EXAMINATION OF DR. MELVIN WHITEHEAD CARTER
Director, Southwestern Radiological Health Laboratory

Direct Examination by Mr. Yannacone:

Q. Doctor, would you give us your full name and address for the record?

A. Melvin Whitehead Carter, ***

Q. And what is your job title, please?

A. Director, Southwestern Radiological Health Laboratory.

Q. How long have you been so employed?

A. For approximately two years.

Q. And before that, what did you do?

A. I was director of the civil laboratory in Montgomery, Alabama.

Q. Do you want to give us a brief rundown of your educational background and experience?

A. Well, I have a bachelor's degree in civil engineering from Georgia Tech, a Master's degree in public health engineering from Georgia Tech., And a PhD in sanitary and environmental engineering from the University of Florida. I have been employed as a commissioned officer in the Public Health Service for approximately 20 years, working primarily in the environmental area, and most of that time with radiological help.

Q. Are you still officer in the Public Health Service?

A. Yes, sir.

Q. What is your rank?

A. I'm the equivalent of Capt. The grade in the Public Health Service is director.

Q. And whom do you report to in the regular course of your business?

A. Well, within our own organization, I report to the Bureau of Radiological Health.

Q. Which is located where?

A. Rockville, Maryland.

Q. With respect to project Rulison you report to?

A. The Director of Nuclear Operations.

Q. To the Public Health Service?

A. To the Atomic Energy Commission.

Q. And who is that?

A. Doctor Robert Thalgott.

Q. Would you briefly summarize prescient duties with respect to Project Rulison?

A. We were involved in establishing the radiological safety program for Project Rulison during its operational phases.

Q. What were the elements of that radiological safety program?

A. Well, the first thing we did was take us statistical look at the numbers of people and the distribution in the area; also, the numbers of other items and distributions, such as milch cows, dairies and so forth. We sampled the environment, several phases of the environment, and these samples were checked and analyzed in the laboratory. We also provided terrain monitors during the operation from a safety standpoint and also be prepared to do any monitoring which may have been necessary.

Q. Now, what kind of monitoring did you do before the shot? What did you measure and how did you measure it?

A. Well, we measured air samples. We measured milk and water samples. We used thermoluminescence to measure external gamma radiation, and we had a network of these various kinds of stations around the Rulison area.

Q. And what levels were you capable of measuring?

A. Well, this varied to some extent with the particular medium you are talking about and also with the particular neutron. If

we want to take one, for example, such as tritium we can measure it on a routine basis, essentially 400 picocuries per liter in the case of water or milk.

Q. Now, before we go too much further, would you be kind enough to define for us the rem?

A. Well, as Mr. Miller said, ren is the acronym for Roentgen equivalent in man and it's equated with the rad by appropriate multiplication of a quality factor.

Q. What is the quality factor?

A. This has to do with the relative biological effectiveness as far as the particular radiation for causing damage.

Q. Is this due to the fact that the quality factor multiplication is different for different tissues, different organs, and different organisms to convert rems to rads?

A. The quality factor usually refers to the radiation itself, not to the organism. In other words, neutrons are different from alpha particles, and these are different from gamma radiation, and so forth.

Q. And one is a rad?

A. The rad is a physical measurement of radiation, and it's equivalent to 100 ergs per gram of tissue.

Q. And this is a measurement that takes place with respect to action upon tissue?

A. That's the way it's used. It's not measured normally that way.

Q. How is it measured, doctor?

A. It's normally measured by an instrument in the particular medium or in the air.

Q. And that instrument actually measures the energy equivalent of the radiation prescient, right?

A. It measures the amount of ionization produced, yes, energy deposition.

Q. And for the purposes of converting this to rads you convert this

to actual energy, don't you? The erg is a unit of energy, is it not?

A. Yes.

Q. The erg is convertible into calories for instance?

A. Yes.

Q. Is the erg function or unit, an absolute unit of energy or is it an integrated unit with respect to time?

A. It's an absolute unit.

Q. And the rem is not, is it?

A. Well, you can use the rem both ways. It's actually a measure to measure this. However, it can be used over a period of time.

