OVER THE COUNTER

No.

IN THE SUPREME COURT OF THE STATE OF TENNESSEE

ANNE PAYNE,

Plaintiff–Appellee

v.

CSX TRANSPORTATION, INC.,

Defendant–Appellant.

On appeal from the Circuit Court of Knox County, No. 2-231-07
Court of Appeals, Eastern Division: No. E2012-02392-COA-R3-CV

APPENDIX OF APPELLANT (Volume 2 of 2)

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the 80's and 90's?

A. It would average two.

Q. And what shifts did you work?

A. All of them.

Q. Did you work one more than others?

A. Third shift more than others.

MR. BAKER: Thank you, counsel.

Page 28, lines 22 through 24.

REDIRECT EXAMINATION

BY MR. BAKER:

Q. Is it fair to say in the 60's and 70's that you mostly worked third shift?

A. Yes.

MR. BAKER: Page 34, Lines 1 through 25 and Page 35, Lines 1 through 9.

Q. Was there a separate job that you would bid on where you would stay in the yard, stay in the West Knox Yard?

A. Yes.

Q. And then was there a separate job you could bid on where you would be in the yard and then also you would get on these trains and go work these industries?

A. Yes.

Q. Now, which was the more favored

job?

A. Industries.

Q. So is it fair to say at the beginning, in the 1962 to 1975 period, you being the low man on the totem pole, that you weren't able to work the industries as much?

A. Correct.

Q. Did you work them at all?

A. Yes.

Q. But infrequently.

A. Yes.

Q. Infrequently.

A. Yes.

MR. BAKER: Page 35 lines 24 through you 5 and Page 36 lines 1 through 3.

Q. So between '62 and '75, '76, infrequently you worked these industries; the rest of the time you were -- you worked these yards, you worked in the yard.

A. Yes.

MR. BAKER: Thank you.

MR. JORDAN: Next witness, Your Honor, is Dr. David Weill.

A. Yes.

Q. Now, you're certainly aware that Mr. Payne contracted lung cancer and that he died from it.

A. Yes.

Q. And have you become familiar with the typical causes of lung cancer?

A. Yes, I have.

Q. And have you done any scientific research into the causes of lung cancer?

A. No, I haven't.

Q. Have you published in the field of lung cancer?

A. Yes.

Q. Now, the leading cause of lung cancer is what?

A. Cigarette smoke.

Q. Now, Dr. Weill, are there different cell types of lung cancer?

A. There are.

Q. And can the cell type of a lung cancer give a physician such as yourself a clue as to what might be the cause of the lung cancer?

A. Yes.

Q. Is there a particular type --

particular cell type of lung cancer that is most readily associated with cigarette smoking?

A. Yes, it's a squamous cell cancer.

Q. And what cell type of lung cancer did Mr. Payne have?

A. He had squamous cell.

Q. Now, I asked you to look at the radiation piece as well.

Is radiation exposure something unusual?

A. No.

Q. Do we all have it?

A. Yes.

Q. Can exposure to radiation cause cancer?

A. In certain settings it's been reported to and those studies really require very heavy exposures, and I think the most notable thing is in the uranium mines in the Four Corners area of western Colorado.

Q. Are low doses of radiation associated with an increased risk of lung cancer?

A. No, there's no evidence to suggest that.

Q. Now, we mentioned earlier that

there's a particular cell type of lung cancer that is readily associated with cigarette smoking, and I think you said that was squamous cell.

Is there a particular cell type of lung cancer that's most readily associated with radiation exposure?

A. Yes, it's an oat cell cancer.

Q. Oat?

A. Oat, yes, o-a-t.

Q. Did Mr. Payne have that?

A. No.

Q. Do you have any -- did you have any information, Dr. Weill, about how Mr. Payne said he was exposed to radiation at the railroad?

A. It involved him moving from the Oak Ridge laboratory canisters and scrap metal, I believe, back to Knoxville. During that transport process is where he's claiming exposure.

Q. Where did you get that information?

A. From some of the IH, industrial hygiene reports and also from his deposition testimony.

Q. Did you form any opinions as to the significance of that exposure, if any?

A. In my view it was a low dose

exposure, if there was any.

Q. Did you form any opinions about whether that radiation exposure increased his risk of getting lung cancer?

A. I did, and I don't think it did in his case.

Q. Do you have an opinion as to whether his radiation exposure played any role in causing his lung cancer?

A. I do.

Q. What is your opinion, sir?

A. I don't think it played any role.

Q. Why do you say that?

A. I think if you compare his exposure to the kinds of exposure that has been shown in the medical literature to increase the risk of lung cancer, Mr. Payne's exposure would have been very small and I think not contributed toward it.

Q. I know you spent a good bit of your career interested in asbestos diseases?

A. Yes.

Q. And can asbestos cause lung cancer?

A. It can in certain settings.

Q. Tell us about those settings.

When is it proper for a

professional like yourself to say asbestos caused somebody's lung cancer?

A. In my view, in order to attribute a lung cancer to asbestos, there needs to be radiographic or histologic tests, pathology evidence of asbestosis, and without that I don't think the lung cancer risk is elevated from asbestos exposure.

Q. Is it unusual for people to have asbestos fibers in their lungs?

A. No, it's not unusual at all. We all have that.

Q. And is that going to hurt us?

A. No.

Q. In this case, Dr. Weill, did you attempt to determine whether Mr. Payne had asbestosis or not?

A. I did.

Q. And did you attempt to determine if he had any lung diseases caused by cigarette smoking?

A. I did as well.

Q. Did you have some imaging studies like chest x-rays and CT scans and --

A. Yes.

MR. JORDAN: Your Honor, at this

time, may I ask Dr. Weill to come down and use the view box to demonstrate what he had?

THE COURT: All right.

Q. (BY MR. JORDAN) Dr. Weill, let me hand you a film that's not Mr. Payne's film.

A. All right.

Q. Do you recognize what that is?

A. Yes.

Q. You told us a moment ago about B Readers and looking at chest films to see if somebody has asbestosis or not.

What is this film and is that something that's used in the B reading process?

A. It is.

So this is International Labor Organization or ILO, which puts out a standard set of films that folks are supposed to use to compare the film that they are interested in.

And what this film shows is a normal film. So you can see -- I don't know if you all can see that.

But at the bottom it says 0/0, and those numbers mean that it's a normal film. And so what you see is fairly clear lung fields all the way throughout, and then just pulmonary artery here, pulmonary artery here, and that's why that area looks whiter. But the lung fields themselves look more black and that would be a normal film.

Q. So this isn't Mr. Payne?

A. No, that's not Mr. Payne.

Q. Do we even know who that is?

A. No. No.

Q. There's a bunch of white markings like right in here and right in there.

A. Yes.

Q. Is that disease?

A. No, that's the center of the film. These are pulmonary arteries and they come off, just like all blood vessels do, as white on the x-ray.

Q. Where is the heart?

A. The heart sits right in the middle here. White as well.

Q. And what are these angles down in here?

A. These are -- this is the diaphragm. So the big breathing muscle below your lung that moves the lung up and down, the diaphragm sits right below these and forms a white shadow as well.

Q. So that person has a normal chest?

A. Yes.

Q. You mentioned that's a 0/0 film?

A. Right.

Q. Have you seen that before?

A. Yes.

Q. What is that?

A. So this is the 12 profusion categories, and how this works is -- it looks confusing but it's really not.

The first number is what the reader thinks is the most likely interpretation of the film, and so zero being normal and 3 being most abnormal. So a 3 is a very sick patient, zero not sick.

The second number after the slash is the number that the reader also considered when he or she was making their opinions. So the first number I feel very strongly about it, second number, maybe it was that. Because all these things have some subjectivity to them. You're interpreting a picture and so the Iowa classification system takes into account that it's not necessarily always black and white, and that's why there's a two number definition.

Q. So does the disease, the extent of disease get worse as you go from zero to 1?

A. Yes. So that's the most normal and down here is the most abnormal and they put a plus sign there because they want to show that it's even above a 3 if that's possible.

Q. Let me hand you another film and again represent to you that that's not Mr. Payne's film.

A. Okay.

Q. What -- what is that film?

A. So this is, again, a profusion category where the designation is 2/2. So zero normal, 1 slightly abnormal, 2 getting more abnormal, 3 most abnormal.

And I think what you can see is if you look side to side, you can appreciate that this film -- and again, looking at the side of the film is the best way to do it. This film looks like it has more white lines running through the lung fields, if you can see that, and that indicates that there's what's called "interstitial fibrosis" or the scarring of the lung. The scar happens in a line, in a linear fashion. So this is fairly typical linear scarring of the lung.

Q. Now, would that film, the one that's on the far right, you said was 2/2, would that be consistent with somebody that had asbestosis?

A. Yes.

Q. And is that the scarring that you told us about, is that asbestosis?

A. Yes.

Q. Now, that's not cancer, is it?

A. No. No. Asbestosis is a fibrosis of the lung.

Q. Okay. Let's look at one more and then I'm going to ask you to look at Mr. Payne's films.

A. I'll leave them up so we can have a comparison.

So this is, again, at the bottom of the film, we see 3/3. So this is the most abnormal film you can really get and, again, I think you can appreciate the difference. There's more white lines running through the lung material. Again, not to get confused by the area of the center of the lung, But if you look farther out, you can see more white lines running through those lung fields, and it's starting to look more and more white if you compare the 2/2 film to the 3/3 film.

Q. So the one that you just put up on

the far left, first of all, that's not Mr. Payne?

A. No.

Q. Secondly, that's a pretty sick person. Right?

A. It is.

Q. Is that film also consistent with someone who might have advanced asbestosis?

A. It is. This gentleman would probably be coming to talk to us about a transplant. He would be pretty sick.

Q. Okay. Now let's get down to Mr. Payne's films.

And what I've just handed you is a film that was taken of Mr. Payne.

A. Let's see.

Q. That looks different, doesn't it?

A. Yes. So -- if you look at the lung fields again, you can see the heart sitting in the middle here, lung fields looking black on both sides.

There's also -- this is a film where he has cancer present on the film and the cancer is in this area right here, and what you see also is a little bit of fluid around the lung which is typical in people who have cancer developing fluid.

Q. Do you see any evidence of asbestosis on that film?

A. No.

Q. That film looks a little darker to me.

A. It is. The technique that was used to shoot this film is what we call "over penetrated," meaning the beam that was sent to the patient was too much, so the x-ray appears darker than it should be ideally.

Q. Okay. Can you see any evidence of cigarette related damage on that film or is it too dark?

A. It's too dark to really read that.

Q. Okay. I think we may have some films that we can show you digitally that may be a little different. So unless there's something else you want to do with this, I think we're done.

A. I think so.

Q. Okay. Shown on this photograph is another chest x-ray of Mr. Payne, and that looks a little lighter to me.

A. This is a more appropriately shot film. In other words, they got the amount of kilowatts about right, the amount of radiation they gave him was about right in this film.

So as you start on the left side, you see very similar lines to what you saw before. Where the lung cancer is in this area right here, I think you can make out the border of it here, and it sort of whites out this area of the lung and then there is pleural effusion or fluid around the lung on the left side that is very typical of lung cancer.

If you go over to the right lung, and remember, this is the right lung and this is the left lung. It's sort of reverse when you are looking at an x-ray, but if you go over to the right lung, you can look at the lung fields and see that it doesn't have that kind of white density or white interstitial infiltrates that show on some of the more diseased films. And so this film of Mr. Payne indicates that he does not have asbestosis present on the film.

Q. Do you see any evidence of any cigarette damage on that film?

A. The chest x-ray, one way to determine that, and I would have to swing you over I think to the lateral to really see that, and these are pretty small -- there, thank you. Project it all the way up.

What you can see here and this is right behind the breast bone, so it's shot on the side.

But what you see here is an air-filled cavity that I'm outlining here that shows up on the film very black. And so what that is is what's called a bullae. It's an area of diseased lung by cigarette smoking that destroyed the lung, so you've got basically this empty air-filled sac which shows up right behind the breast bone on the side view here.

Q. Is that just a hole?

A. Yes, just a hole in the lung.

Q. How does that affect somebody's breathing?

A. Well, adversely. It doesn't -- this area doesn't get any real gas exchange happening. In other words, oxygen doesn't get into that area and carbon dioxide doesn't get eliminated so nothing happens in that area.

Q. Once you get a bullae like that, is there anything you can do about it?

A. No. There was some enthusiasm a

number of years ago about removing those to try to help the patient breathe better but that didn't work so well so we've really mostly stopped doing that.

Q. Well, on either of these films with what you call an AP where the patient is like this?

A. Right.

Q. And this is lateral, do you see any evidence of asbestos disease on either of those films?

A. No.

Q. Thank you, Doctor. You can take the stand I have a few more questions for you.

(Witness is seated).

Q. There's been in the case a good bit of discussion, Dr. Weill, about when it's proper to say that asbestos played a role in causing somebody's lung cancer. Have you studied that issue over the years?

A. Yes, I have.

Q. And what is your opinion about when it's proper scientifically to say asbestos played a role in lung cancer?

A. I think for me to attribute a lung cancer to asbestos exposure, there has to be radiographic or pathologic evidence of asbestosis.

Q. Do other people have different views?

A. Yes, they do.

Q. Do some people think that you don't have to have asbestosis in order to attribute lung cancer to asbestos?

A. Yes.

Q. Why do you feel the way you do?

A. I think the weight of the scientific evidence, and particularly if you look at epidemiologic studies that are properly done, show that that's the case. In other words, you have to have baseline asbestosis in order to elevate the risk, and I think the medical literature has been clear on that point.

Q. Have you studied that issue over the years?

A. Yes, I have.

Q. Does the mere exposure to asbestos without any evidence of asbestosis, just being around asbestos, does that increase your risk of getting lung cancer?

A. No, not in my view.

Q. You said Mr. Payne didn't have asbestosis.

What does that do in terms of your belief about whether asbestos played a role in causing his cancer or not?

A. In my view, because he did not have baseline asbestosis, I don't think his asbestos exposure elevated his cancer risk at all.

Q. Do you have to have a lot of exposure to get asbestosis?

A. Yes.

Q. One other issue briefly.

The jury has heard about synergism or the term "synergy."

A. Yes.

Q. It's like when you have two carcinogens together, the sum of the harm they can do is -- I'll say the total of the harm that they can do is more than the sum of two parts; is that right?

A. Right.

Q. And there's been some discussion about how there's a synergistic relationship between cigarette smoking and asbestos in producing lung cancer. Some of that came out of Dr. Selikoff and Dr. Hammond's work in New York way back when. Right?

A. Right.

Q. Are you familiar with all of that?

A. Yes.

Q. In a situation like Mr. Payne's situation where he was a railroad worker switching all the trains, does the concept of synergy apply to his lung cancer?

A. No, not in my view.

Q. Why is that?

A. Well, there's a couple of different things.

One, in Dr. Selikoff's work, he indicated that synergy might exist between asbestos exposure and cigarette smoke, but in a setting of people who were very, very heavily exposed. Some of the greatest exposures that have been seen have been in insulator cohorts.

The other issue that I think is important to keep in mind about the Selikoff work and that synergy question that's being addressed is that he didn't really know, and his cohort, who had asbestosis and who didn't. So he just knew that they were asbestos exposed, they also many of them smoked and their cancer risk was elevated. But he wasn't able to ferret out what I think is the important question, and the one that is being debated today, is did those patients also have asbestosis.

Q. Okay. What did you understand Mr. Payne's cigarette smoking history to be?

A. It was reported a couple different ways in the medical records. Anywhere from 20 pack years to 30 pack years and I think I saw a document that reported by Mr. Payne himself that he smoked one pack a day for 30 years.

Q. Is that a significant history of cigarette smoking to you?

A. Yes, either one is, either 20 pack years or 30 is significant.

Q. Have you seen a lot of patients in your practice that have had lung cancer?

A. Unfortunately, yes.

Q. Are most of them smokers?

A. Yes.

Q. And have you seen patients who have smoked the same amount that Mr. Payne smoked and got lung cancer because of it?

A. Yes.

Q. Is that amount of cigarette smoking, let's say 20 to 30 pack years, is that amount sufficient to cause a lung cancer separate and apart from any contribution from anything else?

A. Yes, it is.

Q. Did Mr. Payne have emphysema?

A. Yes.

Q. And did he have the bullae you were telling us about earlier?

A. Yes.

Q. Were those caused by his cigarette smoke?

A. Yes, they were.

Q. Did you understand that Mr. Payne quit smoking cigarettes I believe in 1988, that he quit a while back?

A. Yes.

Q. That was a good thing for him to do, wasn't it?

A. Yes, very smart.

Q. Did that decrease his lung cancer risk?

A. It did.

Q. Did he still continue to have a risk of lung cancer because of his past smoking?

A. Yeah. The lung cancer risk even in people that quit cigarette smoking never goes back to that of a nonsmoker. It just doesn't return all the way down to that level.

Q. Still ought to quit if you're smoking though, shouldn't you?

A. Yes, for sure.

Q. Now, Dr. Weill, based on everything you have seen in this case and everything we've asked you to review in your career dealing with lungs all through these years, do you have an opinion that you can tell this jury as to what was the most likely cause of Mr. Payne's lung cancer?

A. I think his cancer was caused by cigarette smoking.

Q. Was that the sole cause of his lung cancer?

A. Yes.

Q. Did asbestos play any role in that?

A. No.

Q. Did radiation exposure play any role in that?

A. No.

Q. Have all the opinions you've given us today opinions that you hold to a reasonable degree of medical certainty?

A. Yes.

recess, and can we confirm with the Court about where we go from here?

THE COURT: Okay. (To the Jury) Go out there about five minutes.

Don't get lost.

(Jury dismissed from courtroom).

MR. BAKER: May I have a word.

I hate to -- two things.

Number one thing has to do with the exhibits.

We intend to rest. We would like to have some guidance on the exhibits before doing so.

Did I state that correctly?

MR. JORDAN: Yes.

