Department of Health decided to buy the house my wife, who was Justice Mary Gaudron, and the children, had to move out on medical advice and I stayed at Hunters Hill until it was finally sold.

The house was sold to the Department of Health for approximately $250,000-odd where the house across the street was valued at round about $800,000-odd. The reason for this was that the house was valued by the Valuer General as an unhealthy site. In 1984 United States Surgeon recorded over 14,000 deaths from lung cancer and they advised that every single house in America should be tested for radon. There is not one Health Department in the whole of Australia that is testing for radon. I think the previous speaker would tend to indicate that radon is a very, very important thing and to not test for it is really silly. In America you can buy what they call gas sniffers for $115-odd to allow you to do preliminary tests and if it is over the level of 4, you should get further readings.

Also, I would like to see come out of the inquiry general public awareness of the danger of radon and that radon gas testing be carried out in the whole of Hunters Hill, not just on the site, and that the sites where tailings were dumped should also be tested. In other words, there should be a real public awareness of what this site represents. I have been financially affected. My daughter has thyroid cancer, which is due to radon radiation, so I am fully affected. There has been a large number of people who have had leukaemia and for some reason the Department of Health has kept it very, very quiet and an inquiry like this should bring out every single factor that does affect the public. What was previously a very important reading was that it affects children more than adults. That is what I think is fundamental to this inquiry.

CHAIR: Looking at your submission you said, "We also understand that large quantities were used as filling around Hunters Hill and further"?

Mr NURSE: Yes.

CHAIR: Do you have any clear recollection of removal of the material or placing it anywhere else in the local area?

Mr NURSE: Not when I was living there.

CHAIR: So what do you base that statement on?

Mr NURSE: On statements that when the plant was in operation, basically the radon oxide was sent to Madam Curie in France. It represents 1 per cent of the oil body, so 99 per cent of the oil body stayed there. The site came from larger and larger dumpings and then sold as filling all over Hunters Hill. I have been told recently that someone has been monitoring where this filling has gone and it has gone as far as Vaucluse, but I do have not got those readings. Someone has been collecting those.

CHAIR: Do you have any opportunity to get that information? Do you know who has collected that information and whether they could furnish it to the Committee?

Mr NURSE: I will try to get that.

CHAIR: That would be appreciated. In the submission from the Department of Environment and Conservation, which you have contradicted, it is said that the department measured the radon gas in No. 11 during the 1970s. You owned the house during that time. Do you recall the department ever doing any sort of survey to check for radon?

Mr NURSE: No survey. They could have measured it outside. I do not know. They could have wandered around the site and measured it. I am not quite sure.

Ms NURSE: We are not sure if the Tom Uren papers have been tabled.

CHAIR: I know there has been mention of Tom Uren raising the issue.

Ms NURSE: There is one internal letter within the Department of Health stating that a radon monitor should be put inside the house but within two weeks of that we were told not to worry about any radon tests, not to worry about any medical tests, that our health was completely safe, so somewhere along the line there was no radon testing put in.

The Hon. LYNDA VOLTZ: On a point of clarification: Have you actually seen the 1977 report by B.W. Scott?

Ms NURSE: I was only shown it yesterday.

The Hon. LYNDA VOLTZ: Are you aware that within that report there is a table showing 5, 7, 9 and 11?

Ms NURSE: Yes.

The Hon. LYNDA VOLTZ: The one on which 7 was based is where the table shows that radons were detectable and shows for 5, 9 and 11, that while there were no radons detectable, there was a very low range of daughters, which I understand, are the breakdown of radons, of 0.00?

Ms NURSE: Yes.

The Hon. LYNDA VOLTZ: You have not seen that report?

Ms NURSE: I only saw it yesterday. We do not recall anyone ever entering our house to do radon tests. If they were conducted, they were done on the land and not shown to us.

CHAIR: Perhaps if you could table those papers the Committee would be able to assess that.

Documents tabled.

Ms NURSE: They are basically from the period January 1977 to March 1977 and the Scott report came out in April. I cannot imagine how the data could change between February and April.

CHAIR: You do not recall anyone testing for radon on No. 11 during the time that you owned the property?

Mr NURSE: No. In fact, around about 1976 the Department of Health had no radon testing equipment at all. Equipment was leased from a New York company and then the Department of Health decided it was a useful piece of equipment and they would keep it. At that stage there were very few people fully trained in its use.

CHAIR: This is specific equipment to test radon rather than other radiation emissions?

Mr NURSE: Just radon.

The Hon. HELEN WESTWOOD: Just a point of clarification. What years were you actually living at No. 11 Nelson Parade?

Ms NURSE: 1974 to 1980.

CHAIR: They were the years that you owned the property or were they the years you were there?

Ms NURSE: They were the years we lived there and my father developed it the two years before that.

Mr NURSE: No, one year.

CHAIR: So 1973 to 1980. We had a look at a bedroom on the third floor down on the eastern side of the property. Whose bedroom was that?