Q. Is it a fact that the rem is not an absolute physical measure of anything?

A. This is true.

Q. Now what is the Roentgen or the R?

A. Well, the old Roentgen goes back to the definition of a gram of radium. However, this was approximately 83 ergs per gram, and this unit was abandoned essentially a number of years ago to get a unit that was a little more precise. This was 100 ergs per gram or rad.

Q. In other words then, we can, by very simple constant multiple, convert rads to roentgens and roentgens to rads, can't we?

A. Right.

Q. Now with respect to your particular monitoring operations and your safety work with Project Rulison, are you dealing with radiation and ionizing radiation energy in terms of rems or rads?

A. We normally deal with this, at least on a preliminary basis, on the basis of concentrations.

Q. Well, how do you convert that to rems and rads?

A. Well, this depends on the intake. It also depends on the type of radiation and the amounts and so forth.

Q. Doctor, with respect to measuring the ambient level of ionizing radiation material in a given volume of air and water, that is not

possible to convert at the rems or rads without respect to living tissue?

A. I don't think I understand that particular question.

Q. All right. I'll rephrase the question. Isn't it a fact, Doctor, that you can't convert units of radiation measured in terms of curies per unit volume of air or water to rems without reference to biological tissue?

A. That is true.

Q. Does the same hold true with respect to the unit, the rad?

A. Well, from a biological effectiveness, you have to convert this into the term of rem.

Q. I didn't ask that. I just asked, can you convert, as a matter of pure dimensional analysis and pure analysis, the level of radiation in curies or some fraction of curies per unit volume 2 rads?

A. Yes.

Q. And you can do that without any reference to the qualitative difference among the radiation present?

A. Yes.

Q. A rad of gamma radiation is going to be exactly the same as a bad of electron radiation?

A. This depends on your measuring device, but in general, yes.

Q. Now with respect to biological effects, there is a standard that is been talked about here in 0524 indicating that a certain level of rems integrated or averaged over a whole year is safe. Are you familiar with that?

A. Yes.

Q. Do you know how that was determined?

A. In general terms, yes.

Q. Tell us.

A. It's related to the amount of background radiation in the process is rather elaborate. And I don't purport to be an expert in the biological effects of radiation.

Q. You don't purport to be an expert in the biological effects of radiation?

A. This is right. It's a very specialized area.

Q. I See. Now, with respect to your safety test with Project Rulison, what is the interest you are supposed to protect?

A. The people living in the area.

Q. Anything else?

A. Well, we are involved with domestic animals and this type of thing, yes.

Q. And don't you have to know about the biological effects of radiation in order to protect people from them?

A. In general terms. Not as far as specific details are concerned.

Q. Then where do you get your information as to whether safe or unsafe for the people in a given area?

A. These are essentially regulations from the Atomic Energy Commission which are consistent with the Federal Radiation Council Guides.

Q. In other words, you take these measurements as they are giving to you, right?

A. Yes.

Q. And you measure and monitor in air and water in terms of picocuries per unit volume, right?

A. Normally, yes.

Q. If you find curies per unit volume, you get upset?

A. Yes.

Q. A picocuries is 10 to the minus 12 curies, is that right?

A. Yes.

Q. That's a very small quantity?

A. Yes.

Q. How do you convert curies per unit volume to rads?

A. Well, this depends on what you're measuring. The measurements that we make are not only this kind of

measurement, but there are also more direct measurements which are a make.

Q. Such as?

A. Well, such as TLD, which measures in terms of millirad or rads.

Q. What does the TLD stand for?

A. Thermoluminescence dosimeter.

Q. In this particular case, then the incidence of radiation is converted to heat energy or thermoluminescent energy, and then picked off by some electronic means and that is calibrated in terms of absolute measurement, is that correct?

A. That's correct

Q. From this I assume you have had TLD measurements of the same area where you have total quantity of radiation measurements at the same time, haven't you?

A. I don't know what you mean by "total quantity."

Q. In other words, in a particular area, you might have measured the actual level in terms of picocuries per unit volume of air and at the same time you have a TLD reading in terms of rads?

A. Right, this is possible.

Q. What is the relationship between the two by order of magnitude?

A. I would say your concentration measurements which you make it one given time, and these are obviously transient measurements, which are normally lower than a device such as TLD, which is integrated over an appreciable period of time.