MR. BAKER: And then secondly, for the record, I would like to make an objection about the instructions, in all deference and respect to you, Your Honor, about the thyroid.

The Court instructed the jury about the thyroid, that the last cross examination heard by Mr. Gilreath was about thyroid cancer, and then you rightfully instructed the court that there is no claim for thyroid cancer in this case and the jury was to disregard any suggestion that thyroid cancer had anything to do with this case.

That's not the only issue, in our humble opinion. This is why we object.

The issue isn't just about what is -- that there is no claim for thyroid cancer, there was an agreement and a court ruling that thyroid cancer would not be discussed, not a part of this case, and that included cross examination of defense witnesses.

Plaintiff violated this ruling and planted a prejudicial inference in the jury's mind. What happened was that plaintiff's counsel followed the question about whether Mr. Payne had thyroid cancer with the question of whether radiation causes thyroid cancer, and this further creates the prejudice, so this is our objection to the instruction.

THE COURT: All right. Now, we mentioned exhibits.

When we left Wednesday we sorted out -- you folks sorted out between you

THE COURT: In cases where it is deducted, if there's no other evidence it may be up to the defendant to the offer evidence to show what a proper deduction would be, but I still think that's a better way to go about that. So go ahead.

MR. BAKER: And then, finally, we believe that there was no testimony from Mrs. Payne about the 38 hours of work, and we believe that that is required for Dr. Bohm to be able to give an opinion and have to introduce that evidence.

THE COURT: He gave an opinion of what 38 hours would be. If the jury figures some other number would be more appropriate they can lower or raise that figure.

Any other motions of this nature right now?

MS. THOMPSON: I think you should give the jury a directed verdict on cesium and exposure at the Oak Ridge spur track near the Y-12 facility.

THE COURT: We talked about cesium, too.

MS. THOMPSON: The plaintiff, of

course, never established any proof whatsoever in their case in chief and rested, and then of course they came up and threw up a slide during Mr. Maynard's testimony that we objected to about cesium and the track removal, and we were forced to put on a witness. And the bottom line is it is completely uncontroverted in any evidentiary stage that this man was exposed to harmful levels of cesium that caused his lung condition or had any exposures at the Oak Ridge spur track that he worked on for one year, and we would ask for a directed verdict because the plaintiff has not proven their case on that issue.

THE COURT: Any other comments about these last things?

MR. SHAPIRO: Well, cesium was discussed by Mr. Badders in his examination. He's their industrial hygienist. He said the track was taken up, it was taken up because of cesium. Mr. Payne worked there. We can show evidence on the defense case that we might not have been able to show in the plaintiff's case. It's perfectly okay.

And he said, "No."

THE COURT: Got two minutes left.

MR. GILREATH: "Did you ask him?"

"No."

"Did you care?"

"No."

That's the whole attitude of this railroad in this case. Didn't care.

Now, let me say this. Mr. Payne has to accept some responsibility for smoking. I told Mrs. Payne that and she realizes that. There's going to be a place for contributary negligence. That means was Mr. Payne negligent. I said you've got to accept responsibility for that because he smoked. You have to do that. That's the right thing to do.

So in your verdict form, if you say Mr. Payne is guilty of contributory negligence after the railroad is guilty of negligence, then you put the percentage down of his contributory negligence. If you take 25 percent, that reduces his verdict by 25 percent.

If you take 35 percent, that

reduces his verdict by 35 percent. Whatever responsibility you put on him, he has to accept some, I agree. That reduces the verdict. The judge will do that for you, but you can assign whatever responsibility that you think he deserves on Mr. Payne. And I suggest to you that he did quit in '88, 17 years before he got the cancer. So give him credit for that, if you would.

Thank you all very much for listening to us. Love you all.

THE COURT: So we'll take a 20 minute break now and then come back and finish this up.

(Off the record at 3:33 p.m.)

(On the record at 3:54 p.m.)

MR. SHAPIRO: Your Honor, we were just given the verdict form. Under No. 2 where there's the wording, "Did the negligence have some causal connection to the harm suffered by plaintiff?" We would suggest, "Did the negligence cause, in whole or in part, the harm suffered by plaintiff," because it mirrors the statute. We would suggest the same thing under No. 3.

do, all when prompted by considerations which ordinarily regulate the conduct of human affairs.

Negligence is, in other words, the failure to use ordinary and reasonable care under the circumstances at the time in the management of one's person or property.

Ordinary care in this sense is that care which reasonably prudent and careful persons exercise in the management of their own affairs, management of their own affairs in order to avoid injury to themselves or their property or the persons or property of others.

Ordinary care is not an absolute term, but ordinary care in this sense is a relative term. That is to say deciding whether ordinary care was exercised in the given case, the conduct in question must be viewed in the light of all surrounding circumstances as shown by the evidence in the case at the time.

Because the amount of care exercised by reasonably prudent and careful persons varies in proportion to the dangers known to be involved in what is being done, it follows that the amount of caution required in the exercise of ordinary care will vary with the nature of what is being done and all the surrounding circumstances shown by the proof in the case.

To put it another way, if any danger that should be reasonably foreseen increases so the amount of care required by law increases.

The mere fact that a person suffered harm, injury, illness or death standing alone without more does not permit an inference that the harm, injury, or death was caused by anyone's negligence.

You have heard reference to the Federal Employers Liability Act or FELA. That law provides in part that every common carrier by railroad engaging in commerce between any of several states shall be liable for damages to any person suffering injury while he is employed by such carrier in such commerce for such injury resulting in whole or in part from the negligence of any of the officers, agents or employees of on the plaintiff to establish by a preponderance of the evidence first that the defendant was negligent in one or more of the particulars alleged by the plaintiff, and second, that the defendant's negligence caused or contributed to harm, illness or death of the plaintiff.

Going back to the FELA, in other words, that the harm, illness or death resulted in whole or in part from the negligence of one of the officers, agents or employees of the railroad in question.

Plaintiff also alleges in this case that certain regulations or statutes were violated.

With regard to railroad cars, one such regulation provides that a person should not remain unnecessarily in, on, or near a transport vehicle containing radioactive materials.

Another one provides that each transport vehicle used for transportation, transporting radioactive materials and exclusive -- as exclusive use, must be surveyed with appropriate radiation detection instruments after each use, that vehicle may not be returned to service until the radiation dose rate and any accessible surface is less than .5 millirem per hour or less and there is no significant removable radioactive surface contamination as defined in the law.

A 1961 regulation provided that no person should remain in a car containing radioactive material unnecessarily, and the shipper must furnish the carrier with such information and equipment as is necessary for the protection of the carrier's employees.

Section from 1976 provides a person may not remain unnecessarily in a railcar containing radioactive materials.

Another regulation provides radioactive material means any material or combination of materials which spontaneously emit ionizing radiation, materials in which the estimated specific activity is not greater than .002 microcurie per gram of material and in which the radioactivity is essentially uniformly distributed are not contributed to one of the causes of harm suffered by the plaintiff.

As to contributory negligence, the FELA, the law in question provides in part, "In all actions brought against any railroad to recover damages for personal injury to an employee, the fact that the employee may have been guilty of contributory negligence shall not bar a recovery, but the damages shall be diminished by the jury in proportion to the negligence attributable to the employee. So if you should find from a preponderance of the evidence that the defendant was guilty of negligence but the plaintiff was also guilty of negligence and such negligence on the part of the plaintiff caused any harm to the plaintiff, then the total award of damages to the plaintiff must be reduced by an amount equal to the percentage of fault or contributory negligence chargeable to the plaintiff.

If you should find that the defendant was not guilty of negligence or the defendant was negligent but such negligence was not a cause in whole or in you answered yes back to question two, was the plaintiff negligent with regard to harm he suffered and was that negligence a cause in whole or in part to harm which the plaintiff did suffer.

Next question asks, and now we're to the point if you answered all these questions with a yes or some of them with a yes and the last question with a yes, asks you to tell me what percentage you feel plaintiff's negligence contributed to the harm that he suffered. And that leaves a space for a percentage.

Then if you found that the plaintiff is entitled to recover, the final question asks what amount of money do you find without deduction for any negligence which you may find on the plaintiff's part will fairly represent adequate compensation.

If you answer that question, any figure that you put there will be not subject to any taxation and that figure you will determine according to the following considerations. The amount there would propose, and there's no mathematical way to existed at the time in the particular case.

Okay. So let us know if you have more questions or how you are getting along.

(Jury dismissed from courtroom at 1:58 p.m.)

(Jury returned with verdict at 3:56 p.m.)

THE COURT: Okay. Mr. Alexander has been chosen here. If you will refer to the verdict, you can tell me briefly.

Question No. 1, was the defendant negligent as defined in these instructions?

JURY FOREMAN: Yes.

THE COURT: Question No. 2, did that negligence cause, in whole or in part, the harm suffered by the plaintiff?

JURY FOREMAN: Yes.

THE COURT: Question No. 3, was the defendant negligent with regard to asbestos exposure?

JURY FOREMAN: Yes.

THE COURT: With regard to diesel exposure?

JURY FOREMAN: Yes.

THE COURT: With regard to radiation exposure?

JURY FOREMAN: Yes.

THE COURT: Did the negligence of the defendant cause, in whole or in part, the harm suffered by plaintiff as a result of asbestos exposure?

JURY FOREMAN: Yes.

THE COURT: Diesel exposure?

JURY FOREMAN: Yes.

THE COURT: Radiation exposure?

JURY FOREMAN: Yes.

THE COURT: Did the defendant violate the Locomotive Inspection Act or any regulation concerning locomotives regarding asbestos, and was any such violation a legal cause of the plaintiff's harm?

JURY FOREMAN: Yes.

THE COURT: Did the defendant violate the Locomotive Inspection Act or any regulation concerning locomotives regarding diesel fumes, and was any such violation a legal cause of the plaintiff's harm?

JURY FOREMAN: Yes.

THE COURT: Did the defendant violation any regulation regarding the operations of railroad cars and transportation of radioactive materials, and was any such violation a legal cause of harm suffered by the plaintiff?

JURY FOREMAN: Yes.

THE COURT: Question 5, was the plaintiff negligent with regard to the harm he suffered?

JURY FOREMAN: Yes.

THE COURT: Your answer was yes.

To what extent, expressed in percentages, did the plaintiff's negligence cause, in whole or in part, the harm that he suffered?

JURY FOREMAN: 62 percent.

THE COURT: And finally, what amount of money do you find, without deduction for any the negligence, that would the fairly represent adequate compensation in this case?

JURY FOREMAN: 8.6 million.

THE COURT: Okay. Now, let me further inform you that by answering yes to questions listed on this form in Part 4 about the Inspection Act or any regulations, by answering yes to all of those questions, the concept of contributory negligence may not apply in this case. In that situation, the plaintiff would receive the entire amount of money that you have listed on the answers to the seventh question.

If that is what you intend in this particular case, please indicate by raising your right hand?

(Jury foreman raised hand).

THE COURT: Okay. That is something that we hadn't talked about before, but under the authority of that case that was handed to you by Mr. Shapiro yesterday, we need to know if that is your intention.

Again, by answering yes to the questions listed under Part 4 of the verdict form, the effect of yes answers there is that the recovery would be 100 percent of the amount listed on the response to Question 7.

MR. SHAPIRO: Your Honor, can we approach the bench one moment, the attorneys?

THE COURT: Yes.

MR. SHAPIRO: Your Honor, under the

FELA, the decision on this regulatory violation is not a jury decision. The Court has no choice but to impose the verdict in the way it was rendered by the jury. The Court, not the jury, then considers the fact that contributory negligence may not be considered by the jury. It's inappropriate to ask this jury to change their verdict.

MR. BAKER: I disagree.

THE COURT: That was raised in that case you gave me.

What is your feeling now?

JURY FOREMAN: Could we have a moment to discuss that?

THE COURT: All right.

(Jury dismissed from courtroom at 4:05 p.m.)

(Off the record at 4:05 p.m.)

(Jury returned to courtroom at 4:13 p.m.)

(On the record at 4:13 p.m.)

THE COURT: Based on a previous discussion, Mr. Alexander, it is the intention of the jury that the plaintiff recover a total amount of what?

JURY FOREMAN: $3.2 million.

If everyone agrees with that, raise

your right hand.

The jury has raised their right hand indicating that's their feeling in this particular case.

Anything else with the jury before we dismiss them?

MR. SHAPIRO: Yes, Your Honor. I would like to say that I think that the Court would need to instruct the jury that the FELA provides that there is no reduction of the jury's determination for contributory fault to the plaintiff as a matter of law and that sending the jury back without that instruction was inappropriate.

THE COURT: That's what I just told them, that if they answered yes to those things that there would be no deduction for contributory fault, and they said that in their opinion the total recovery would be that.

Now, we'll talk about it later, the legal effect of all this, but that's where we are.

You have been on the longest case that the Court has had in more than 20

FILED

IN THE CIRCUIT COURT FOR KNOX COUNTY, TENNESSEE

2011 APR -6 P 3:59

ANNE PAYNE, widow of WINSTON PAYNE, deceased	§	
	§	
Plaintiff,	§	No.: 2-231-07
	§	*Jury Demand*
vs.	§	
	§	
CSX TRANSPORTATION, INC.,	§	
	§	
Defendant.	§	

DEFENDANT CSX TRANSPORTATION, INC.'S MEMORANDUM IN SUPPORT OF ITS MOTION FOR JUDGMENT NOTWITHSTANDING THE VERDICT OR, IN THE ALTERNATIVE, FOR NEW TRIAL

BAKER, O'KANE, ATKINS & THOMPSON

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Attorneys for CSX Transportation, Inc.

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(Proceedings began at 2:02 pm.)

THE COURT: So, is everybody hooked up and ready?

MR. GILREATH: I guess.

THE COURT: Well, I took a lot of time to go over all this again and we had a number of motions that we discussed at our last meeting. The Court has come to this conclusion, that the motion for new trial is warranted. I hate to admit this because a lot of the problems come back to me, but in particular the jury instructions I feel were incomplete, therefore insufficient and inadequate and incorrect. This was illustrated graphically by their response and what we had to do to try to understand what they meant.

During the trial itself I agree that there were too many things that had been ruled improperly for the jury to consider that were considered and the presented to the jury, and probably the worst of those was when we started talking about this thyroid cancer which he apparently didn't have. The Court took it upon itself to make a comment about that and made a comment which could well have been misinterpreted. I just made -- did not express what I tried to express by saying that is not part of this lawsuit. It could be understood that he actually had that and it was not being considered now.

I deeply regret what I just said because, you know, I like to get cases over with, but at the same time I feel that this one was probably not handled appropriately and needs to be handled again, whether by me or somebody else. So that's the extent of what I want to say today.

MR. BAKER: All right, Your Honor, we'll prepare the order.

(End of Proceedings at 2:04 p.m.)

IN THE CIRCUIT COURT FOR KNOX COUNTY, TENNESSEE

FILED
2011 SEP -6 P 1:43
CATHERINE F. QUIST
CIRCUIT COURT CLERK

ANNE PAYNE, widow of WINSTON PAYNE, deceased Plaintiff, vs. CSX TRANSPORTATION, INC., Defendant.	§ § § § § § § § § §	No.: 2-231-07 ***Jury Demand***

ORDER GRANTING NEW TRIAL

The Defendant, CSX Transportation, Inc.'s Motions for Judgment Not Withstanding the Verdict, or in the Alternative, for a New Trial, came on for hearing before the Court on July 22, 2011. After considering the Motions, together with the Defendant's Memorandum in Support of the Motions with Exhibits and the Plaintiff's Memorandum in Opposition to the Motions, the oral argument of counsel for all parties, and the record as a whole, the Court took the Motions under advisement.

On August 19, 2011, the parties reconvened for the purpose of the Court announcing its decision. The Court's ruling, rendered form the bench, is attached to this Order and incorporated herein by reference as ***Exhibit "A."***

The Court applies the appropriate Federal standard for considering motions for new trial in FELA cases to the instant Motion. Applying that standard, and for the reasons stated in the Court's ruling from the bench on August 19, 2011, the Court finds that Defendant CSX Transportation, Inc.'s Motion for New Trial is warranted and is hereby GRANTED.

The Court makes this decision based upon specific prejudicial errors including, but not limited to, instructional and evidentiary errors that resulted in an injustice to Defendant and, independent of considerations regarding sufficiency of the evidence, warrant a new trial. Accordingly, it is ORDERED, ADJUDGED and DECREED that the Defendant's Motion for new trial is GRANTED, and it is ORDERED that the clerk reset the case for trial.

Enter this 6 day of September, 2011.