Mr NURSE: Our daughter Danielle, who had cancer of the thyroid.

CHAIR: She was raised there in her early years?

Mr NURSE: Yes.

CHAIR: Do you have any conditions if ANSTO, for example, was to do further testing on the Nelson Parade site? Do you have any specific conditions or issues that you would like to highlight at this point in time as to how they would go about it and what you would see as a satisfactory level of assessment?

Ms NURSE: I think, based on the material that has come out in the last two days, the testing is quite different between the Australian Radiation Services and ANSTO, so we would like them to do it in conjunction perhaps with another independent authority so that we can have absolute, unequivocal testing of the site.

The Hon. RICK COLLESS: Mr Nurse, you built the house in 1973, I think you just told us?

Mr NURSE: Yes.

The Hon. RICK COLLESS: Did the health department know that that site was contaminated before the house was built?

Mr NURSE: We paid $30 for a health certificate, which said the land was clear.

The Hon. RICK COLLESS: So you had no warning of the contamination that was there prior to building it?

Mr NURSE: No.

The Hon. RICK COLLESS: When did you become aware that those radiation concerns were there?

Mr NURSE: We were told that a retired professor from the Blue Mountains was investigating cancer clusters and he noted that there was a large cancer cluster in Nelson Parade. This then started the ball rolling, and that is when we heard about it. I do not know who the professor was but I think perhaps the health department might know.

The Hon. RICK COLLESS: What did the health department ask your family to do at that stage?

Mr NURSE: Nothing. They said it was healthy land. But they then carried out some tests.

The Hon. RICK COLLESS: Were you shown the results of any of those tests?

Mr NURSE: The tests were on us. We went down to Lucas Heights and had tests done there.

The Hon. RICK COLLESS: But not on the house?

Mr NURSE: Not on the house, no. I wanted to find out if we were affected by radon. The equipment failed; we were also told we were to be sent down to Melbourne Hospital that specialised in measuring radon effects of the lung. We were not sent down; we do not know why. We were also told that we were going to go out to Lidcombe Hospital, which was a Department of Health hospital; we were not sent out. That is when my wife panicked and she was told that the house was unsafe and she then left with the two kids and I was to stay there until they were to get the Department of Health to buy it.

CHAIR: Just a point of clarification there. In terms of the requests that were made and the investigations that were carried out, you keep saying "radon". Were your issues directly related to radon exposure as opposed to exposure from other forms of radiation?

Mr NURSE: Mainly because it was radon that they mentioned. That is why they got this equipment in from New York that they thought would be a useful piece of equipment to have and test.

The Hon. RICK COLLESS: You sold No. 11 in 1980?

Mr NURSE: Could be, yes.

The Hon. RICK COLLESS: Who did you sell it to?

Mr NURSE: The Department of Health.

The Hon. RICK COLLESS: Why did they want to buy it then?

Mr NURSE: They didn't want to buy it; they were compelled to buy it. They decided to, I suppose, satisfy the excuse for buying it by installing Department of Health officers in the house. So for at least 3 or 4 years, or it might be even longer periods of time, there were Department of Health officers occupying the place as offices.

The Hon. RICK COLLESS: If you do not want to answer this question I will understand why, but do you feel that you were given the market price for the place at the time?

Mr NURSE: No. The Valuer General valued it on the basis that it was an unhealthy site, so consequently that was the largest figure that they would be prepared to give. Obviously I do not consider it to be a fair price, and at that stage, as you know—

The Hon. RICK COLLESS: Could I ask you then if you think it was below the market price if it was not regarded as an unhealthy site?

Mr NURSE: The houses on the other side that was sold were roughly valued—and I think even the Valuer General must have mentioned it—at least $800,000-odd. So it was about close to about one-third of its value. Our solicitors then looked at suing the Department of Health because of the Department of Health certificate, but at that stage the defence was that the Crown could not be sued.

The Hon. RICK COLLESS: Were any provisions put on that sale, do you know?

Mr NURSE: No.

The Hon. RICK COLLESS: Do you have any knowledge of any bags of material that were placed on the foreshore?

Mr NURSE: Before we arrived there was talk about having the site cleared. The unions opposed the movement of any material from the site because they reckoned that in dry weather the dust could spread all over Sydney and they just refused to have anything to do with the removal of material from the site. They also put some material in stainless steel cans on the site. But I think it was done before we actually got there.

The Hon. RICK COLLESS: Have you any idea what happened to those stainless steel cans?

Mr NURSE: I have not been around the site, obviously.

Ms NURSE: We have not seen the diagram but it looks like there is a big hotspot on the foreshore and I suspect that is where those bags were.

The Hon. ROBERT BROWN: A point of clarification. Which site were the bags and the cans on, 11 or the ones next to it?

Mr NURSE: They were on 9 and 7.

Ms NURSE: But the foreshore was unfenced, so it was open.

Mr NURSE: You could walk along the site.