Q. In other words, the TLD and the dosimeter measurements integrate the total amount over a period of time, right?

A. Yes.

Q. So, they are effectively summation devices, aren't they?

A. Yes.

Q. In other words, you're getting the total amount of rads over a period of time, right?

A. At some particular location.

Q. Now, would you tell me how your measurements that you're making with respect to Project Rulison are to be converted to rems in terms of annual dose within the meaning of AEC Appendix 0524?

A. Well, as I mentioned, that particular kind of device does this sort of directly.

Q. Just a moment, Doctor. Do you mean to tell me that the thermoluminescence dosimeter converts directly from ionizing radiation that may be present over a unit of time in a given volume in a given area to rems?

A. No. It does this to the rad on the rad basis.

Q. And how do you convert the rads to the rems?

A. Then we have to know more about the particular nuclei we are measuring.

Q. So you have to make other measurements, don't you?

A. Yes.

Q. What other measurements do you make?

A. Well, these are made mostly by looking for concentrations in various media.

Q. What are you doing, looking with respect for, say, tritium?

A. Well, we look for tritium concentrations in air. We look for these in water. We look for them in milk, vegetation, soils, perhaps animals and other things.

Q. How extensive is your sampling program with respect to Project Rulison?

A. Well, in my opinion, it's very extensive.

Q. Tell us briefly how extensive.

A. Well, these are approximate numbers.

Q. Just round numbers.

A. Okay. I would say, as far as water sampling stations, we probably have two or three dozen of these. We have approximately 25 air sampling stations. We probably have seven dozen TLD stations, if you will. We sample milk from approximately 10 individual cows in the nearby areas. These are individual milch cows. And, as I recall, there are five dairies. We sampled these periodically within 10 miles of Rulison.

Q. And have you determined the actual levels of tritium present?

A. Yes, sir.

Q. What have these been?

A. Well, in general, and milk samples and in water samples, the numbers vary, say, from approximately 500 to perhaps 1,200 picocuries per liter.

Q. And with respect to the pre-blast background, what did you get?

A. Essentially the same kind of numbers.

Q. In the total background level of tritium in the atmosphere has been what prior to the test?

A. What part of the atmosphere you talking about? Are you talking about in the air?

Q. Yes, at ground level.

A. Here again, I would say on the order of may be about a thousand picocuries per liter, and that's pretty rough. We do not measure that directly. We collect them — the moisture out of the air and will analyze the moisture collected for tritium and related to the volume collected.

Q. What is the burden in the waters? Is it in the same areas as the air samples?

A. The numbers I gave you previously. It varies between this count. I would say the highest was probably on the order of 1,200 picocuries per liter. The lowest we go down to in a routine procedure is 400 picocuries per liter and many of them are below this level of protection.

Q. Is it possible to convert those levels to rems?

A. Yes, you can take this number, and based on assumptions as far as consumption of these and on the other contributions of tritium in the body, you can calculate the dose. It would be a pretty small number, I might add.

Q. Are you familiar with the no-affect level for tritium in living tissue?

A. The no effect level?

Q. Yes.

A. No, I am not familiar with that terminology.

Q. Isn't it a fact that there is no known zero-effect level for tritium in living tissue?

A. I would suspect that would depend on whom you asked.

Q. Doctor, are you familiar with the term dose response curve?

A. Yes.

Q. Are you familiar with the term for various drugs in human beings?

A. I am most familiar with the one as far as radiation is concerned.

Q. Well, originally you were a sanitary engineer, weren't you?

A. Yes.

Q. And in the course of your regular professional education you dealt with sewage, did you not?

A. I did it one time.

Q. And in the course of studying the purification of drinking water, I assume became familiar with the dose response curve or the methods for determining various effects from the introduction of certain materials into drinking water such as chlorine?

A. Yes.

Q. And you know, of course, that there is apparently a no-effect level for chlorine in drinking water as far as human health is concerned, isn't that correct?

A. No, I'm not aware that. Chlorine is edited water for health purposes.

Q. And there is a level at which you can add chlorine at which will show no damage to human beings, is that correct?

A. That is correct.

Q. And this is been well determined, hasn't it?

A. Yes.

Q. And this is called the law fact or zero-effect level for chlorine in human beings, isn't it?

A. Well, I have never heard a call back.

Q. You have heard of dose response curve though?

A. Yes.

Q. And you know that, with respect to material such as chlorine in human beings and their drinking water, this curve intersects zero at some point?