The Honorable Harold Wimberly
Circuit Court Judge

APPROVED FOR ENTRY:

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Rule Docket (all openings)

CIRCUIT 1-3 Division 2

		ISSUED - DISPOSITIVE ORDER			
11/09/2011	FILED PAPER FROM COURT OF APPEALS (COAP)	ORDER PLTF'S APPLICAITON FOR EXTRAORDINARY APPEAL IS DENIED	1	1	4.00
11/09/2011	FILED PAPER FROM COURT OF APPEALS (COAP)	DENYING TRAP RULE 10 APPLICATION	1	1	4.00
10/04/2011	FILED PAPER FROM COURT OF APPEALS (COAP)	RULE 10 APPLICATION FILED	1	1	4.00
10/04/2011	FILED PAPER FROM COURT OF APPEALS (COAP)	APPEAL BOND FILED	1	1	4.00
10/03/2011	APPEAL BOND (APB)	BY PLTF	1	1	6.00
10/03/2011	NOTICE OF APPEAL (NOTA)	BY PLTF	1	1	4.00
09/06/2011	MAILED COPY ORDER (MCO)	ATTYS	2	2	7.00
09/06/2011	EXHIBIT ATTACHED (EXBA)	A-RULING FOR MOTION FOR NEW TRIAL	1	1	4.00
09/06/2011	ORDER GRANTING NEW TRIAL (OGNT)		2	1	6.00
07/27/2011	COST COLLECTION LETTER SENT (CCL)	2,882.50 JOHN W. BAKER, JR	1	1	0.00
07/20/2011	RETURNED MOTION NOTICE (RMNT)	RICHARD N. SHAPIRO	1	1	0.00
07/18/2011	OPPOSITION (OPPS)	DEFT CSX TRANSPORTATION'S TO PLTF'S MOTION FOR DISCRETIONARY COSTS	1	1	4.00
07/15/2011	OPPOSITION (OPPS)	DEFT CSX TRANSPORTATION'S TO PLTF'S RENEWED MOTION TO ALTER & AMEND JUDGMENT	1	1	4.00
06/30/2011	SETTING OF ALL PENDING MOTIONS (APM)	SET FOR 07/22/2011 09:00:00	1	1	6.00
06/30/2011	ISSUED NOTICE	TO ATTORNEY DEFENDANT BUCKLEY, GRANT C SET FOR ALL PENDING MOTIONS (APM) ON 07/22/2011 09:00:00	1	1	4.00
06/30/2011	ISSUED NOTICE	TO ATTORNEY DEFENDANT YOUNG, KAREN JENKINS SET FOR ALL PENDING MOTIONS (APM) ON 07/22/2011 09:00:00	1	1	4.00
06/30/2011	ISSUED NOTICE	TO ATTORNEY DEFENDANT JORDAN ESQ, RANDALL A SET FOR ALL PENDING MOTIONS (APM) ON 07/22/2011 09:00:00	1	1	4.00
06/30/2011	ISSUED NOTICE	TO ATTORNEY DEFENDANT BAKER, JR, JOHN W SET FOR ALL PENDING MOTIONS (APM) ON 07/22/2011 09:00:00	1	1	4.00
06/30/2011	ISSUED NOTICE	TO ATTORNEY PLAINTIFF SHAPIRO, RICHARD N SET FOR ALL PENDING MOTIONS (APM) ON 07/22/2011 09:00:00	1	1	4.00
06/30/2011	ISSUED NOTICE	TO ATTORNEY DEFENDANT THOMPSON, EMILY L. HERMAN SET FOR ALL PENDING MOTIONS (APM) ON 07/22/2011 09:00:00	1	1	4.00
06/30/2011	ISSUED NOTICE	TO ATTORNEY PLAINTIFF GILREATH, SIDNEY W SET FOR ALL PENDING MOTIONS (APM) ON 07/22/2011 09:00:00	1	1	4.00
05/10/2011	SETTING OF ALL PENDING MOTIONS (APM)		1	1	6.00
05/10/2011	ISSUED NOTICE	TO ATTORNEY DEFENDANT BUCKLEY, GRANT C SET FOR ALL PENDING MOTIONS (APM) ON 06/03/2011 09:00:00	1	1	4.00
05/10/2011	ISSUED NOTICE	TO ATTORNEY DEFENDANT YOUNG, KAREN JENKINS SET FOR ALL PENDING MOTIONS (APM) ON 06/03/2011 09:00:00	1	1	4.00
05/10/2011	ISSUED NOTICE	TO ATTORNEY DEFENDANT JORDAN ESQ, RANDALL A SET FOR ALL PENDING MOTIONS (APM) ON 06/03/2011 09:00:00	1	1	4.00

IN THE SUPREME COURT OF TENNESSEE
AT KNOXVILLE

ANNE PAYNE v. CSX TRANSPORTATION, INC.

Circuit Court for Knox County
No. 223107

No. E2011-02107-SC-R10-CV

ORDER

Upon consideration of Anne Payne's application for extraordinary appeal and the record before us, the application is denied.

PER CURIAM

IN THE CIRCUIT COURT FOR KNOX COUNTY, TENNESSEE

WINSTON PAYNE,	§	
	§	
Plaintiff,	§	No.: 2-231-07
	§	*Jury Demand*
vs.	§	
	§	
CSX TRANSPORTATION, INC.,	§	
	§	
Defendant.	§	

AFFIDAVIT OF DAVID A. DOOLEY, PH.D., CHP

STATE OF FLORIDA
COUNTY OF PALM BEACH

PERSONALLY APPEARED before the undersigned, an officer duly authorized by law to administer oaths under the laws of the State of Florida, this day came David A. Dooley, Ph.D., CHP, who after being duly sworn, on oath deposes and states as follows:

1. **Personal Background Information.** I am over the age of eighteen and make this affidavit on behalf of CSX Transportation, Inc. ("CSXT"). I am a certified health physicist and hold a Ph.D. in radiation biology. The science of health physics is devoted to the recognition, evaluation and control of radiation-related health hazards to individuals and the public. I have over 37 years of experience as a health physicist, 27 years as a certified health physicist, and I am familiar with the various pathways by which the human body can be exposed to radiation, particularly in workplace environments.

I am currently the Senior Project Advisor to the Dose Reconstruction Program of the National Institute of Occupational Safety and Health ("NIOSH"). In the NIOSH Dose Reconstruction Program, I have responsibility for overseeing the conduct of internal dose reconstructions pursuant to the Energy Employees Occupational Illness Compensation Program Act (the "EEOICPA"). The EEOICPA provides federal statutory compensation remedies for certain employees and contractors of the U.S. Department of Energy relating to radiation-linked illnesses, including certain types of cancer. Through my work with the EEOICPA, and on many other occasions in my professional career, I have conducted numerous dose reconstructions relating to occupational claims of radiation exposure.

In this lawsuit, my comments, opinions and conclusions are based on my personal knowledge as an expert in issues of radiation exposure and dose reconstruction analysis, my education and experience as a health physicist, a continuing review of pertinent scientific literature dealing with testing and evaluation of radioactive exposures and dose reconstruction, and my review and knowledge of the particular alleged sources of radiation exposure in this case. I have been qualified as an expert in radiation in numerous state and federal courts.

2. **Materials Reviewed**. I have reviewed the following documents which were provided to me by counsel for CSXT in connection with this case: (a) Complaint; (b) Answer; (c) Plaintiff's responses to CSXT's discovery requests; (d) the October 2, 2009 deposition of Winston Payne; (e) the October 17, 2009 deposition of Winston Payne; (f) certain fact and coworker depositions taken in this case; (g) Plaintiff's CSXT personnel file; (h) certain medical records for Mr. Payne; (i) data available from air, soil and smear testing at various locations within the Witherspoon scrap yard located 901 Maryville Pike in Vestal, TN; (j) certain personal air monitoring studies done on railroad switch crews at 901 Maryville Pike; (k) data from radiation testing of rail cargo and rail gondolas that entered and exited the Witherspoon site; (l) additional industrial hygiene data relating to properties owned by David Witherspoon, Inc.; (m) documents relating to shipping, receiving, processing, and other business practices of David Witherspoon, Inc.; (n) documents generated pursuant to state and federal site visits and investigation into contamination of properties owned by David Witherspoon, Inc.; (o) certain articles documenting radiation

contamination and remediation efforts at areas in and near Oak Ridge, Tennessee; (p) expert reports from Daniel Mantooth, Arthur Frank and Leonard Vance; (q) trial testimony of Daniel Mantooth; and (r) the Position Statement of the Health Physics Society entitled "Radiation Risk In Perspective."

3. <u>Importance of Analyzing Dose in Health Physics</u>. Analyzing dose is an essential component of assessing whether exposure to a carcinogenic or otherwise harmful agent is dangerous and, in some cases, whether it has caused or contributed to the onset of disease. In my work for NIOSH under the EEOICPA, we are required to conduct dose reconstructions in order to determine whether and to what extent federal and federal contractor radiation workers are to be compensated for radiation exposure. In conducting any dose reconstruction, one must utilize available data relevant to the sources of radiation and the levels of radiation emitted from those sources. It is not necessary to have a worker wear a radiation measurement badge (known as a dosimeter) in order to assess dose properly. Information sufficient to reconstruct dose can often be—and regularly is—obtained by relying on air, soil and work area contamination levels by smear testing in the vicinities where the worker claims exposure and legacy testing of the materials the worker worked with or near. Dose reconstructions utilizing these forms of data have been subjected to peer-review analysis, are widely accepted by health physicists, and reflect standard scientific methodology. Further, substantial information on these accepted methodologies is available through a variety of published literature and online sources.

4. <u>Data Available to Reconstruct Mr. Payne's Radiation Dose During his CSXT Career</u>. There is sufficient data available in this case from which to quantify the bounding estimate of Mr. Payne's dose of radiation while at CSXT. While it is often not possible to ascertain a worker's specific quantitative dose, a bounding estimate is a useful method of

analysis that involves construing all available data so as to maximize the worker's potential for exposure. A bounding estimate permits a health physicist to determine a worker's health risks by analyzing the worker's "worst case" exposure scenarios. In conducting the dose reconstruction for Mr. Payne, I analyzed data available from air, soil and smear testing of the vicinities near the areas where Mr. Payne was allegedly exposed. I also analyzed radiation surveys conducted at the Witherspoon yard site located 901 Maryville Pike and utilized radiation testing data of cargo and rail gondolas that entered and exited this site. I relied on literature published by recognized experts for the potential makeup of surface contaminated scrap metals released by government facilities for reclamation processing of the kind that was performed at Witherspoon. I further reviewed personal air monitoring testing done on railroad switch crews from 1985 at 901 Maryville Pike. The test results that I have relied on to reconstruct Mr. Payne's dose are of the type I regularly rely on in performing dose reconstructions, including dose reconstructions for NIOSH under the EEOICPA.

5. <u>**Mr. Payne's Reconstructed Dose to Radiation During His Railroad Career.**</u> My reconstruction of Mr. Payne's radiation dose while working at CSXT, and certain supporting documentation, are attached hereto. As set forth therein, I reviewed a substantial amount of historical material for information that could be used to estimate the amount of time Mr. Payne spent working at the Witherspoon site at 901 Maryville Pike Road, Knoxville, TN and riding in gondolas containing contaminated scrap metal. My exposure calculations were based upon several factors including how long Mr. Payne was physically present in specific locations, and what the radiation exposure levels were during those time periods. Consistent with accepted health physics practice, I construed the data and other pertinent information so as to create the highest potential for exposure. At most, Mr. Payne would have sustained a total of 1.44 rem of

radiation exposure during his career at CSXT, which is an exceedingly minimal dose. As set forth in my report, I also analyzed his risk of developing lung cancer as a consequence of the calculated conservative dose estimate, and compared that risk to other factors which may have caused Mr. Payne's cancer. As stated in my report, the probability that Mr. Payne's cancer was caused or contributed to by radiation exposure is extraordinarily low, and is likely statistically meaningless.

6. **The Health Physics Society's Position on Low Dose Causation.** The Health Physics Society is a scientific and professional organization specializing in occupational and environmental radiation safety. Its nearly 6,000 members represent all scientific and technical areas related to radiation safety including academia, government, medicine, research and development, analytical services, consulting, and industry. The Society, founded in 1956, is chartered in the United States as an independent nonprofit scientific organization and, as such, is not affiliated with any government, industrial organization or private entity. Its mission is to support its members in the practice of their profession and to promote excellence in the science and practice of radiation safety. Since 1975, I have been a Plenary Member of the Health Physics Society. Since 1985, I have been a Diplomat of the American Academy of Health Physics. The Health Physics Society is the leading and most authoritative voice within the field of health physics.

In a 1996 position statement titled "Radiation Risk In Perspective," the Health Physics Society stated as follows: "the Health Physics Society recommends against quantitative estimation of health risks below an individual dose of 5 rem in one year or a lifetime dose of 10 rem above that received from natural sources." It continued, "below 5-10 rem (which includes occupational and environmental exposures), risks of health effects are either too small to be observed or are nonexistent." Noting that "[e]pidemiological studies have not demonstrated adverse health effects in individuals exposed to small doses (less than 10 rem) delivered in a period of many years," it concluded that estimation of health risks below these doses "remains speculative" and "should not be used." A true and correct copy of the Health Physics Society' "Radiation Risk In Perspective" Position Statement is attached hereto.[1]

The position of the Health Physics Society regarding low dose exposures is the mainstream view among health physicists. It also corroborates that Mr. Payne's total dose of 1.44 rem over his entire career at the railroad cannot be considered a cause of his subsequent disease.

7. <u>Mr. Mantooth's Methodology and Opinions in this Lawsuit</u>. Mr. Mantooth stated in his trial testimony that he agrees with the prevailing health physics position that doses below 5 rem in one year and 10 rem in a lifetime cannot be associated with subsequent disease causation. He further testified that while he did not analyze, and does not know, Mr. Payne's level of exposure while at CSXT, he thinks it is unlikely that Payne's total exposure was as high as 10 rem. In my view, Mr. Mantooth's opinion that Mr. Payne was nonetheless harmfully exposed to radiation at CSXT cannot be reconciled with his own stated criteria for attribution and does not reflect sound health physics methodology or positions adopted by the Society. To assess a worker's health risks without assessing a worker's level of exposure is a misapplication of the most fundamental precepts of industrial hygiene, of which health physics is a subset. Further, to state that Mr. Payne's exposures were harmful, while admitting they were below the threshold at which harm can be established, is contrary to the Health Physics Society's accepted positions on radiation risk.

[1] Since 1996, the Health Physics Society has twice updated its position without any material changes; once in August 2004 and again in July 2010.

8.- **Opinions**. Based on my knowledge and experience as a certified health physicist, and on my review of the data and other materials referenced above, I hold the following opinions to reasonable degree of scientific certainty:

a) In order to properly assess a worker's radiation-related health risks, a health physicist must, as a fundamental component of generally accepted health physics methodology, conduct a dose-based analysis of the worker's level of exposure and the radiation environment to which he was potentially exposed.

b) Based on my years of experience as a health physicist, including my work overseeing dose reconstructions for NIOSH under the EEOICPA since 2002, and my knowledge and review of the information pertinent to Mr. Payne's alleged exposures to radiation in this case, there is sufficient data available that can be analyzed using standard health physics methodology in order to reconstruct and reasonably quantify the maximum amount of exposure to radiation that Mr. Payne may have received during his railroad career.

c) Based on a comprehensive review of all data and pertinent information, and using standard health physics methodology, I reconstructed the maximum amount of radiation that Mr. Payne could have received at CSXT. At most, Mr. Payne would have received a total dose to the lung of 1.44 rem, which is an exceedingly minimal level of exposure. The probability that Mr. Payne's lung cancer was caused or contributed to by radiation exposure from his railroad employment is extraordinarily low and is most likely statistically insignificant.

d) Mr. Mantooth's opinion that Mr. Payne sustained a harmful dose of radiation while working at CSXT is not the product of sound health physics methodology. Mr. Mantooth did not attempt to analyze Mr. Payne's radiation dose as a CSXT employee, which is a required component of any reasonable health physics inquiry. And, Mr. Mantooth's opinion that it is impossible to assess Mr. Payne's dose ignores the availability of data (e.g., air, soil, and contamination levels via smear testing, as well as dosimeter data from other individuals) that is of a type routinely used in dose reconstruction.

Further, while acknowledging that a total exposure of less than 10 rem over an extended period of time cannot reliably be considered as a cause of radiation-related illness, he opines that Mr. Payne's exposure, while likely less than 10 rem, was nonetheless harmful. In my view, his opinion cannot be reconciled with sound health physics methodology and is inconsistent with standard health physics as practiced in the field.

FURTHER AFFIANT SAYETH NOT

This 28th day of August, 2012.

David A. Dooley, Ph.D., CHP

Sworn and Subscribed before

Notary Public
My Commision Expires: 4/25/2016

Kristi Truong
Notary
My Comm. Expires
April 25, 2016
No. EE 192999
Public
State of Florida

Dr. David A. Dooley's Report for Payne vs CSX Case

1. Introduction

The purpose of this document is to summarize the results of a series of calculations and analyses that were used to determine a calculation of dose that Mr. Payne may have received in the course of his employment with CSX. In addition, this document discusses the risk of developing lung cancer as a consequence of the calculated conservative dose estimate, and compares that risk to other factors which may have caused Mr. Payne's cancer. It demonstrates that the probability of his cancer being caused or contributed to by radiation exposure is extraordinarily low, and is likely statistically meaningless.

The exposure calculation is based upon several factors including how long Mr. Payne was physically present in specific locations, and what the radiation exposure levels were during those time periods.

As previously stated, a large amount of historical material has been reviewed for information that could be used to estimate the amount of time Mr. Payne spent working on the Witherspoon site at 901 Maryville Pike Road, Knoxville, TN. The list of materials, reports and documents used to support the conclusions of this report includes:

- Plaintiff's depositions
- Plaintiff's CSX personnel files
- Plaintiff's fact and co-worker witnesses and depositions
- Written discovery documents in this case
- Reports of Plaintiff's expert witnesses and plaintiff's medical records
- File materials from the Tennessee Department of Remediation (f/k/a Superfund)
- File materials from the Tennessee Dep[illegible]ent of Radiological Health
- The file of CSX industrial hygienist M[illegible] Badders pertaining to the Witherspoon Scrap yard located at 901 Maryville Pike Road, Knoxville, TN
- Direct radiation surveys, soil and air sampling and radiological analysis and other radiological testing conducted at Witherspoon Scrap Yard by Wm. C. Fields, CRU, Tenera, TN Dept of Radiation Health, TN Dept of Remediation, Dept. of Energy (DOE) and its agents
- Expert medical letter of Arthur L. Frank, MD, PhD, Professor of Public Health and Chair, Department of Environmental and Occupational Health.

This report also documents the amount of time he spent traveling in and around the railcars used to transport slightly radioactively contaminated ferrous and non-ferrous metal scrap and other similar radioactive materials to and from the DWI site between 1963 and 1975/6 and again from 1984 to October of 1985. It should be recognized that all scrap metal shipments to and from the DWI site did not necessarily consist of radioactively contaminated material. Many of the shipments to and from the site involved normal scrap metal. For the purposes of this report I will conservatively assume that all shipments into and out of DWI involve uranium contaminated scrap metal.