The Hon. ROBERT BROWN: We have been to visit the site and have a look at the house that is there now. Is that the house that you built or has it been extended since?

Mr NURSE: The only work that has been done on it is that there has been a pitched roof put on it. We had a flat roof that you could actually go on top of and sit in the sun, and someone put a tiled roof on top.

The Hon. ROBERT BROWN: Chair, would it be in order for me to show Mr Nurse this diagram and try and get an indication of where the bedrooms are that he was talking about?

CHAIR: Yes.

The Hon. HELEN WESTWOOD: Mr Nurse, in some of the submissions that we have received it has been suggested to us that the house at No. 11 was built around 1967. That is obviously wrong. Was there another house there that you demolished?

Mr NURSE: No. The previous owner, a Mr Camp—you have got a submission from him—spent a large amount of time excavating the site and building the sea walls. In fact, we had many hundreds of metres of paving that he had taken off the site and we just built a house to suit the profile of the site.

The Hon. HELEN WESTWOOD: It also talks about excavations. Was that excavation carried out by Mr Camp?

Mr NURSE: Yes. Because it was a column-and-slab house all the foundations had to be excavated. They would have been excavated out of sandstone, but soil might have been moved in some places.

The Hon. HELEN WESTWOOD: Were you living in close proximity to the site prior to moving into No. 11 in 1974 or did you live in another suburb?

Mr NURSE: No.

The Hon. HELEN WESTWOOD: So you do not know where the soil went.

Mr NURSE: No.

The Hon. LYNDA VOLTZ: You have already answered my question. Did you buy the property from Mr Camp?

Mr NURSE: No. Mr Camp sold it to—

The Hon. LYNDA VOLTZ: A boat builder.

Mr NURSE: Yes. We bought it from Associated Securities. Camp sold it to the boatshed owner and he must have sold it to Associated Securities. I bought it from Associated Securities because I was doing quite a bit of development with them.

The Hon. LYNDA VOLTZ: You said you paid $30 for a health certificate.

Mr NURSE: We were happy to get it. It cost about $30. It was a compulsory certificate.

The Hon. LYNDA VOLTZ: Was that because there was a note on the title?

Mr NURSE: No, everyone had to get it.

The Hon. LYNDA VOLTZ: That was just normal and it had to be obtained for any house in Sydney being exchanged.

Mr NURSE: A prudent solicitor would always get a health certificate.

The Hon. LYNDA VOLTZ: Do you have copy of that certificate?

Mr NURSE: I could ask my solicitor for it.

The Hon. LYNDA VOLTZ: That would be helpful.

Mr NURSE: He keeps our files.

The Hon. LYNDA VOLTZ: Was there any notification on the title when it was exchanged and when they did a search?

Mr NURSE: No, I do not know.

The Hon. HELEN WESTWOOD: What would you like to see come out of this inquiry?

Mr NURSE: I would like to see compulsory radon testing done for the every house in Australia. In America, every house is tested for radon. In fact, in many cases you have to get a three-month radon certificate. Two years ago the American Congress decided it wanted the levels dropped down to natural radon levels. They were four and they are now talking about setting the technically impossible level of natural air. In the United

Kingdom people are told to get the test done. In Canada it is compulsory and even Ireland has very extensive radon testing. It even has a map showing all the radon areas where tests should be done.

Given the health hazard that the previous witness told us about, anyone who does not think it should be compulsory has no conscience. The fact children can get cancer because of background radon, which can be easily measured, is terrible. It can be dealt with purely by ventilation. You can ventilate the place to the point at which the radon level is the natural air level. It is so simple. That is what I would like to see coming out of this.

Ms NURSE: Apart from testing by the Department of Health, which should be done on all residences on Nelson Parade and it should be transparent, there is still the issue that No. 11 is in private hands. It should be investigated as to why it has returned to private hands. The Department of Health should reclaim it until the site has been remediated.

The Hon. LYNDA VOLTZ: Did the department purchase Nos 7 and 9 at the same time that it purchased your property?

Mr NURSE: I do not know.

The Hon. ROBERT BROWN: Given that you feel there may be evidence that some of the material was spread around, do you believe it would be prudent to do more testing on the peninsula area of Hunters Hill or within a couple of streets of Nelson Parade at least?

Mr NURSE: Yes. Obviously I think it would be. A lot of the concentration of the radon can be under ordinary single storey houses under the foundations. Testing has to be fairly conclusive because it would have been covered with soil and so on.

CHAIR: You removed a quantity of pavers. Where did they go?

Mr NURSE: I used them for paths. I worked on the site for many months putting in paths.

The Hon. ROBERT BROWN: They were used on the site.

Mr NURSE: Yes.

CHAIR: Thank you very much for appearing before the committee. You have provided valuable information. We will be reporting on it as best we can.

Mr NURSE: Thank you.

(The witnesses withdrew)

(The Committee adjourned at 3.05 p.m.)