A. Well, that's an assumption. How do you measure zero or close to it? You rely on scientific knowledge as far as that possibility.

Q. Let's go to radiation, Doctor. Are you familiar with the dose response curve for the effects of tritium in human beings?

A. I have never seen a particular curve of that sort for tritium, no.

Q. Have you seen a for any ionizing radiation material?

A. Yes.

Q. Such as?

A. Well, in general the curve is drawn for ionizing effects.

Q. Is the curve the same for x-radiation as for neutron radiation?

A. I'm not that familiar with the details.

Q. You've been involved in radiological monitoring and radiation

safety for 20 years, you say?

A. Almost, yes.

Q. In the course of that time, have you ever had occasion to investigate the dose response affects finalizing radiation on living tissue?

A. I have not.

Q. In other words, then, Doctor, your sole job with respect to your agency is to go out and measure certain levels and apply certain numerical calculations to them and say that they meet the standards in 0524 or not, and is that all?

A. In answer your question, the answer is no.

Q. What else do you do?

A. Well, we are involved in various programs not related to Project Rulison or the Atomic Energy Commission.

Q. Such as?

A. We are involved in operating model programs on a national basis. This is a Public Health Service responsibility.

Q. Monitoring what?

A. Air, food, diets.

Q. For what?

A. For various radiation nuclides.

Q. Anything else?

A. Yes. We measure things such as calcium, potassium

Q. Do you measure DDT pesticides now?

A. Part of the Public Health Service does. I do not.

Q. And then the course of your regular professional activities, do you just measure these amounts and report them, or do you evaluate them?

A. We evaluate them, and in light of the guidance which is used we also conduct some research. We conduct training and we do a lot of things.

Q. Are you involved in this research and evaluation program with

respect to radionuclides?

A. People are on the staff.

Q. Do they report to you?

A. Yes.

Q. Have you read their materials?

A. In general, yes.

Q. And at any point in time, have you come across dose response curves for ionizing radiation elements in the population?

A. I answered the question that I am familiar with those response curves earlier.

Q. I am asking you now with specific reference to radionuclides?

A. No. I've seen the current plot of the general gamma radiation.

Q. Have you seen the plot of the short-range low-level electron or beta radiation?

A. If so, I don't recall.

Q. In other words, then you don't know what the dose response curve the substances such as tritium in human tissue is?

A. In a specific context or whether I have determined this myself directly, the answer is no.

Q. Have you ever read it?

A. In that context, I don't believe so.

Q. Do you know what the principal radiation emitted by krypton 85 is?

A. Yes, sir.

Q. What is it?

A. Beta.

Q. I1 energy range?

A. As I recall this is approximately 670 KeV.

Q. And is this different than the radiation emitted by tritium?

A. Yes.

Q. What is the radiation emitted by tritium?
A. Beta.

Q. At what level?
A. I would say approximately 18 MeV.

Q. Other biological effects of both of these materials from the radiation given off by each of these materials the same?
A. No.

Q. And is the effect of function of the energy?
A. Yes.

Q. Is the effect also a function of the chemical properties of the substance emitting the radiation?
A. From the standpoint of where it goes in the body and so forth, yes.

Q. Envision the fact that the dose response curve with the dose factor for tritium and krypton 85 in living tissue is different?
A. I would think so.

Q. Now, is it also a fact that there is no known or recognized no-effect level for either of these compounds in human tissue?
A. Well, again, not familiar with your term or terminology. But if I understand how you use it as far as —

Q. If you don't understand, will have to make it clear.
A. I don't understand.

Q. Doctor you are familiar with the fact that there is a medical specialty referred to as toxicology?
A. Yes.

Q. And are you familiar with the field referred to as pharmacology?
A. In general, yes.

Q. And you know, of course, that in both of these fields attempts are made to determine those response curves at both the biochemical and the whole organism level in animals and humans?
A. I would imagine so.

Q. Now, Doctor, I want you to assume that the no affect level for the purpose of the literature in both these fields is the level at which no effect is noted from a given concentration of induced material at the level that the investigator is looking for, which, in the pharmacological field is at the biochemical cell level and in the anatomical field is that the local organism level.