According to Mr. Payne's testimony, between 1975/6 and 1983 Mr. Payne did not work as a switchman at the West Knox Yard. The time-motion study described in the next section relies on information contained in records from the TN Department of Public Health, Radiological Health Service, responsible for the oversight of the David Witherspoon, Inc. Radioactive Materials License number S-4715-H1 and Source Material License S-4715-E8 as amended from June 1966 until license expiration August 31, 1971 and final termination of site operations in June of 1993. From March 20, 1962 (original expiration 2/28/1969) until May 26, 1966, David Witherspoon, Inc. held a Source Material License from the US Atomic Energy Commission, license number SUB-587. There is some evidence in the record that the AEC license was granted in 1966, but that does not coincide with the reality of the delivery of 20-30 drums of uranium metal turnings to the DWI site in 1963. Regardless, the change in licensing agencies occurred at the time the State of TN assumed agreement State status (9/1/65) and therefore regulatory authority over the Witherspoon site operations under the new State license in June of 1966. Per condition number 26 of the final order issued May 9, 1985 by the TN Department of Health and Environment, Division of Radiological Health, "On January 7, 1987 or any approved extension date thereafter, Respondent (i.e., Mr. Witherspoon) was to voluntarily and immediately relinquish to the Department any and all licenses or permits previously issued to the Respondent by the Division of Radiological Health." This statement implies that the DWI State of TN license S-4715-H1 continued to be in effect at least until January 7, 1987.

2. Some Fundamental Radiation Concepts and Terminology

Naturally occurring radiation and radioactivity is present in all places at all times. Everyone that lives on the Earth is exposed to "background" radiation and radioactivity every day of their lives. Some things that one can do to increase our exposure to radiation above this background level include smoking cigarettes, medical radiation exposure, on-the-job exposure, and other activities.

In order to properly frame our discussion I have included a number of definitions (listed in alphabetical order) extracted directly from the Federal 10 CFR 20 regulation of the NRC, Standards for Protection Against Radiation sections 20.1003, Definitions, and 20.1004, Units of Radiation Dose:

> *Absorbed dose* means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy).
>
> *Activity* is the rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq).
>
> *Airborne radioactive material* means radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.
>
> *Background radiation* means radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material); and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that

contribute to background radiation and are not under the control of the licensee. "*Background radiation*" does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

Collective dose is the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

Committed effective dose equivalent ($H_{E,50}$) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($H_{E,50} = \Sigma W_T H_{T,50}$).

Controlled area means an area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason.

Deep-dose equivalent (H_d), which applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).

Distinguishable from background means that the detectable concentration of a radionuclide is statistically different from the background concentration of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurement technology, survey, and statistical techniques.

Dose or *radiation dose* is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined in other paragraphs of this section.

Dose equivalent (H_T) means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).

Effective dose equivalent (H_E) is the sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (W_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \Sigma W_T H_T$).

Exposure means being exposed to ionizing radiation or to radioactive material.

External dose means that portion of the dose equivalent received from radiation sources outside the body.

Internal dose means that portion of the dose equivalent received from radioactive material taken into the body.

Licensee means the holder of a license.

Limits (dose limits) means the permissible upper bounds of radiation doses.

Member of the public means any individual except when that individual is receiving an occupational dose.

Monitoring (radiation monitoring, radiation protection monitoring) means the measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

Occupational dose means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released under § 35.75, from voluntary participation in medical research programs, or as a member of the public.

Public dose means the dose received by a member of the public from exposure to radiation or to radioactive material released by a licensee, or to any other source of radiation under the control of a licensee. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released under § 35.75, or from voluntary participation in medical research programs.

Rad is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).

Radiation (ionizing radiation) means alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in this part, does not include non-ionizing radiation, such as radio- or microwaves, or visible, infrared, or ultraviolet light.

Rem is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 sievert).

Survey means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Total Effective Dose Equivalent (TEDE) means the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Unrestricted area means an area, access to which is neither limited nor controlled by the licensee.

Whole body means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee.

In addition to the above definitions Table 1004(b).1 is reproduced below showing the quality factors for different radiation types relevant to the exposure scenarios discussed in this report. Finally, use of the term "conservative" as related to the type of dose reconstruction that has been performed for Mr. Payne's work activities while employed by CSX, implies that the scenarios considered are very generous in nature and favorable to Mr. Payne with regard to the potential exposures considered.

Table 1004(b).1-Quality Factors and Absorbed Dose Equivalencies

Type of radiation	Quality factor (Q)	Absorbed dose equal to a unit dose equivalent[a]
X-, gamma, or beta radiation	1	1
Alpha particles, multiple-charged particles, fission fragments and heavy particles of unknown charge	20	0.05
Neutrons of unknown energy	10	0.1
High-energy protons	10	0.1

[a] Absorbed dose in rad equal to 1 rem or the absorbed dose in gray equal to 1 sievert.

People can be exposed to radiation in two ways. The first way is referred to as direct exposure. This is when people spend time in proximity to sources of radiation. For example, if someone stands near something that is radioactive, sufficiently energetic gamma rays (similar to x-rays) from the source may be absorbed by the body causing exposure. This is somewhat like when photographic film is exposed to light. When the person is no longer near the radioactive source, the exposure stops.

The second way is referred to as indirect exposure. This happens when radioactive materials are taken into the body. This can happen if one ingests or inhales the radioactive material, or it is absorbed through the skin or through open wounds. Once inside the body the radioactive materials emit radiation that may be absorbed by surrounding tissues. For example, when a smoker inhales cigarette smoke, radioactive polonium-210 particles become embedded within the lung. The polonium particles give off alpha radiation that is absorbed by the surrounding lung tissue. This is an example of indirect radiation exposure. Indirect exposure continues as long as the material remains within the body and continues to give off radiation. Often radioactive materials taken into the body expose one or more specific organs, rather than the entire body. This is called exposure to the "target organ". For example, inhaled polonium-210 "targets" the lungs. The isotope of potential concern in Mr. Payne's case is uranium, which when inhaled targets the lungs in a manner similar to polonium.

Another term that needs to be defined is "source term". Source term refers to the physical and chemical make up of the radioactive material to which people can be exposed. In the present case the source term consists of uranium contaminated scrap metal. The source term will be further described in the following sections.
When people are exposed to radiation it may increase the risk of developing certain cancers. Not all persons exposed to radiation will develop cancer. The risk is proportional to the amount of exposure. For example, if the amount of exposure is increased, the probability of developing cancer is increased. Conversely if the exposure is reduced, the risk is reduced. Therefore extremely low exposures pose only an extremely low chance of causing cancer.

3. Time-Motion Study for Mr. Payne's Railroad Work History Between 1963 and 1985

In order to calculate a potential radiation dose, it was necessary to determine what areas were occupied by Mr. Payne, how long he was present in each area, and what activities he may have performed related to his job responsibilities. This is referred to as a "time motion study". It determines the "occupancy" or how long a person was present in a location where they may have been exposed to radiation.

One of the most challenging tasks for the time motion study is to establish Mr. Payne's occupancy and whereabouts while working for CSX on the Witherspoon Site. From his testimony related to his employment and where he worked, he apparently accompanied railcars that traveled to and from the site for the period 1963 to 1975/1976. For one year during this period Mr. Payne reports that he worked as a dispatcher in a depot unrelated to the DWI site. Which year this actually was he could not recall. Regardless, I will assume that for this period (1963-1975/6) represents a total of 13 years when he performed on site activities related to movement of railcars. For a period of 7 years beginning in 1975/6 he worked outside the Knoxville area and returned in 1983 to spend a year working on the Oak Ridge site rail yard. From 1984 to October 1985 he returned to work delivering and retrieving rail cars at the DWI until in mid-October. After mid-October 1985, CSX employees were no longer allowed to enter the DWI site per a CSX directive. The 1 plus 7 year gaps in performing work at the DWI site is taken directly from page 114 of Mr. Payne's testimony (Payne vs CSX, October 17, 2008, 2-231-07) which states that for a period of about 8 years, from late 1976 to 1983 he did not work for the RR in the Oak Ridge/Knoxville area. Further, I will rely on the State of TN, Department of Public Health, Radiological Health Service records provided to the agency by DWI that show the movement of rail shipments to and from the site over these time periods when Mr. Payne had access to the site. I will conservatively assume that Mr. Payne was involved in each and every shipment into and out of the David Witherspoon, Inc. site located at 901 Maryville Pike, Knoxville during the periods of time he could have been present. The following is a discussion of realistic yet very conservative exposure scenarios.

a. Time-Motion Discussion for RR Car Deliveries and Pickups

In order to properly frame the discussion relative to the direct radiation exposure Mr. Payne may have received in the course of his employment by CSX while making deliveries to and picking railroad cars up from the DWI site, I must first determine on the frequency with which these activities took place. A review of receipt and shipment records for the DWI operation between 1964 and 1971 shows that, on average, 7 rail shipments a month were received by DWI and/or shipped from the DWI facility. This information is presented in Table 1 below.

It is apparent from the individual monthly shipment records that for nearly 6 months at a time there were few or no shipments coming into or out of the facility. For our purposes, I will assume that Mr. Payne is riding inside open gondola cars for both incoming and outgoing shipments. I will also conservatively assume that each and every shipment into and out of DWI contains radioactively contaminated scrap metal. It is my opinion that this is likely conservative by at least a factor of 2 or more in Mr. Payne's favor. Per Mr. Payne's testimony, in addition to the 30 minute ride from the West Knox Yard to the gate at DWI, he would spend an additional 60 minutes (10/17/08 testimony reports "at least one hour", p75) on site dropping off the gondola cars, setting/releasing brakes, uncoupling cars, etc. and picking up empty cars and/or cars loaded with scrap shipments headed to another destination.

Based on this information and testimony of Mr. Payne, I can establish that, on average, Mr. Payne between 1963 and 1975/6, and then again from 1984-1985 may have been on the DWI site approximately 2 hours per week, for 50 weeks per year or a total of 100 hours per year.

I assume then that the data presented in Table 1 (which tends to coincide with Mr. Payne's testimony that he was at the site somewhere between "infrequently" (p123-126 of 10/17/08 deposition) and "3 times per week" (p55 of 10/17/08 deposition) is generally favorable to Mr. Payne.

Table 1. Average Monthly Rail Shipments to and from David Witherspoon, Inc. 1964-1971.

Average Monthly Rail Shipments by Year

Year► / Month▼	1964	1965	1966	1967	1968	1969	1970	1971
Jan		8	1	8	2	0	8	0
Feb		5	2	3	3	0	5	0
Mar		18	0	4	11	20	4	2
Apr		22	1	19	9	18	3	
May		11	5	17	9	11	27	
Jun	4	7	1	39	0	20	6	
Jul	7	13	5	33	4	0	1	
Aug	5	7	6	18	7	4	3	
Sep	5	0	4	15	4	0	2	
Oct	3	0	9	14	1	0	1	
Nov	6	1	18	9	0	0	0	
Dec	6	1	14	5	0	3	0	
Average/mo.	5.1	7.8	5.5	15.3	4.2	6.3	5.0	0.7
Average/yr.	1964-1970	7.0						

Year	Monthly Ave. Shipments	Annual On-Site Hours*
1964	5	60
1965	8	96
1966	6	72
1967	15	180
1968	4	48
1969	6	60
1970	5	12
1971	1	16

Average** [illegible]	7[illegible]	84[illegible]

* Annual hrs assumes 1 hr/trip

** Averages omit 1971 due to small amount of data

For purposes of calculating a conservative estimate of potential dose favorable to Mr. Payne, of dose two different work-related time periods were considered. The first was the time spent riding inside the gondola cars as the cars were moved from the West Knox Yard to the DWI facility gate. The second period was the time spent on the ground inside the DWI site, checking switches, walking along the cars as they were moved onto the site and positioned under the metal process shed, then setting brakes, uncoupling cars, etc. It is assumed that he would continue to perform similar duties to pick up scrap loads that were being moved off the DWI site.

With regard to the time spent inside the gondola cars, it was estimated that the exposure time included 2 shipments per week, 50 weeks per year, at 30 minutes per shipment. This adds up to 50 hours per year spent inside the gondola cars.

With regard to time spent on the ground on the DWI site, it was estimated to be 60 minutes per shipment, 2 shipments per week, 50 weeks per year, for a total of 100 hours per year. It should be noted per the above discussion that these estimates are in agreement with Mr. Payne's testimony of his time spent at DWI and is likely in his favor by at least a factor of 8/7 or 1.15.

b. Direct Exposure to Scrap and Other Materials

According to Mr. Payne's testimony, working as a Switchman, he would accompany the gondola cars loaded with uranium contaminated metal scrap from the West Knox Yard. The origin of the material was the Oak Ridge Y-12 facility, the Fernald facility and other AEC/DOE sites. According to his testimony, the cars would be pushed by a diesel engine from the West Knox Yard to the Witherspoon site; Mr. Payne would ride at the front of the train in the first gondola car to be able to look back on the remaining cars in the train. To do this he testifies that he would ride inside the lead gondola car, especially when crossing the railroad bridge over the Tennessee River since there was no walkway on the bridge for pedestrian traffic. The speed on the train was low (~10 mph) and the distance traveled (~3 miles) was short. Therefore, the first opportunity for direct exposure is when Mr. Payne is riding in the lead gondola and is potentially receiving direct exposure from the uranium contaminated scrap and other radioactively contaminated material delivered to the DWI site.

Based on measurements made by the DWI radiation safety officer, Mr. Fields and by the State of TN Department of Public Health, Radiological Health Service inspectors, the potential direct exposure rates from this uranium contaminated scrap metal and other radioactively contaminated material, varied considerably.

For routine loads of uranium contaminated scrap I will conservatively assume that Mr. Payne was in a radiation field of 1 mR/hr while traveling inside the gondola cars. Again I will use the same assumptions above that deliveries are made 2 times per week 50 weeks per year and that Mr. Payne rides in the cars for 30 minutes per delivery. This results in an annual exposure of 50 mRem. The maximum dose to the lung is calculated as 1.1385 times 50 mrem/yr or 56.9 mrem/yr.

The lung dose calculation factor applied to a whole body dose assumes that while Mr. Payne is riding inside the gondola that 37.5% of the time the dose to the lung is anterior/posterior (A/P, or front to back), 37.5% of the time posterior/ anterior (P/A, or back to front) and the remaining 25% is rotational (i.e., while in the process of turning around). The dose conversation factor for exposure to the lung under these assumptions of physical positioning is 1.1385.

In 1963 Mr. Payne reported riding to the DWI site with drums of scrap later described in the record as uranium turnings. Mr. Payne's testimony shows that he recalls making several trips to get all the drums to the DWI site. To conservatively estimate this dose, I assume that there are a total of 30 drums (20-30 drums reported in October 17, 2008 testimony, p133), that 3 drums were delivered at a time and that he was at the point of the highest measured contact reading for any of the drums per a 1980 inspection report or 4 mrem/hr. Therefore, assuming10 trips at 30 minutes per trip at 4 mrem/hr gives Mr. Payne a dose of 20 mrem. The lung dose is calculated as 1.1385 times 20 mrem or 22.8 mrem. It should be noted that this activity was completed after the tenth trip and was never repeated.

One last exposure scenario with regard to Mr. Payne traveling in gondola cars with the uranium contaminated waste is to conservatively take into account exposures to unique types of scrap delivered to DWI that had reported exposure rates between 4 mrem/hr and 150 mrem/hr. In these cases each event is considered to be a one of a kind occurrence that lasted for 30 minutes. The maximum whole body dose is 102 mrem and the maximum lung dose calculated for these activities is 116 mrem.

In summary, Mr. Payne has 3 different types of doses to the lung while riding in gondola cars being delivered to the DWI site:

- A lung dose of 56.9 mrem/yr for a total of 15 years (853.5 mrem)
- A lung dose of 22.8 mrem from the drum transport trips, and
- A lung dose of 116 mrem for other non-routine shipments
- The total estimated lung dose from these activities is 992.3 mrem

Several of the key assumptions made above in determining the lung dose while riding in the gondola are in Mr. Payne's favor and include:

- All shipments are received by rail at DWI and that Mr. Payne was involved with every shipment even though he was likely not. This also assumes that no shipments are received by truck at DWI which is contrary to the written record.
- Assuming a total of 30 versus 20 drums of uranium turnings
- Assuming that only 3 drums of uranium turnings are delivered at a time (10 trips)

- Assuming Mr. Payne is always standing next to the drum with the highest measured exposure rate
- Assuming that for "routine" trips that Mr. Payne is again standing next to material exhibiting the highest exposure rate
- Assuming for the non-routine trips that the measured exposure rates do not have a measured beta radiation component and are strictly gamma radiation measurements (i.e. roughly a factor of 10 high)
- Assuming that each and every delivery to the DWI site involves uranium contaminated scrap or other similarly contaminated radioactive material. The record is clear that not all scrap metal received was radioactively contaminated(see Reference I)

ii. **Direct Exposure While Working on the DWI Site**

The next activity for which a dose due to direct exposure must be calculated is for the time Mr. Payne spent on the site performing the actual delivery of the gondola cars at the DWI site. Per the narrative above, I assume that this evolution takes one hour to complete. I have also assumed that this activity occurred over a period of fifteen (15) years and that there were 100 shipments per year.

It has been well established that the drums left on the west side of the tracks in approximately 1963 containing uranium metal turnings had measured dose rates of from 0.026 mR/hr to 0.4 mR/hr. However, I could assume that Mr. Payne is walking the majority of the time (> 50%) on the east side of the track leading to the metal processing shed at DWI since it appears to be the easier side to walk with fewer obstructions. Regardless of this assumption of Mr. Payne's whereabouts on site, I will make the conservative assumption that he is exposed to the highest measured exposure rate or 0.4 mR/hr the entire time he spends on the DWI site. This simplifies the calculation as follows: 1 hour per shipment, 100 shipments per year times 0.4 mR/hr gives a total whole body dose of 40 mrem/yr. The dose to the lung would be 36 mrem/yr due to the assumption of a rotational exposure geometry dose conversion factor based on Mr. Payne's movements on the site. Over 15 years of exposure, this totals 600 mrem whole body dose and 540 mrem to the lung.