A. All right.

Q. Now, assuming that, Doctor, you know whether or not tritium and krypton 85 have any known no effect level?

A. No, because I think when you get to the no-effect as I think you are using the term, you can need to measure the insult note can you measure the effect. So, this is academic.

Q. This is a fact, Doctor, that you can measure the effect of even a picocuries quantity of a weak beta such as tritium on living tissue?

A. If it's been done at that level, I'm certainly not aware of it.

Q. Are you familiar with the literature of the Atomic Energy Commission on the biological effects of tritium?

A. Only in very general terms.

Q. Is tritium one of the things you monitor regularly in the course of your regular professional activities?

A. Only in recent years have we put much emphasis on tritium.

Q. How recent?

A. All, this is an approximate answer, but I would say sometime after the early 60s. [This testimony was given on December 8, 1969]

Q. Doctor, in the course of your regular professional activity since the 1960s, have you reviewed the scientific literature with respect to the biological effects of tritium?

A. As far as the complete review of the literature, the answer is no.

Q. The course irregular professional activities since 1960, have you had occasion to review the scientific literature with respect to the

monitoring and analysis of tritium?

A. To some extent, yes.

Q. Only to some extent?

A. Are you familiar with the volume the literature on the subject?

Q. Very familiar, doctor.

MR. EARDLEY: he's read it all.

MR. YANNACONE: you said it, Mr. Eardley.

A. He's got a bigger warehouse than we do to hold it.

MR. YANNACONE: Yes, it's called Brookhaven National Laboratory. But let's go on from there.

Q. Have you or have you not examined the literature?

A. I answered that question; to some extent, I have looked at it.

Q. Now, Doctor, and regular course your professional activities, have you had occasion to monitor Krypton 85?

A. Yes.

Q. How long of you been doing that?

A. Our laboratory has done that. So, I have been involved. I have been involved in the laboratory essentially for approximately two years.

Q. During that time, have you read any of the review literature with respect to analysis and monitoring of krypton 85?

A. Yes.

Q. Have you read any of the literature with respect to the biological effects of krypton 85?

A. To some extent, yes.

Q. Doctor in the regular course your association with Project Rulison — which began when, by the way?

A. Well, if you want to know that on planning basis, this went back a considerable period of time. I suspect that Rulison was in the discussion stages — in fact, it was when I came into the laboratory. So, for almost 2 years I'm generally familiar with it.

Q. And during that time, have you ever had occasion to search the literature with respect to the common environmental radioactive contaminants to be used in the detonation of the device such as to be used at Rulison?

A. Yes.

Q. Doctor, in the course of your regular professional activities have you filed a Personal Security Questionnaire and received a security clearance?

A. Yes.

Q And were you given access to the classified information with respect to the device to be used in project Rulison? Just answer yes or no I don't want to know what it is.

A. Are you saying, would I have access to it if I needed it?

Q. Did you have access to it?

A. I would say the answer was yes.

Q. And did you require this in order to make the evaluation of proposed monitoring program?

A. No, sir.

Q. Now, in order to properly monitor the effects of this particular detonation, did you consider the need to fully determine background radiation profile for all the radionuclides in the Rulison area before the shot?

A. I don't know what you mean by "all the radionuclides in the area." There are number them in the area.

Q. Right. And did you monitor the background levels of all of them?

A. No.

Q. Which ones did you monitor?

A. We monitored those that would normally be found in milk. This is strontium 90, strontium 89, barium, lanthanum 40, and cesium 137, tritium. And in there somewhere nuclides, we also look for krypton and so forth. We did not look for radium, for example.