It is my opinion that this calculated on site dose is a significant overestimate of the dose Mr. Payne could have received since I have used the highest measured exposure rate for the Candora triangle portion of the site where he frequented rather than an average general area exposure rate that is on the order of 0.04 mR/hr or less. This highest reading was measured in one localized spot in an array of drums of uranium metal turnings stored on the west side of the track leading to the metal shed by State of TN officials in 1985 (See Figure 1 below). Therefore, the estimated total dose associated with his work activities on the DWI site is considered to be in Mr. Payne's favor by a factor of 10 or more.

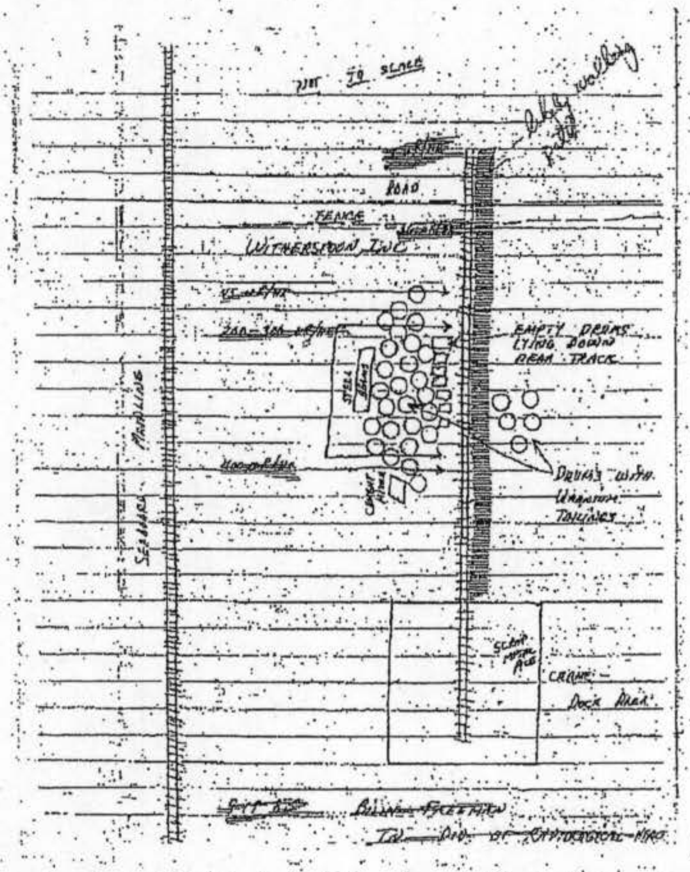

Figure 1. 1985 Hand-Drawn Radiation Survey Map by State of TN Regulator of Uranium Turnings (Labeled "Tailings") September 19, 1985. (Note: Highlighting and additional text supplied by author of present report.)

c. Indirect Exposure to Potential Airborne Uranium Contamination

The indirect exposures that must be considered for the time period encompassing Mr. Payne's work activities involving the DWI site are derived from: 1) the inhalation exposure potential due to the presence of uranium contaminated scrap metal in the shipments and 2) from the ground surfaces at the DWI facility that may have become resuspended in the air due to onsite activities associated with rail car deliveries. In both cases I assume for purposes of this dose reconstruction that the resuspended uranium particulates could have been inhaled by Mr. Payne in the course of performing his work activities for CSX.

Per Mr. Payne's testimony, many times when he was performing his work on the DWI site, the site would be muddy, something he complained of since it made walking with along on the ground as the train is moved onsite more difficult (p77, October 17, 2008 deposition). However, from an exposure pathway point of view, muddy soil and rain would negate this inhalation exposure pathway, both from the release of uranium contamination from the soil as well as from the uranium contaminated scrap metal if it was in an open gondola car.

Meteorological reports from the Knoxville area show that rain occurs on average 126 days per year. Table 2 shows the information retrieved from the web site http://www.met.utah.edu/jhorel/html/wx/climate/daysrain.html which lists similar data for a host of US cities. These data are also directly relevant for the time period Mr. Payne is reported to have worked for CSX making these deliveries to and pickups from the site.

Table 2. Average Days of Precipitation by Month, 0.01 Inches or More (51 years of Data Through 1993) for Knoxville TN

YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
51	12	11	13	11	11	10	11	9	8	8	10	11	126

From this meteorological information it is readily apparent that at least one third of the time that the unprotected scrap metal making its way to and from the site in open gondola railcars would be wet as would the soil on the site, thus the reason for Mr. Payne's complaints about the mud in his testimony. It is also reasonable to assume that since the DWI site soil would not dry instantly that it would retain moisture and likely was only in a "dusty" condition in the traditional "drier" months of the year namely August through as late as October. Therefore based on these data and the limited time Mr. Payne spent on the DWI site(assumed conservatively to be 100 hours/year) it is assumed that exposure to any airborne radioactive contaminants in the soil or resident in and on loads of uranium contaminated scrap was significantly diminished or completely negated by these rainy and/or wet conditions. From the precipitation data above, on average it rains 34.5% of the time. It is my opinion that 1/3 of the time of the 100 hours Mr. Payne is reported to have been on site that this same probability of rain exists. Therefore I will assume that for only 65.5 hours per year Mr. Payne has the potential to be exposed to airborne uranium contamination regardless of origin. I believe this assumption is favorable to Mr. Payne given that the site soil and the scrap in the open gondola cars could remain wet for some time after the rain stops which would further reduce his potential for airborne exposure to suspended radioactive particles regardless of origin.

As described above, Mr. Payne rode at the front of the first gondola car when loads of scrap metal (contaminated or not) were moved onto the DWI site. This pathway analysis also assumes that Mr. Payne also rode in gondola cars leaving the DWI site. Two issues are relevant to Mr. Payne riding in the gondola with respect to possible inhalation of uranium contamination on scrap metal surfaces; first, his exposure potential is greatly reduced if not completely negated because the air he is breathing while riding in the front car is not washing over the contaminated surfaces toward him. In fact it would be directed away from him and thus are not available for Mr. Payne to inhale. Second, the prevailing wind in the Knoxville area of the TN valley is from the southwest. A standard wind rose diagram showing the wind direction and frequency for Knoxville TN is shown in Figure 2. These data were retrieved from the internet from the site http://home.pes.com/windroses/.

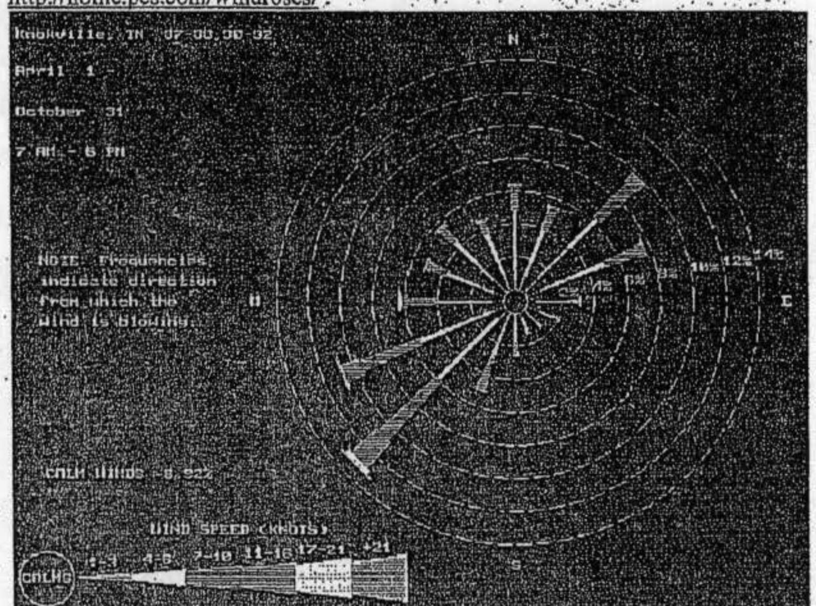

Figure 2. Wind Rose Prepared by Pacific Environmental Services, Inc. (PES) Using the Program WRPLOT that was Developed by PES for the U. S. Environmental Protection Agency.

Given that the rail cars are being moved from the north to south to reach the DWI site from the Knoxville yard, this prevailing wind, when present and in the absence of any train movement, would tend to blow any contamination that might be dispersed away from Mr. Payne rather than toward him. Therefore, the probability whereby Mr. Payne is exposed to resuspended contamination existent on scrap metal while it is being transported to DWI is considered to be significantly less than his on site exposure potential.

The estimated dose can then be calculated for these two work activities whereby Mr. Payne is potentially exposed to airborne contamination as follows:

Airborne Exposure to Uranium on Scrap Metal during Transport
For the case where Mr. Payne is riding at the front of the gondola car as it is pushed to the DWI site and the converse where he is riding in the last car as it is pulled offsite, I will use the maximum contamination level allowed for release of contaminated scrap metal of 25,000 DPM/100 cm^2 alpha. It should be noted here that AEC Manual 0520 required scrap metal smearable (removable) beta/gamma contamination levels for material released off site to average an alpha contamination level of 5,000 DPM/100 cm^2 and to be no more than a maximum of 25,000 DPM/100 cm^2. Our assumption for uranium contamination levels on scrap metal loads entering the DWI site are therefore 5 times the allowable average value. It is extremely unlikely that a shipment with this high an alpha smearable contamination level would have ever been released to a radioactive materials licensee.

With regard to the source term for this calculation I have used the information contained in NCRP Report 141 (Reference b), on page 31, Table 3.5 it provides the nuclide make up of scrap metal derived from uranium enrichment facilities such as Y-12. The nuclides and their activity are as follows:

Nuclide	Activity (%)
Tc-99	55
U-234	43
U-235	1.4
U-238	0.5
Pu-239	0.01
Np-237	0.001

Based on the above discussion and the specific nuclide source term, if I assume that these concentrations are resuspended into Mr. Payne's breathing zone, the total lung dose received from intakes over the 15 years of this activity would be 280 mrem. The corresponding committed effective dose equivalent (CEDE) would be 47 mrem. These dose calculations take into account the amount of annual reported rainfall in the Knoxville area. I conclude that the scrap in open top gondola cars would be wet and/or damp as much as 34.5% of the time and therefore unavailable for resuspension. The timing of deliveries of this material to DWI where the possibility of resuspension such that Mr. Payne inhaled this material is thought to be at most 65.5% of the time he performed this work thereby reducing the lung dose and CEDE calculated above. Despite this reduction in dose due to local weather conditions, it is my opinion that Mr. Payne's estimated doses for this exposure scenario is overstated by a factor of at least 5 and more likely by a significantly larger margin.

Indirect Exposure to Airborne Uranium Contamination in Onsite Soils
For the case where Mr. Payne is performing his work activities at the DWI site acting as a flagman and switchman and walking next to the train as it is pushed into position under the metal process shed. Figure 1 depicts a cartoon drawing of

one of the potential paths he could have taken while walking along side the train as it was moved into place. To estimate Mr. Payne's potential for airborne exposure to resuspended uranium contaminated soils that existed along the tracks, I will use the average of the highest 10 uranium soil concentrations measured on site of 501 pCi/g (see Reference m). Assuming a normal resuspension factor of 1 in a million (1E-06) for disturbed soils, a heavy worker breathing rate of 1.7 cubic meters (m^3) of air per hour and the same nuclide activity ratios as given above from NCRP Report 141, the calculated 15 year exposure CEDE is 263 mrem and the corresponding lung dose is 1560 mrem. This dose estimate takes into account a reduction of 34.5% as described above for the fact that the site soils would be unavailable for resuspension due to rainfall occurring on average 126 days per year.

It should also be noted here that the above dose estimate assumes a nuisance dust level of 12.5 mg/m^3 or 2.5 times the current OSHA level of 5 mg/ m^3 for respirable dust.

d. CSX Worker Exposure to Ambient Radiation Sources and Cs-137 at Oak Ridge RR Yard in 1983

Kocher (1990) issued a report (Reference j)where ORAU measured and calculated an annual dose of 2 mrem/yr while ORNL measured and calculated a dose to CSX workers of 4 mrem/yr from the presence of Cs-137 contamination on and below the railroad ballast along the tracks near the Y-12 facility. For the purposes of this report, I will assume that a 4 mrem whole body dose was received by Mr Payne in 1983, the year he was reported to have worked on the Oak Ridge site. A corresponding lung dose from this Cs-137 contamination exposure in 1983 is estimated to be 2 mrem.

Additional dose assumed to be received by Mr. Payne from working on the Y-12 site in 1983 derived from Reference k, results in a whole body and lung dose of 19.35 mrem. The total of all potential exposure for Mr. Payne from his working on the Y-12 site in 1983 is 23.35 mrem to the whole body. The dose conversion factor assigned for the lung for this dose estimate is for an isotropic geometry. The resulting lung dose is 13 mrem.

4. Time Line of Regulations Pertinent to CSX Operations

Whether any of the regulations discussed in this section apply to Mr. Payne specifically is very much in doubt, however, this discussion aims to provide a framework against which his potential historical exposures can be evaluated.

a. Discussion of Regulatory Framework

Broadly, five areas of federal regulation may have applied to this case:

- Atomic Energy Commission (AEC) - 1946 – 1974

- Nuclear Regulatory Commission (NRC) – since 1975
- Energy Research and Development Agency (ERDA) – Oct 1974 to Oct 1977
- Department of Energy (DOE) – since 1977
- Department of Transportation (DOT)
- Department of Labor (OSHA)

During the referenced time period, the AEC regulations succeeded to ERDA regulations in 1970 and in turn to the DOE regulations in 1974. These regulations governed the actions of Oak Ridge in the use, possession, storage, production, and transfer of radioactive materials. They would have little or no application beyond the physical boundaries of ORNL.

The DOT regulations applied to radioactive materials in the course of transportation and prescribed requirements for packaging, labeling, allowable radiation levels, shipping papers, etc.

The OSHA radiation regulations (OSHA formed in 1971) generally regulate employers who are not NRC/DOE or "Agreement State" radioactive materials licensees. The OSHA regulations in part govern permissible levels of radiation exposure in "Restricted Areas".

AEC Regulations

While the AEC regulations had little or no bearing on the CSX employees with respect to exposures received not on the ORNL site, the worker exposure limitations can help place Mr. Payne's exposure in perspective.

The AEC limited the allowable occupational exposure to an adult at an average of 5000 mR per year (1,250 mR per calendar quarter) whole body exposure. The "whole body" included the trunk of the body, the lens of the eye, the major blood forming organs (large bones), and the gonads. Higher limits applied to exposure to the skin and extremities. A worker could receive up to 12,000 mR in a year (3000 per quarter) as long as they stayed below the 5000 mR average (As long as their cumulative exposure did not exceed 5000 times their age in years minus 18). Occupational exposure to minors (less than 18 years old) was limited to 10% of the adult limit, or 500mR per year. The limit to the fetus of an occupational worker was limited to 500 mR during the gestation period.

In addition the AEC regulations established "maximum permissible concentrations" for airborne radioactivity. Specific concentrations were established for each isotope including uranium and its daughter isotopes. Limits were established for exposure within restricted areas, and for releases outside of restricted areas. The limits were weighted upon a presumed 40 hr work week.

DOT Regulations

To provide the proper framework for this discussion of Department of Transportation (DOT) regulations as they relate to this case, it is important to understand the history as it pertains to the Federal Railroad Administration (FRA) and the transport of hazardous materials.

In 1966 DOT was created and/or recodified and provided that the FRA, the Federal Highway Administration (FHA) and the Federal Aviation Administration (FAA) would come under the DOT. The DOT secretary doled out and delegated authority.

The 1975 Hazardous Material Transportation Act enacted as 40 USC 1801 under the 49 CFR 1.49 regulations, gave FRA the authority over regulating hazardous materials. EPA expressly adopted the DOT hazardous material regulations in 49 CFR 262 and 263.

In 49 CFR 171 and 172 is the regulation governing transportation for hazardous materials. In 49 CFR 172.1(f) it talks about the fact that no person may transport a hazardous material in commerce without following the regulations, "then each carrier who transports a hazardous material in commerce may rely on information provided by the offeror of the hazardous material or a prior carrier unless the carrier knows or, a reasonable person acting in the circumstances and exercising reasonable care, would have knowledge that the information provided by the offeror or prior carrier is incorrect."

The DOT regulations as currently specified in Title 49 of the Code of Federal Regulations, as currently enforced by the FRA and other agencies, are complex and place many requirements upon persons who ship radioactive materials. Some general concepts included in these regulations are:

- Packaging – the required packaging for shipping radioactive materials must meet rigid specifications. The required packaging is commensurate with the types and quantity of radioisotopes present, and the associated potential hazards. Materials with low concentration of radioactivity (low specific activity or LSA) and or low levels of surface contamination may be shipped in bulk containers (e.g. in gondola cars).
- Placards were required to be affixed to the outside of vehicles and rail cars if they contained packages exceeding certain radiation exposure levels at the surface and set distances from the package, or if they are LSA materials. Many shipments did not require these placards.
- Specific packaging (container) requirements were established. For some low concentration (bulk) materials the vehicle (e.g. the rail car) could serve as the package.
- Shipping papers were required for most shipments. For rail shipments this typically was included in the train "consist" documents and would be in the possession of the engineer or the conductor.

OSHA Regulations:
Since 1978, the regulations of the Occupational Safety and Health Administration (OSHA), has applied to workers involved in "plant" or fixed facility activities such as repair facilities, depots, etc., and similar industrial settings which describes only a very small part of Mr. Payne's work activities while employed by CSX (i.e., work in a railroad repair facility). OSHA regulations do not apply to train transport operations. These operations are governed by the Federal Railroad Administration.

The following is a summary of relevant sections of the current OSHA standard that have been in effect for many years, citing the regulation and providing comment for each.