Q. What about water?

A. In water we would have looked for any sort of fresh fish and product. We would also look for tritium.

Q. Isn't it a fact, Doctor, that the Colorado area does contain background levels of radon, radium and thorium?

A. Parts of it, yes.

Q. What radionuclides do you expect to find in the Rulison background that you didn't measure?

A. Well, I would expect some of uranium chain to be in the area.

Q. Which chain? There are four of them. Which one?

A. Probably any of them that is associated with uranium use in the area.

Q. What is the principal uranium isotope used in the area? I'm a New Yorker. We don't have any uranium mines there.

A. Also, I don't work in the uranium plant there. I don't know.

Q. Have you ever had occasion to monitor the background levels of uranium chain products?

A. Yes.

Q. What did you find?

A. Well, we found that we can measure uranium and soils. We can measure frame almost anywhere you want to look for.

Q. Is there radon on the atmosphere?

A. Yes. And then in all the media.

Q. Where else do you find radon?

A. Oh, you can find it on the water. You can find it in humans.

Q. What other radioisotopes do you find in that chain?

A. Well, their isotopes involved in the decay of radium I's, B's, and so forth

Q. You find in the course your evaluation of background that you have ever had occasion to evaluate the total background radiation level of the Rulison area in terms of absolute units of energy, such as rads?

A. No, not directly.

Q. Have you done it indirectly?

A. From the extent of watch TLD data I gave you, we have done this kind of a thing. We have not edit up, you know, the several dozen nuclides you might find and analyze and made appropriate calculations, no.

Q. Are you responsible on a continuing basis, exclusive of Project Rulison, for the radiological safety of the Colorado area?

A. That state is within our jurisdictional area, yes, or the state, I should say.

Q. And you have never determined the total background radiation level in terms of absolute units of ionizing radiation energy?

A. Well, the way you define the term, no.

Q. In other words then, you overlooked only for selective radionuclides to measure their background and ignored certain others?

A. We've only look for those that, within our experience, should be looked for in a particular project.

Q. Doctor, is it a fact that there is uranium mining going on the state of Colorado?

A yes.

Q. And is in the fact that the tailings from these uranium mines contain quantities radioisotopes?

A. Yes.

Q. In the Sonoma fact that these tailings can be environmentally distributed by wind water?

A. Yes.

Q. Is it a fact that, once distributed by wind and water, they can exert the effects of ionizing radiation at places removed from the site of deposition?

A. This is conceivable, yes.

Q. And is it a fact that this is certainly a measurable quantity by monitor-station measurements?

A. It can be measured if you won't to look for it are enough, yes.

Q. But you haven't looked for it, have you?

A. Not in connection with Project Rulison.

Q. Now, Doctor, I asked you with respect to your preliminary background evaluation in the state of Colorado did you or did you not ever evaluate the total background radiation levels in the state of Colorado?

A. Not with respect to project Rulison, no.

Q. I didn't ask you with respect to Project Rulison. I said did you ever evaluate the total background radiation levels of the state of Colorado.

A. Qualifying them throughout the state of Colorado, the answer is no.

Q. Did you do it at any point in the state of Colorado?

A. We've looked at a number of parts of Colorado for particular things. We've looked at uranium mill detailing problems.

Q. Dr. Carter, have you ever, in the course of your regular professional activities, at any time, at any place in the state of Colorado, determine the total nonionizing radiation background present?

A. No.

Q. Now, isn’t it a fact that the biological effects of ionizing radiation are dependent upon the existing level of exposure of the organism prior to the new insult?

A. If you talk about the total, then the answer would be yes.

Q. Isn't it a fact that the total amount of radiation incident upon human tissue is accumulative or an integrative phenomenon and its biological effect is a function of the total amount received over a period of time?

A. This is true. But some parts of form more important than others.

Q. That's correct. And is there the fact that there are two elements to determining the biological effect of the incident of a particular kind of ionizing radiation, one of them being the rate at which it

is received, and the other being the total accumulation?

A. It depends on the type of radiation, whether it's localized and so forth. These are not the only two factors.

Q. What are the other factors?

A. Well, it certainly depends on the amount that depends on the rate. It depends on the type of radiation. It depends on the organism with tissue that is affected.

Q. But in any event the total amount received in the rate at which it is received of both independent variables that determine the total effect isn't that right?

A. I would say yes.

Q. Now with respect to the organs of which this radiation is received some organs are more sensitive than others, correct?

A. Yes.

Q. One of the most sensitive organs to low-energy ionizing radiation of the kind produced by tritium?

A. I would say probably genetic materials and those where the rate of change of proliferation is very rapid.

Q. Is it a fact that there is genetic material in every cell?

A. Yes.

Q. So, therefore is in the fact that every cell is at least at some level susceptible to the effects of ionizing radiation even of the low energy levels produced by tritium?