Regulation - Definitions:

Restricted Area – means any area access to which is controlled by the employer for purposes of protection of individual from exposure to radiation or radioactive materials

Unrestricted Area - means any area access to which is not controlled by the employer for purposes of protection of individual from exposure to radiation or radioactive materials

Interpretation/Comment:

It is possibly a key issue whether the plaintiff ever entered a restricted area. Presumably he worked in unrestricted areas. The expectations placed on employers for actions in unrestricted areas under OSHA are essentially none. Restricting access to an area because of security concerns does not make it a restricted area in this context….only if the restriction is for the purpose of radiation protection.

Regulation - Exposure Limitations 1:

1910.1096 (b)(1)

Except as provided in paragraph (b)(2) of this section, no employer shall possess, use, or transfer sources of ionizing radiation in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from sources in the employer's possession or control a dose in excess of the limits specified in Table G-18:

TABLE G-18

	Rems per calendar quarter
Whole body: Head and trunk; active blood-	1 1/4

forming organs; lens of eyes; or gonads	
Hands and forearms; feet and ankles	18 3/4
Skin of whole body	7 1/2

Interpretation/Comment:

If the plaintiff worked in a restricted area the above limits would have applied. The whole body limit is typically the most restrictive for individuals who are not physically handling radioactive materials. OSHA regulations do not address exposures in non-restricted areas.

Regulation - Exposure Limitations 2:

1910.1096(b)(2)
An employer may permit an individual in a restricted area to receive doses to the whole body greater than those permitted under subparagraph (1) of this paragraph, so long as:

1910.1096(b)(2)(i)

During any calendar quarter the dose to the whole body shall not exceed 3 rems; and...*1910.1096(b)(2)(ii)*

1910.1096(b)(2)(ii)
The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5 (N-18) rems, where "N" equals the individual's age in years at his last birthday; and

1910.1096(b)(2)(iii)
The employer maintains adequate past and current exposure records which show that the addition of such a dose will not cause the individual to exceed the amount authorized in this subparagraph. As used in this subparagraph ***Dose to the whole body*** shall be deemed to include any dose to the whole body, gonad, active blood forming organs, head and trunk, or lens of the eye.

Interpretation/Comment:

The higher limit of 3 rem per quarter could have been applied at times for exposure within a restricted area. This provision probably will have no bearing on the case.

Regulation - Exposure Limitations 3:

1910.1096(c) ***Exposure to airborne radioactive material.***

1910.1096(c)(1)
No employer shall possess, use or transport radioactive material in such a manner as to cause any employee, within a restricted area, to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Table 1 of Appendix B to 10 CFR Part 20. The limits given in Table 1 are for exposure to the concentrations specified for 40 hours in any workweek of 7 consecutive days. In any such period where the number of hours of exposure is less than 40, the limits specified in the table may be increased proportionately. In any such period where the number of hours of exposure is greater than 40, the limits specified in the table shall be decreased proportionately.

1910.1096(c)(3)
Exposed as used in this paragraph means that the individual is present in an airborne concentration. No allowance shall be made for the use of protective clothing or equipment, or particle size.

Interpretation/Comment:

If CSX employees worked within a restricted area, the concentration of airborne uranium would have to be less then the established limits. The concentration could be proportionately higher for persons who worked less than 40 hours per week. The current limit for uranium oxides is 2 E -11 microcuries per cubic centimeter (cc). In the present dose reconstruction for Mr. Payne's on site (DWI) exposure potential, it was assumed that the concentration of uranium oxides to which he may have been exposed was 300 times this current limit.

Regulation - Exposure Limitations 4:

1910.1096(d)(2)

1910.1096(d)(2)
Every employer shall supply appropriate personnel monitoring equipment, such as film badges, pocket chambers, pocket dosimeters, or film rings, and shall require the use of such equipment by:

1910.1096(d)(2)(i)
Each employee who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 25 percent of the applicable value specified in paragraph (b)(1) of this section;

Interpretation/Comment:

Since Mr. Payne would not be expected to receive an exposure of 25% or more of the limit, no radiation dosimeters would have been required.

Summary

The overall conclusion that I have reached from this research is that CSX violated no law with regard to Mr. Payne's potential radiation exposure while employed regardless of his work activity. It is my opinion within a reasonable degree of scientific certainty that CSX provided Mr. Payne with a reasonably safe work place.

5. **Summary of Estimated Lung Doses for Mr. Payne's Various Work Activities**
Table 3 below summaries the dose information contained and discussed in the above sections.

Table 3. Lung Dose Summary for Various Exposure Scenarios in This Report

Scenario	Lung Dose(mrem)
Direct Exposure - Gondola (routine)	854
Direct Exposure - Gondola (non-routine)	116
Direct Exposure - Uranium Turnings Drum Transport	22.8
Direct Exposure - DWI Site	540
Direct Exposure - Oak Ridge (Cs-137)	2
Direct Exposure - Ambient (Y-12)	10
Internal Exposure - Ambient (Y-12)	1
Inhalation - Gondola	280
Inhalation - DWI Site	1560

Figure 3 graphically reports the information contained in Table 3 above in a bar graph format to more easily compare the relative magnitude of these dose estimates for Mr. Payne's work activities while employed by CSX.

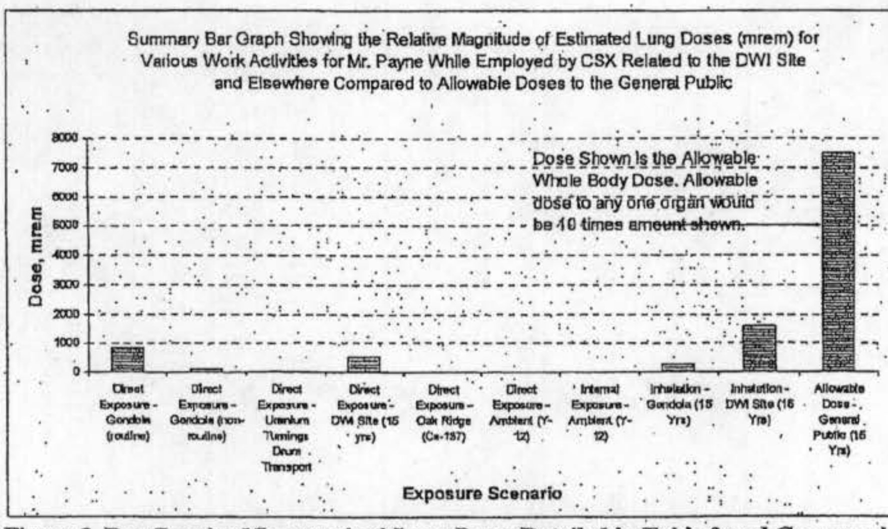

Figure 3. Bar Graph of Summarized Lung Doses Detailed in Table 3 and Compared to Allowable Whole Body Dose for a Member of the General Public for 15 Years.

Figure 3 above shows the comparison of the conservative estimates of lung dose for Mr. Payne's activities as they concern the DWI site and his work in 1983 at the Oak Ridge Yard to the allowable whole body dose to member of the general public from licensed activities. It is clear that this allowable general public dose is large when compared to Mr. Payne's conservatively estimated dose, but it becomes even more significant when one considers that the allowable dose to any one organ (such as the lung) to a member of the general public was a factor of 10 higher than the then the last bar shown in Figure 3 above.

To make this point clearer that the allowable organ dose to a member of the general public is ten times higher than that shown in Figure 3 above, Figure 4 compares the actual allowable organ dose over a 15 year period with the sum of all doses for Mr. Payne's CSX-related work activities. Figure 4 demonstrates graphically that Mr. Payn, as a member of the general public, could have received a dose to the lung nearly 23 times higher than the sum of all estimated doses for his activities as a CSW worker.

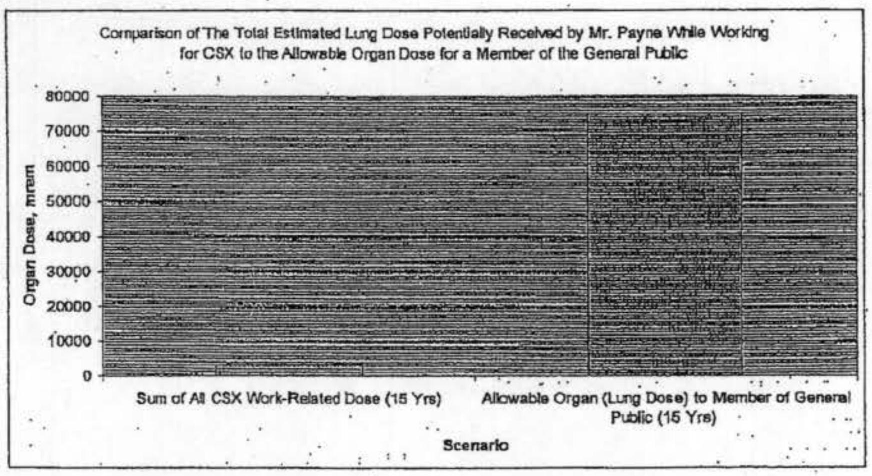

Figure 4. Bar Graph Comparison of Mr. Payne's Total Estimated Lung Dose to the Allowable Organ Dose for a Member of the General Public for 15 Years.

6. Comparison of Dose Scenarios to Po-210 Radiation Dose Received From Smoking Cigarettes

In this section I will provide a Pie chart which repeats the data from Table 3 that reports the conservatively estimated lung doses calculated for all of Mr. Payne's work activities but now adds a comparison to the estimated radiation dose to the lungs he potentially received from Po-210 radiation exposure based on his 26 year smoking history. The lung dose reported in Figure 5 uses an average of several reports for Po-210 dose estimates to the lung that range from a low of 1100 mrem to a high of 52000 mrem (average of 29300 mrem) for a pack a day smoker over a 26 year timeframe(References a, e, f, g and h).

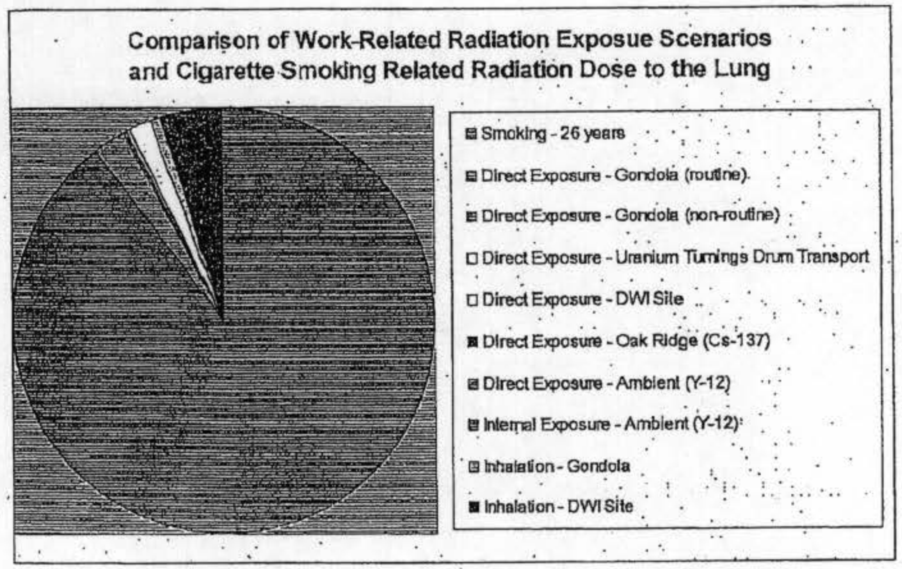

Figure 5. Comparison of Lung Dose Estimates From Work Activities Over 15 Years and From Smoking for 26 years

Summary

In summary, Figure 4 above shows that in relative terms, and assuming very conservative estimates of lung dose for Mr. Payne's work-related activities while employed by CSX, the dose to the lung based on Mr. Payne's smoking history conservatively represents 89% of the total estimated lung dose. Based on the conservatisms used in the work-related lung dose estimates described in this report, it is my professional opinion that work-related exposure scenarios for Mr. Payne are overestimated by at least a factor of 10 related to the DWI site.

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Addendum 1 to Main Report by Dr. David A. Dooley for Payne vs CSX

Introduction

In this addendum to the main dose reconstruction report for Mr. Payne, a detailed list of key assumptions, in addition to the general assumptions discussed in the report, are provided to allow the reader the opportunity to follow the logic used to provide input parameters to the dose calculation program IMBA (Reference 1) and the probability of causation program IREP (Reference 5). These programs will be described followed by the assumptions used for each in performing our analyses.

IMBA Professional Plus (Integrated Modules for Bioassay Analysis) Version 4.0.36

A computer code, the Integrated Modules for Bioassay Analysis (IMBA), was used to estimate annual organ doses (Reference 1). The IMBA Professional Plus edition was used for this dose reconstruction. The ICRP 66 (Reference 2) lung model with default aerosol characteristics was assumed, in conjunction with ICRP 68 (Reference 3) metabolic models. IMBA Professional Plus includes the capability to assess an intake from bioassay measurement data, calculate bioassay quantities at different times from a specific intake, and calculate equivalent organ doses and effective dose from a single intake. IMBA Professional Plus enables the user to perform basic internal dosimetry calculations (*e.g.*, calculating doses from a specified intake, estimating an intake from bioassay measurements and calculating bioassay quantities from a given intake). It implements the latest ICRP biokinetic models. For standard calculations, all of the ICRP default values can be selected from built in databases at the touch of a button. For more detailed calculations, the user can enter individual parameter values. The product has been extensively quality assured and comes with complete documentation.

IREP (*Interactive RadioEpidemiological Program*)

Under the Energy Employees' Occupational Illness Compensation Program Act of 2000 (EEOICPA), the National Institute for Occupational Safety and Health (NIOSH) is charged with the development of guidelines to determine whether a claimant's cancer meets the criterion for causation by workplace exposure to ionizing radiation. The basis for this determination, as specified in EEOICPA, is the set of radioepidemiological tables developed by a National Institutes of Health Ad Hoc working group in 1985 (Reference 4), as they are updated periodically. These radioepidemiological tables serve as a reference tool providing probability of causation estimates for individuals with cancer that were exposed to ionizing radiation. Use of the tables requires information about the person's dose, gender, age of exposure, date of cancer diagnosis and other relevant factors. The tables are used by the Department of Veterans Affairs (DVA) to make compensation decisions for veterans with cancer who were exposed in the line of duty to radiation from atomic weapon detonations. The primary source of data for the 1985 tables is research on the occurrence of cancer-related deaths among Japanese atomic bomb survivors from Word War II.

Since this information is specific for different types of cancers and the target organ for each type of cancer may vary, the doses entered into the IREP (Reference 5) program are organ doses (such as lung in this case). Organ doses can be significantly different than whole body equivalent doses, so both have been given in this report. The IREP program is available to be run at the following web site: https://www.niosh-irep.com/irep_niosh/.

IMBA and IREP Assumptions Used for Calculations:

Witherspoon Internal Dose (Onsite and Rail Cars)
For the intake rates for all airborne potential at the Witherspoon site and on the gondola cars, the following assumptions were made:

- Total alpha contamination was assumed to be 100% total uranium.
- The NCRP 141 (Reference 6) report breakdown of radionuclides was then applied to this intake rate based on U-234/5/8 being 100% of the total uranium rate calculated from the airborne hazard.
- For the intake of the radionuclides, the ICRP 66 lung model was used with the ICRP 68 parameters applicable to each radionuclide and a 5 micron AMAD. The lung solubility types were selected to maximize the dose to the lung (most insoluble recognized ICRP 68 solubility type for of each was selected as shown below).

Nuclide	Activity	Lung Solubility Type in IMBA
Tc-99	55%	M
U-234	43%	S
U-235	1.4%	S
U-238	0.5%	S
Pu-239	0.01%	S
Np-237	0.001%	M

- Annual lung doses were calculated for each radionuclide from the beginning of exposure through the date of cancer diagnosis (October 28, 2005).
- These annual lung doses were entered into IREP as chronic doses, using a radiation type of "electron>15keV" for the Tc-99 and "alpha" for the rest of the radionuclides, and a constant distribution (based on this being an upper bound of the exposure, no distribution lower than the calculated doses was assigned). The calculated doses are entered into the parameter 1 column. Some doses may appear to be 0.000 rem, but the input file only shows the dose down to mrem; these rows actually contain values that are smaller than 0.5 mrem (and were rounded down to 0.000 in the display).
- In the IREP input sheet(see Appendix 1), exposure# 1 – 43 represent the alpha dose from resuspension onsite.
- In the IREP input sheet, exposure# 44 – 86 represent the electron dose (Tc-99) from resuspension onsite.
- In the IREP input sheet, exposure# 87– 129 represent the alpha dose from resuspension in the rail car.

- In the IREP input sheet, exposure# 130 – 172 represent the electron dose (Tc-99) from resuspension in the rail car.

Y-12 Switch Yard Internal Dose
For the intake rates for all airborne potential at the Y-12 switchyard (1983), the following assumptions were made.

- The U-234/5 and U-238 intake rates from the Y-12 environmental TBD were used (Reference 7). The 95th percentile of the intake rates for 1983 were corrected from a 2000 hour exposure year to 150 hours.
- These intakes were entered into IMBA and IREP in the same method and using the same parameters as the uranium discussed above except the fact that only U-234/5 and U-238 were considered per the TBD.
- In the IREP input sheet, exposure# 173 – 195 represent the alpha dose from this exposure.

Y-12 Switch Yard External Dose
For the external potential at the Y-12 switchyard (1983), the following assumptions were made.

- The annual ambient external exposure for the years 1948 – 2002 had been compiled and combined into a distribution of dose rates (Reference 7). The 95th percentile of these values was used for this assessment (129 µR/hour). This value was used to assess the total dose based on 150 hours onsite.
- The full annual Cs-137 direct exposure dose was assigned for this year although it was calculated based on 200 hours per year and there was actually only 150 hours of exposure in this case.
- Both exposures were adjusted to lung dose from whole body dose based upon dose conversion factors (DCF) used in conjunction with IREP (Reference 8). For this exposure scenario, the isotropic DCFs (Hp(10) doses to Organ doses) were used since the source dose is already in Hp(10) whole body form and the source is not unidirectional, but the exposure would be isotropic (all directions). The min/average/max DCFs for each energy range (30-250 keV photon for the uranium exposure and >250 keV photons for the Cs-137) were applied to give minimum, average, and maximum lung doses.
- These min/average/max doses were entered into IREP as a chronic exposure, triangular distribution (with those values in parameters 1, 2, and 3 respectively). The Y-12 ambient was assigned as 30-250 keV photons and the Cs-137 was assigned as >250 keV photons.
- In the IREP input sheet, exposure# 196 represent the Y-12 ambient direct dose from this exposure.
- In the IREP input sheet, exposure# 197 represent the Cs-137 direct dose from this exposure.

Witherspoon External (1963 Delivery of Uranium Turnings Barrels)
For the external potential on the gondola cars delivering the uranium turnings barrels in 1963, the following assumptions were made.

- Ten total trips with exposure to the barrels (4 mR/hour).

- Exposure was adjusted to lung dose from whole body dose based upon dose conversion factors (DCF) used in conjunction with IREP (ref OCAS-IG-0001). For this exposure scenario, the DCFs (Exposure (R) to Organ Dose (HT)) were used since the source dose is in Exposure form and the source is unidirectional.
- Since it was unknown which direction the worker was facing, it was assumed that he would be facing forward or backward (away from or toward the source) for 75% of his time and in the midst of twisting and turning during the other 25% of his time (based on the fact that he needed to be aware of the train's surroundings at all times).

DCF geometry		
AP	37.5%	anterior to posterior - facing source
PA	37.5%	posterior to anterior -facing away from source
ROT	25.0%	rotational - twisting and turning
	100.0%	

- The min/average/max DCFs for the energy range (30-250 keV photon for the uranium exposure) were applied to give minimum, average, and maximum lung doses.
- These min/average/max doses were entered into IREP as a chronic exposure, triangular distribution (with those values in parameters 1, 2, and 3 respectively) assigned as 30-250 keV photons.
- In the IREP input sheet, exposure# 198 represent the 1963 barrel delivery direct dose from this exposure.

Witherspoon External Dose (Onsite)

For the external potential while working onsite at the Witherspoon site, the following assumptions were made.

- 100 hours of annual exposure to the area source term (400 μR/hour) for 15 years of work.
- Exposure was adjusted to lung dose from whole body dose based upon dose conversion factors (DCF) used in conjunction with IREP (ref OCAS-IG-0001). For this exposure scenario, the rotational DCFs (Exposure (R) to Organ Dose (HT)) were used since the source dose is in Exposure form and the source is generally unidirectional (assumed mainly from the barrels on the other side of the tracks). The rotational exposure geometry was selected since the worker was assumed to be in constant motion while flagging, signaling, walking, coupling/uncoupling, setting/releasing brakes, etc.
- The min/average/max DCFs for the energy range (30-250 keV photon for the uranium exposure) were applied to give minimum, average, and maximum lung doses.
- These min/average/max doses were entered into IREP as a chronic exposure, triangular distribution (with those values in parameters 1, 2, and 3 respectively) assigned as 30-250 keV photons.
- In the IREP input sheet, exposure# 199 - 213 represent the direct dose while working onsite at the Witherspoon site from this exposure.

Addendum 1 to Main Report

Witherspoon External Dose (On Gondola Cars)

For the external potential while working on the gondola cars between the Witherspoon site and the Knox yard, the following assumptions were made.

- 50 hours of annual exposure to the area source term (1 mR/hour) for 15 years of work and various special direct exposures based on equipment found during investigations at the site.
- Exposure was adjusted to lung dose from whole body dose based upon dose conversion factors (DCF) in the same manner as for the uranium turnings barrel deliveries outlined above (based on the scrap being in the gondola car in the same manner as the barrels).
- The min/average/max DCFs for the energy range (30-250 keV photon for the uranium exposure) were applied to give minimum, average, and maximum lung doses.
- These min/average/max doses were entered into IREP as a chronic exposure, triangular distribution (with those values in parameters 1, 2, and 3 respectively) assigned as 30-250 keV photons.
- In the IREP input sheet, exposure# 214 - 228 represent the direct dose while riding in the gondola cars during routine deliveries.
- In the IREP input sheet, exposure# 229 - 233 represent the direct dose while riding in the gondola cars during the special cases.

Overarching IREP Information

- Since IREP is a Monte Carlo calculation tool, it requires a starting value for the random number generator used in the calculations (the random "seed" selected was 99) and also the number of iterations for each calculation. The number of iterations was selected to be 2,000.
- The IREP lung dose/risk tables take into account the smoking history of the individual. Since Mr. Payne reported quitting smoking in the later 1980's, he was considered a former smoker for IREP calculation purposes.

IMBA, IREP and Probability of Causation

The probability of causation (PC) (Reference 9) is calculated as the risk of cancer attributable to radiation exposure (RadRisk) divided by the sum of the baseline risk of cancer to the general population (BasRisk) plus the risk attributable to the radiation exposure, then multiplied by 100 percent, as follows:

$$\frac{\text{RadRisk}}{\text{RadRisk} + \text{BasRisk}} \times 100\% = \text{PC}$$

This calculation provides a percentage estimate between 0 and 100 percent, where 0 would mean 0 likelihood that radiation caused the cancer and 100 would mean 100 percent certainty that radiation caused the cancer.

Scientists evaluate the likelihood that radiation caused cancer in a worker by using medical and scientific knowledge about the relationship between specific types and levels of radiation dose and the frequency of cancers in exposed populations. Simply explained, if research determines that a specific type of cancer occurs more frequently among a population exposed to a higher level of radiation than a comparable population (a population with less radiation exposure but similar in age, gender, and other factors that have a role in health), and if the radiation exposure levels are known in the two populations, then it is possible to estimate the proportion of cancers in the exposed population that may have been caused by a given level of radiation. If scientists consider this research sufficient and of reasonable quality, they can then translate the findings into a series of mathematical equations that estimate how much the risk of cancer in a population would increase as the dose of radiation incurred by that population increases. The series of equations, known as a dose-response or quantitative risk assessment model, may also take into account other health factors potentially related to cancer risk, such as gender, smoking history, age at exposure (to radiation), and time since exposure. The risk models can then be applied as an imperfect but reasonable approach to determine the likelihood that the cancer of an individual worker was caused by his or her radiation dose.

Probability of Causation Calculation for Mr. Payne

Appendix 2 to this Addendum shows the output from the IREP program which calculates the probability of causation PoC for Mr. Payne based on the conservative estimates of radiation doses he may have received as a worker for CSX. These radiation doses have been discussed in detail in the main report on this topic prepared by Dr. Dooley and the additional assumptions pertaining to these calculations are explained in this document. The dose estimate is used to determine the Excess Relative Risk (ERR). The probability of Causation (POC) is determined directly from the ERR. The relationship is: $POC = ERR/(1+ERR)*100\%$

From this equation it can be seen that an ERR of 1 is required to yield a PoC of 50% (this means that the risk due to exposure is the same as the risk naturally). For a given scenario, of time since exposure, age at diagnosis, type of cancer, type of radiation, etc., the ERR varies essentially linearly with the dose. Thus, the PoC is actually a curve that would technically never reach 100% since that would mean that there is no chance the cancer was natural, but it approaches 100% as ERR increases.

Based on the estimation of radiation dose while employed by CSX, Mr. Payne's smoking history and reported type of lung cancer and its related history, the calculated ERR was 0.0308 and the associated PoC for Mr. Payne's estimated radiation dose as the cause of his lung cancer is 2.99% at the 95th percentile.

NRC Regulations – Organ Dose vs. Whole Body Dose

In our comparison to regulatory standards in Figure 3 of the main report, we stated that Mr. Payne as a member of the general public could have received a dose of 500 mrem/yr for the 15 years he was employed by CSX due to the activities of radioactive materials licensees. We also state that the organ dose to a member of the public, in this case Mr. Payne's lung could have been 5000 mrem/yr for 15 years under the same circumstances. While the current 10 CFR 20 limit is 100 mrem/year to a member of the public, this limit was adopted in 1994. Prior to 1994 the annual dose limit to a member of the general public was 500 mrem/yr as it was for the State of TN.

The regulation does not specify the organ dose limit, but can be inferred from the information in 20.1201 where the occupational dose limit is 5 rem total effective dose equivalent (TEDE) or 50 rem total organ dose equivalent (TODE). The organ dose limit is clearly 10 times higher based on the fact that organ doses for critical organs will always be larger than the whole body effective dose. The following describes the current limits for members of the public and for occupational workers under NRC and State of TN regulations given they are an agreement state.

§ 20.1301 Dose limits for individual members of the public.

(a) Each licensee shall conduct operations so that —

(1) **The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year,** exclusive of the dose contributions from background radiation, from any administration the individual has received, from exposure to individuals administered radioactive material and released under § 35.75, from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with § 20.2003, and

(2) The dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with § 35.75, does not exceed 0.002 rem (0.02 millisievert) in any one hour.

(b) If the licensee permits members of the public to have access to controlled areas, the limits for members of the public continue to apply to those individuals.

§ 20.1201 Occupational dose limits for adults.

(a) The licensee shall control the occupational dose to individual adults, except for planned special exposures under § 20.1206, to the following dose limits.

(1) An annual limit, which is the more limiting of–

(i) **The total effective dose equivalent being equal to 5 rems** (0.05 Sv); or

(ii) **The sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems** (0.5 Sv).

(2) The annual limits to the lens of the eye, to the skin of the whole body, and to the skin of the extremities, which are:

(i) A lens dose equivalent of 15 rems (0.15 Sv), and

(ii) A shallow-dose equivalent of 50 rem (0.5 Sv) to the skin of the whole body or to the skin of any extremity.

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4. National Cancer Institute(NCI), 2000, Draft Report of the NCI-CDC Working Group to revise the 1985 NIH Radioepidemiological Tables, May 31.
5. NIOSH, (2002) *NIOSH-Interactive RadioEpidemiological Program (NIOSH-IREP) Technical Documentation, Final Report*, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio.
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8. NIOSH, (2007) *External Dose Reconstruction Implementation Guideline, Rev 3*, OCAS-IG-001, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio
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Appendix 1 – IREP Input Information

Appendix 1. IREP Input Parameters for Mr. Winston Payne's Lung Cancer and Estimated Doses for CSX Work and Related Activities

PERSONAL INFORMATION

Claimant Name	NIOSH ID #	DOL Case No	DOL District Office	Gender	Birth Year	Year of Diagnosis	Cancer Model	[illegible]
Winston D. Payne	[illegible]	[illegible]	CL	Male	1940	2004	Lung	N

CLAIMANT CANCER DIAGNOSES

	Primary Cancer #1	Primary Cancer #2	Primary Cancer #3	Secondary Cancer #1	Secondary Cancer #2	Secondary Cancer #3
Cancer Type	lung	N/A	N/A	N/A	N/A	N/A
Date of Diagnosis	2004	N/A	N/A	N/A	N/A	N/A

EXPOSURE INFORMATION

Number of exposures: 233

Exposure #	Exposure Year	Exposure Rate	Radiation Type	Dose Distribution Type	Parameter 1	Parameter 2	Parameter 3	Exposure Scenario
1	1953	chronic	alpha	Constant	0.043	0.000	[illegible]	Soil [illegible] Uptake (1953-75, 84-88)
2	1954	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
3	1955	chronic	alpha	Constant	0.072	0.000	[illegible]	
4	1956	chronic	alpha	Constant	0.077	0.000	[illegible]	
5	1957	chronic	alpha	Constant	0.081	0.000	[illegible]	
6	1958	chronic	alpha	Constant	0.085	0.000	[illegible]	
7	[illegible]	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
8	1970	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
9	1971	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
10	1972	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
11	1973	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
12	1974	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
13	1975	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
14	1976	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
15	1977	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
16	1978	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
17	1979	chronic	alpha	Constant	0.021	0.000	[illegible]	
18	1980	chronic	alpha	Constant	0.017	0.000	[illegible]	
19	1981	chronic	alpha	Constant	0.015	0.000	[illegible]	
20	1982	chronic	alpha	Constant	0.013	0.000	[illegible]	
21	1983	chronic	alpha	Constant	0.011	0.000	[illegible]	
22	1984	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
23	1985	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
24	1986	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
25	1987	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
26	1988	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
27	1989	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
28	1990	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
29	1991	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
30	1992	chronic	alpha	Constant	[illegible]	0.000	[illegible]	
31	1993	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
32	1994	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
33	1995	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
34	1996	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
35	1997	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
36	1998	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
37	1999	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
38	2000	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
39	2001	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
40	2002	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
41	2003	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
42	2004	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
43	2005	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
44	1963	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	Soil Drains To-62 [illegible]
45	1964	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
46	1965	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
47	1966	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
48	1967	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	

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49	1968	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
50	1969	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
51	1970	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
52	1971	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
53	1972	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
54	1973	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
55	1974	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
56	1975	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
57	1976	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
58	1977	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
59	1978	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
60	1979	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
61	1980	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
62	1981	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
63	1982	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
64	1983	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
65	1984	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
66	1985	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
67	1986	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
68	1987	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
69	1988	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
70	1989	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
71	1990	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
72	1991	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
73	1992	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
74	1993	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
75	1994	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
76	1995	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
77	1996	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
78	1997	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
79	1998	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
80	1999	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
81	2000	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
82	2001	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
83	2002	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
84	2003	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
85	2004	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
86	2005	chronic	electrons E>15keV	Constant	[illegible]	[illegible]	[illegible]	
87	1963	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	Rail Car [illegible]
88	1964	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
89	1965	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
90	1966	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
91	1967	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
92	1968	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
93	1969	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
94	1970	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
95	1971	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
96	1972	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
97	1973	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
98	1974	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
99	1975	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
100	1976	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
101	1977	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
102	1978	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
103	1979	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
104	1980	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
105	1981	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
106	1982	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
107	1983	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
108	1984	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	
109	1985	chronic	alpha	Constant	[illegible]	[illegible]	[illegible]	

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110	1986	chronic	alpha	Constant	0.004	0.001	0.000	
111	1987	chronic	alpha	Constant	0.004	0.001	0.000	
112	1988	chronic	alpha	Constant	0.003	0.001	0.000	
113	1989	chronic	alpha	Constant	0.002	0.001	0.000	
114	1990	chronic	alpha	Constant	0.002	0.001	0.000	
115	1991	chronic	alpha	Constant	0.002	0.001	0.000	
116	1992	chronic	alpha	Constant	0.002	0.001	0.000	
117	1993	chronic	alpha	Constant	0.001	0.001	0.000	
118	1994	chronic	alpha	Constant	0.001	0.001	0.000	
119	1995	chronic	alpha	Constant	0.001	0.001	0.000	
120	1996	chronic	alpha	Constant	0.001	0.001	0.100	
121	1997	chronic	alpha	Constant	0.001	0.026	0.100	
122	1998	chronic	alpha	Constant	0.001	0.026	0.100	
123	1999	chronic	alpha	Constant	0.001	0.026	0.100	
124	2000	chronic	alpha	Constant	0.001	0.026	0.100	
125	2001	chronic	alpha	Constant	0.001	0.026	0.100	
126	2002	chronic	alpha	Constant	0.001	0.026	0.100	
127	2003	chronic	alpha	Constant	0.001	0.026	0.100	
128	2004	chronic	alpha	Constant	0.001	0.026	0.100	
129	2005	chronic	alpha	Constant	0.001	0.026	0.100	
130	1963	chronic	electrons E>15keV	Constant	0.002	0.026	0.100	Rad Conc. To 09 [illegible]
131	1964	chronic	electrons E>15keV	Constant	0.002	0.026	0.100	
132	1965	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
133	1966	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
134	1967	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
135	1968	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
136	1969	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
137	1970	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
138	1971	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
139	1972	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
140	1973	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
141	1974	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
142	1975	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
143	1976	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
144	1977	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
145	1978	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
146	1979	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
147	1980	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
148	1981	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
149	1982	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
150	1983	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
151	1984	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
152	1985	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
153	1986	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
154	1987	chronic	electrons E>15keV	Constant	0.002	0.010	0.100	
155	1988	chronic	electrons E>15keV	Constant	0.002	0.026	0.100	
156	1989	chronic	electrons E>15keV	Constant	0.002	0.026	0.100	
157	1990	chronic	electrons E>15keV	Constant	0.000	0.026	0.100	
158	1991	chronic	electrons E>15keV	Constant	0.000	0.026	0.000	
159	1992	chronic	electrons E>15keV	Constant	0.000	0.026	0.000	
160	1993	chronic	electrons E>15keV	Constant	0.000	0.026	0.000	
161	1994	chronic	electrons E>15keV	Constant	0.000	0.018	0.000	
162	1995	chronic	electrons E>15keV	Constant	0.002	0.002	0.000	
163	1996	chronic	electrons E>15keV	Constant	0.000	0.001	0.000	
164	1997	chronic	electrons E>15keV	Constant	0.000	0.001	0.000	
165	1998	chronic	electrons E>15keV	Constant	0.000	0.001	0.000	
166	1999	chronic	electrons E>15keV	Constant	0.000	0.001	0.000	
167	2000	chronic	electrons E>15keV	Constant	0.000	0.001	0.000	
168	2001	chronic	electrons E>15keV	Constant	0.000	0.001	0.000	
169	2002	chronic	electrons E>15keV	Constant	0.000	0.001	0.000	
170	2003	chronic	electrons E>15keV	Constant	0.000	0.001	0.000	