A. Yes.

Q. Isn’t it a fact that the most sensitive areas with respect to biological effects from exposure to tritium vary with the age of the organism?

A. This in general is true.

Q. And isn't it a fact that in newborns and prenatal infants the most sensitive portions of brains are neurological tissue?

A. Not to the best of my knowledge, no.

Q. Are you familiar with the report of the Atomic Energy

Commission dated December 1968, on the affection trading?

A. Not without any more definition than that, no. *** You haven't given the title.

Q. That's the title, "The Effect of Tritium," and its 127 pages long and came from Oak Ridge.

A. Is a subsequent one done by the name of Jacobs, and I have glanced at that, yes.

Q. Do you want to reconsider your answer with respect to the sensitivity of newborn and prenatal infants' brain tissue?

A. No.

Q. You do consider that little work an authority, don't you?

A. From what I know that Mr. Jacobs did, I think that's a fairly good summary tritium, yes

Q. All right. It's a summary review of most of the literature in the field, isn't it?

A. That's my impression.

Q. And you think Mr. Jacobs is competent to review that literature, don't you?

A. I have no reason to disbelieve it.

Q. Now, with respect to infants in the prenatal stage, is there the fact that the organs most sensitive to low-level ionizing radiation of the growing ends of bone tissue and certain connective tissues as well as certain gonadotropin hormone formative tissues?

A. I'll go back to my earlier statement that I am not an expert in biological effects on humans.

Q. Are you familiar with the biological effects upon animals?

A. I'm also not expert in that area.

Q. Biological effects upon botanicals, plants?

A. I'm not expert in that area.

Q. Are you familiar with the effects of ionizing radiation on anything?

A. Only in general terms.

Q. And are you required to make determinations, decisions and evaluations of such biological effects and course your hero activities?

A. I think I've answered your question that we make measurements and we do many other things. These are related to the applicable standards.

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Q. Isn't it a fact that you are responsible for determining whether or not the radiation released from the flaring of Project Rulison will or will not be saved?

A. Within the guidance and environmental measurements we will make, yes.

Q. In other words, your sole responsibility for making measurements and just simply saying whether or not the output as measured at your monitoring stations is within somebody else's levels?

A. Well, we're involved in more than that.

Q. What else are you involved in?

A. How comprehensive the program is and so forth.

Q. What program?

A. The monitoring program.

Q. Are you interested in anything but simply monitoring?

A. Yes. We are interested in what effect this has, if any, on people.

Q. How are you going measure the effect on people, if any?

A. I have gone through while we were due to —

MR. EARDLEY: he has already stated a dozen times that he apparently follows the guidelines that are set forth by the FRC, and that's that.

MR. YANNACONE: Mr. Eardley, he has not yet told us how he expects to convert his monitoring information into that ephemeral quantity, rem, that is mentioned in 0524,

Section 1, Paragraph A. And that's what I have been trying to find out the past half hour.

THE DEPONENT: well, I indicated that we measure where these things are in the environment, and if these are related to people, either directly or through things that are consumed, whether they're drunk or eaten, then we can make these kinds of calculations we can also, if necessary, going sample people directly to verify these calculations.

Q. How do you sample the people?

A. Well, you can holo- body count people, depending on what you're looking for. You can collect urine samples in this type of thing.

Q. Have you done a whole-body count as a preliminary to Project Rulison to get the background radionuclide levels in human beings in the area that you are later on going to monitor?

A. No, because the nuclides we would expect from project Rulison are not those that you can determine this way.

Q. Which once you expect that you can't determine by whole-body count?

A. Primarily tritium and krypton 85.

Q. In other words, the only thing that holo- body counting tells you is gamma emitters?

A. Well, it can be used for high levels of beta emitters, also.

Q. At what level?

A. Where there is sufficient amount of ex-radiation or something of this sort that can be measured externally.

Q. In other words, then when the beta emissions are so great as to produce hard-raise which are at the low level of the low gamma, right?

A. Yes. And in that particular area, I'm not familiar with the details at what levels this takes place.

Q. What do you expect to measure in the urine, if anything?

A. Well, I don't expect we are going to monitor urine. But if we

did, we would look for tritium.

Q. And how would you expect to find it by way of background?

A. I would expect to find numbers on the order of a thousand picocuries per liter of urine, more or less.

Q. And have you already done this background testing?

A. In other places.

Q. Not here?

A. Not specifically for Rulison, no.

Q. Do you have a number, quantity, ambient figure of the total ionizing radiation that can be equated to rems in order to determine the maximum ambient level?

A. No.

Q. In order to determine the maximum amount of radioisotopes you will permit to be released or radionuclides permitted to be released from Project Rulison gas flaring, in order to stay within the standard set forth in Section 2, Paragraph A of Appendix 0524, what did you expect to measure and what is the maximum level that your monitor will say is safe?

A. I would say we would look at the particular nuclides in the various media to which people would potentially be exposed. We would essentially add these up to get this total count of the number that you are talking about. Now, as the guidance, we would use the tables contained in 0524.

Q. Which tables?

A. These are Appendix A.

Q. Now, this table indicates concentrations in the air and water above natural background by compound. In letters time, since they are in alphabetical order, to trivia. And on the tritium, which is not listed as tritium —

A. I think it's hydrogen.

Q. Yes, hydrogen as ^{3}H. It gives numbers, Column 1, air and micro curies per milliliter, t2 times 10 to the minus 7th. That's two-tenths of a picocuries per milliliter, is that right?

A. I would have to look at it. I assume your arithmetic is correct.

Q. And in water in microcuries per liter, they have got 3×10 to the -3. So that's 300 picocuries per milliliter, right?

A. Again, I'm sure your arithmetic is correct.

Q. Now, assume that you don't find these levels, did you any further testing?

A. I don't quite understand for what period of time you're talking about.

Q. For the period that the radioactive gas will be flared.

A. No. We were in continual monitoring programs throughout this flaring operation.

Q. And if you don't find levels in excess of those numbers, I just read that are in this table, you will do no further examination or testing of the population and you will permit the flaring, right?

A. Well, we will conduct our program throughout this operation and I would assume that we will not find levels that are close to this.

Q. Assuming that you don't find a, then you will not in any way interfere with the continued flaring, right?

A. Right.

Q. And if you did find levels of access in these levels, do you have the power to stop the flaring?

A. I don't know that I have the power to stop the flaring. I could certainly make that recommendation.

Q. Who would have the power to stop the flaring?

A. Well, the Atomic Energy Commission is responsible for the health and safety of that.

Q. How long does this monitoring process take? Are you monitoring essentially instantaneous or over long periods of time?

A. Some measurements are of the instantaneous variety. Most of them involve the collection of samples and the analyses of those in the laboratory.

Q. With respect to the air and water standards set forth in here, all these long-term or short-term programs? How long does the analysis take?

A. Well, once you get the samples to where it can be analyzed, tritium and water is a relatively simple procedure. With talking about only on the order of a few hours.

Q. What about tritium in here?

A. Tritium in the air is longer than this.

Q. A day, maybe?

A. Approximately a day.

Q. So from collection to report the laboratory finding is at least the day?

A. Yes.

Q. From laboratory findings to report is how long?

A. This varies from a given time to any given time. It depends on a lot of circumstances.

Q. Now, is the fact that these tables you just referred me to in Appendix A make a number of assumptions with respect to dilution factors?

A. No. These tables are references to the quantities of material that a human can be calculated to give per dose.

Q. That is what I asked you. Don't they assume uptakes in human beings and dilution factors along the way? You're measuring air and water, right?

A. Uptake's but not dilution factors. These are wherever people are exposed for periods of up to one year. These are amounts that can be calculated in the daily intakes for one-year periods.

Q. You're telling me that the ingestion of 2/10 of a picocuries of tritium per milliliter of air for human beings for a year yields less than .17 rems, whole body?

A. I'm saying it should yield very close to the .17 rem.

Q. To convert from micro curies or picocuries per milliliter to rems

involves a number of assumptions, does it not?

A. Yes.

MR. YANNACONE: I have no further questions for Dr. Carter. Thank you very much.

THE DEPONENT: there is a footnote or statement in there as far as Appendix A is concerned. ***

A. Well, it's one that essentially says that is for general population groups and you divide those numbers into Appendix A by a factor of three. And this is the number that I'm referring to as far as our sort of control levels.

MR. YANNACONE: all right. Thank you very much.