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171	2004	chronic	electrons E>15keV	Constant	0.000	0.010	1.000		
172	2005	chronic	electrons E>15keV	Constant	0.000	0.010	1.000		
173	1958	chronic	alpha	Constant	0.001	0.010	1.000		Y-12 Environ U (1983)
174	1959	chronic	alpha	Constant	0.001	0.009	1.000		
175	1960	chronic	alpha	Constant	0.000	0.000	1.000		
176	1980	chronic	alpha	Constant	0.002	0.000	0.300		
177	1987	chronic	alpha	Constant	0.002	0.000	0.300		
178	1988	chronic	alpha	Constant	0.003	0.000	0.300		
179	1989	chronic	alpha	Constant	0.003	0.000	0.300		
180	1990	chronic	alpha	Constant	0.003	0.000	0.300		
181	1991	chronic	alpha	Constant	0.003	0.000	0.300		
182	1992	chronic	alpha	Constant	0.003	0.000	0.300		
183	1993	chronic	alpha	Constant	0.003	0.000	0.300		
184	1994	chronic	alpha	Constant	0.003	0.000	0.300		
185	1995	chronic	alpha	Constant	0.005	0.000	0.300		
186	1996	chronic	alpha	Constant	0.008	0.000	0.300		
187	1997	chronic	alpha	Constant	0.008	0.000	0.033		
188	1998	chronic	alpha	Constant	0.008	0.001	0.033		
189	1999	chronic	alpha	Constant	0.008	0.001	0.033		
190	2000	chronic	alpha	Constant	0.008	0.001	0.033		
191	2001	chronic	alpha	Constant	0.008	0.001	0.033		
192	2002	chronic	alpha	Constant	0.008	0.001	0.033		
193	2003	chronic	alpha	Constant	0.008	0.001	0.033		
194	2004	chronic	alpha	Constant	0.008	0.001	0.033		
195	2005	chronic	alpha	Constant	0.008	0.001	0.033		
196	1963	chronic	photons E=30-250keV	Triangular	0.002	0.001	0.010		Y-12 Environ Direct (1983)
197	1962	chronic	photons E>250keV	Triangular	0.002	0.001	0.033		Y-12 Cs-137 Envir (1983)
198	1963	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.033		1983 Tsuruga Dam Pollution
199	1963	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.033		External Direct Onsite (1960-75, 84-89)
200	1964	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.033		
201	1965	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.033		
202	1966	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.033		
203	1967	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.033		
204	1968	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.036		
205	1969	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.036		
206	1970	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.036		
207	1971	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.036		
208	1972	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.036		
209	1973	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.036		
210	1974	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.036		
211	1975	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.036		
212	1984	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.036		
213	1985	chronic	photons E=30-250keV	Triangular	0.007	0.001	0.036		
214	1963	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		External Used Rail Cars (1963-75, 84-85)
215	1964	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
216	1965	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
217	1966	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
218	1967	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
219	1968	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
220	1969	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
221	1970	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
222	1971	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
223	1972	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
224	1973	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
225	1974	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
226	1975	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
227	1984	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
228	1985	chronic	photons E=30-250keV	Triangular	0.015	0.048	0.167		
229	1972	chronic	photons E=30-250keV	Triangular	0.001	0.006	0.006		Special Case-Dirs1 RR cars
230	1973	chronic	photons E=30-250keV	Triangular	0.002	0.025	0.066		
231	1973	chronic	photons E=30-250keV	Triangular	0.002	0.035	0.006		

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Appendix 1. IREP Input Parameters for Mr. Winston Payne's Lung Cancer and Estimated Doses for CSX Work and Related Activities

232	1982	chronic	photons E=30-250keV	Triangular	0.002	0.012	0.414		
233	1983	chronic	photons E=30-250keV	Triangular	0.001	0.002	0.103		

[redacted]

OTHER ADVANCED FEATURES				
Sample Size	Random Seed			
5000	60			
User Defined Uncertainty Distribution				
Dose Distribution Type	Parameter 1	Parameter 2	Parameter 3	
Lognormal	1.000	1.000	0.100	
SKIN CANCER INPUTS		Not used for cancer selected		
Ethnic Origin				
White Non-Hispanic		1.00		
LUNG CANCER INPUTS				
Exposure from	Smoking History			
Other Sources	Former smoker			
Radon Exposure Information		Not used when Exposure from "Other Sources" not selected		

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Appendix 2 – IREP Output Information

NIOSH-Interactive RadioEpidemiological Program
Probability of Causation Results

Uploaded file: **IREP input Payne.xls**
Date of Run: 3/26/2009
Time of Run: 12:14:13 PM
NIOSH ID #: 000000
Claimant Name: Winston C. Payne

DOL District Office: CL
NIOSH-IREP version: 5.5.3
Analytica/ADE version: 3.0
DOL Case No: 000000000

Claimant Cancer Diagnoses:

Primary Cancer #1: lung — Date of Diagnosis: 2005
Primary Cancer #2: N/A — Date of Diagnosis: N/A
Primary Cancer #3: N/A — Date of Diagnosis: N/A
Secondary Cancer #1: N/A — Date of Diagnosis: N/A
Secondary Cancer #2: N/A — Date of Diagnosis: N/A
Secondary Cancer #3: N/A — Date of Diagnosis: N/A

Claimant Information Used In Probability of Causation Calculation:

Gender: Male
Birth Year: 1940
Cancer Model: Lung (162)
Smoking history (trachea, bronchus, or lung cancer only): Former smoker

Race (skin cancer only): N/A
Year of Diagnosis: 2005
Should alternate cancer model be run?: No

NIOSH-IREP Assumptions and Settings:

User Defined Uncertainty Distribution: Lognormal(1,1)
Number of Iterations: 2000
Random Number Seed: 99

General Exposure Information:

#	Exp. Year	Organ Dose (cSv)	Exp. Rate	Radiation Type
1	1963	Constant (0.0481)	chronic	alpha
2	1964	Constant (0.0639)	chronic	alpha

3	1965	Constant (0.0715)	chronic	alpha
4	1966	Constant (0.0772)	chronic	alpha
5	1967	Constant (0.0814)	chronic	alpha
6	1968	Constant (0.0849)	chronic	alpha
7	1969	Constant (0.0871)	chronic	alpha
8	1970	Constant (0.0892)	chronic	alpha
9	1971	Constant (0.0908)	chronic	alpha
10	1972	Constant (0.0925)	chronic	alpha
11	1973	Constant (0.0934)	chronic	alpha
12	1974	Constant (0.0945)	chronic	alpha
13	1975	Constant (0.0954)	chronic	alpha
14	1976	Constant (0.048)	chronic	alpha
15	1977	Constant (0.0332)	chronic	alpha
16	1978	Constant (0.0261)	chronic	alpha
17	1979	Constant (0.0211)	chronic	alpha
18	1980	Constant (0.0175)	chronic	alpha
19	1981	Constant (0.0148)	chronic	alpha
20	1982	Constant (0.0127)	chronic	alpha
21	1983	Constant (0.0112)	chronic	alpha
22	1984	Constant (0.0582)	chronic	alpha
23	1985	Constant (0.0727)	chronic	alpha
24	1986	Constant (0.0313)	chronic	alpha
25	1987	Constant (0.0208)	chronic	alpha
26	1988	Constant (0.0166)	chronic	alpha
27	1989	Constant (0.0136)	chronic	alpha
28	1990	Constant (0.0114)	chronic	alpha
29	1991	Constant (0.00977)	chronic	alpha
30	1992	Constant (0.00855)	chronic	alpha
31	1993	Constant (0.00754)	chronic	alpha
32	1994	Constant (0.00675)	chronic	alpha
33	1995	Constant (0.00609)	chronic	alpha
34	1996	Constant (0.00556)	chronic	alpha
35	1997	Constant (0.00507)	chronic	alpha
36	1998	Constant (0.00465)	chronic	alpha
37	1999	Constant (0.00428)	chronic	alpha
38	2000	Constant (0.00397)	chronic	alpha
39	2001	Constant (0.00366)	chronic	alpha
40	2002	Constant (0.00338)	chronic	alpha
41	2003	Constant (0.00314)	chronic	alpha
42	2004	Constant (0.00292)	chronic	alpha

43	2005	Constant (0.00223)	chronic	alpha
44	1963	Constant (6.48E-5)	chronic	electrons E>15keV
45	1964	Constant (7.47E-5)	chronic	electrons E>15keV
46	1965	Constant (7.51E-5)	chronic	electrons E>15keV
47	1966	Constant (7.51E-5)	chronic	electrons E>15keV
48	1967	Constant (7.51E-5)	chronic	electrons E>15keV
49	1968	Constant (7.53E-5)	chronic	electrons E>15keV
50	1969	Constant (7.51E-5)	chronic	electrons E>15keV
51	1970	Constant (7.51E-5)	chronic	electrons E>15keV
52	1971	Constant (7.51E-5)	chronic	electrons E>15keV
53	1972	Constant (7.53E-5)	chronic	electrons E>15keV
54	1973	Constant (7.51E-5)	chronic	electrons E>15keV
55	1974	Constant (7.51E-5)	chronic	electrons E>15keV
56	1975	Constant (7.51E-5)	chronic	electrons E>15keV
57	1976	Constant (1.01E-5)	chronic	electrons E>15keV
58	1977	Constant (6.09E-7)	chronic	electrons E>15keV
59	1978	Constant (7.40E-8)	chronic	electrons E>15keV
60	1979	Constant (9.20E-9)	chronic	electrons E>15keV
61	1980	Constant (1.18E-9)	chronic	electrons E>15keV
62	1981	Constant (1.53E-10)	chronic	electrons E>15keV
63	1982	Constant (2.06E-11)	chronic	electrons E>15keV
64	1983	Constant (2.84E-12)	chronic	electrons E>15keV
65	1984	Constant (6.50E-5)	chronic	electrons E>15keV
66	1985	Constant (7.45E-5)	chronic	electrons E>15keV
67	1986	Constant (1.00E-5)	chronic	electrons E>15keV
68	1987	Constant (6.03E-7)	chronic	electrons E>15keV
69	1988	Constant (7.32E-8)	chronic	electrons E>15keV
70	1989	Constant (9.05E-9)	chronic	electrons E>15keV
71	1990	Constant (1.15E-9)	chronic	electrons E>15keV
72	1991	Constant (1.51E-10)	chronic	electrons E>15keV
73	1992	Constant (2.03E-11)	chronic	electrons E>15keV
74	1993	Constant (2.78E-12)	chronic	electrons E>15keV
75	1994	Constant (3.92E-13)	chronic	electrons E>15keV
76	1995	Constant (5.64E-14)	chronic	electrons E>15keV
77	1996	Constant (8.27E-15)	chronic	electrons E>15keV
78	1997	Constant (1.22E-15)	chronic	electrons E>15keV
79	1998	Constant (1.84E-16)	chronic	electrons E>15keV
80	1999	Constant (2.78E-17)	chronic	electrons E>15keV
81	2000	Constant (4.24E-18)	chronic	electrons E>15keV
82	2001	Constant (6.46E-19)	chronic	electrons E>15keV

83	2002	Constant (9.94E-20)	chronic	electrons E>15keV
84	2003	Constant (1.53E-20)	chronic	electrons E>15keV
85	2004	Constant (2.37E-21)	chronic	electrons E>15keV
86	2005	Constant (3.39E-22)	chronic	electrons E>15keV
87	1963	Constant (0.00866)	chronic	alpha
88	1964	Constant (0.0115)	chronic	alpha
89	1965	Constant (0.0129)	chronic	alpha
90	1966	Constant (0.0139)	chronic	alpha
91	1967	Constant (0.0146)	chronic	alpha
92	1968	Constant (0.0153)	chronic	alpha
93	1969	Constant (0.0157)	chronic	alpha
94	1970	Constant (0.016)	chronic	alpha
95	1971	Constant (0.0163)	chronic	alpha
96	1972	Constant (0.0166)	chronic	alpha
97	1973	Constant (0.0168)	chronic	alpha
98	1974	Constant (0.017)	chronic	alpha
99	1975	Constant (0.0171)	chronic	alpha
100	1976	Constant (0.00864)	chronic	alpha
101	1977	Constant (0.00597)	chronic	alpha
102	1978	Constant (0.0047)	chronic	alpha
103	1979	Constant (0.00379)	chronic	alpha
104	1980	Constant (0.00314)	chronic	alpha
105	1981	Constant (0.00265)	chronic	alpha
106	1982	Constant (0.00229)	chronic	alpha
107	1983	Constant (0.00201)	chronic	alpha
108	1984	Constant (0.0105)	chronic	alpha
109	1985	Constant (0.0131)	chronic	alpha
110	1986	Constant (0.00563)	chronic	alpha
111	1987	Constant (0.00374)	chronic	alpha
112	1988	Constant (0.00299)	chronic	alpha
113	1989	Constant (0.00244)	chronic	alpha
114	1990	Constant (0.00205)	chronic	alpha
115	1991	Constant (0.00176)	chronic	alpha
116	1992	Constant (0.00154)	chronic	alpha
117	1993	Constant (0.00136)	chronic	alpha
118	1994	Constant (0.00121)	chronic	alpha
119	1995	Constant (0.0011)	chronic	alpha
120	1996	Constant (10.00E-4)	chronic	alpha
121	1997	Constant (9.11E-4)	chronic	alpha
122	1998	Constant (8.37E-4)	chronic	alpha

123	1999	Constant (7.71E-4)	chronic	alpha
124	2000	Constant (7.13E-4)	chronic	alpha
125	2001	Constant (6.57E-4)	chronic	alpha
126	2002	Constant (6.09E-4)	chronic	alpha
127	2003	Constant (5.64E-4)	chronic	alpha
128	2004	Constant (5.24E-4)	chronic	alpha
129	2005	Constant (4.02E-4)	chronic	alpha
130	1963	Constant (1.17E-5)	chronic	electrons E>15keV
131	1964	Constant (1.34E-5)	chronic	electrons E>15keV
132	1965	Constant (1.35E-5)	chronic	electrons E>15keV
133	1966	Constant (1.35E-5)	chronic	electrons E>15keV
134	1967	Constant (1.35E-5)	chronic	electrons E>15keV
135	1968	Constant (1.35E-5)	chronic	electrons E>15keV
136	1969	Constant (1.35E-5)	chronic	electrons E>15keV
137	1970	Constant (1.35E-5)	chronic	electrons E>15keV
138	1971	Constant (1.35E-5)	chronic	electrons E>15keV
139	1972	Constant (1.35E-5)	chronic	electrons E>15keV
140	1973	Constant (1.35E-5)	chronic	electrons E>15keV
141	1974	Constant (1.35E-5)	chronic	electrons E>15keV
142	1975	Constant (1.35E-5)	chronic	electrons E>15keV
143	1976	Constant (1.81E-6)	chronic	electrons E>15keV
144	1977	Constant (1.09E-7)	chronic	electrons E>15keV
145	1978	Constant (1.33E-8)	chronic	electrons E>15keV
146	1979	Constant (1.66E-9)	chronic	electrons E>15keV
147	1980	Constant (2.11E-10)	chronic	electrons E>15keV
148	1981	Constant (2.75E-11)	chronic	electrons E>15keV
149	1982	Constant (3.70E-12)	chronic	electrons E>15keV
150	1983	Constant (5.10E-13)	chronic	electrons E>15keV
151	1984	Constant (1.17E-5)	chronic	electrons E>15keV
152	1985	Constant (1.34E-5)	chronic	electrons E>15keV
153	1986	Constant (1.80E-6)	chronic	electrons E>15keV
154	1987	Constant (1.08E-7)	chronic	electrons E>15keV
155	1988	Constant (1.32E-8)	chronic	electrons E>15keV
156	1989	Constant (1.63E-9)	chronic	electrons E>15keV
157	1990	Constant (2.07E-10)	chronic	electrons E>15keV
158	1991	Constant (2.72E-11)	chronic	electrons E>15keV
159	1992	Constant (3.65E-12)	chronic	electrons E>15keV
160	1993	Constant (5.00E-13)	chronic	electrons E>15keV
161	1994	Constant (7.05E-14)	chronic	electrons E>15keV
162	1995	Constant (1.02E-14)	chronic	electrons E>15keV

163	1996	Constant (1.49E-15)	chronic	electrons E>15keV
164	1997	Constant (2.20E-16)	chronic	electrons E>15keV
165	1998	Constant (3.30E-17)	chronic	electrons E>15keV
166	1999	Constant (5.00E-18)	chronic	electrons E>15keV
167	2000	Constant (7.63E-19)	chronic	electrons E>15keV
168	2001	Constant (1.16E-19)	chronic	electrons E>15keV
169	2002	Constant (1.79E-20)	chronic	electrons E>15keV
170	2003	Constant (2.76E-21)	chronic	electrons E>15keV
171	2004	Constant (4.27E-22)	chronic	electrons E>15keV
172	2005	Constant (6.10E-23)	chronic	electrons E>15keV
173	1983	Constant (5.07E-4)	chronic	alpha
174	1984	Constant (1.64E-4)	chronic	alpha
175	1985	Constant (8.30E-5)	chronic	alpha
176	1986	Constant (6.03E-5)	chronic	alpha
177	1987	Constant (4.49E-5)	chronic	alpha
178	1988	Constant (3.43E-5)	chronic	alpha
179	1989	Constant (2.67E-5)	chronic	alpha
180	1990	Constant (2.14E-5)	chronic	alpha
181	1991	Constant (1.77E-5)	chronic	alpha
182	1992	Constant (1.49E-5)	chronic	alpha
183	1993	Constant (1.28E-5)	chronic	alpha
184	1994	Constant (1.12E-5)	chronic	alpha
185	1995	Constant (9.90E-6)	chronic	alpha
186	1996	Constant (8.89E-6)	chronic	alpha
187	1997	Constant (8.01E-6)	chronic	alpha
188	1998	Constant (7.29E-6)	chronic	alpha
189	1999	Constant (6.66E-6)	chronic	alpha
190	2000	Constant (6.13E-6)	chronic	alpha
191	2001	Constant (5.62E-6)	chronic	alpha
192	2002	Constant (5.18E-6)	chronic	alpha
193	2003	Constant (4.79E-6)	chronic	alpha
194	2004	Constant (4.44E-6)	chronic	alpha
195	2005	Constant (4.08E-6)	chronic	alpha
196	1983	Triangular (0.00246, 0.00853, 0.00973)	chronic	photons E=30-250keV
197	1983	Triangular (0.00201, 0.00292, 0.00322)	chronic	photons E>250keV
198	1963	Triangular (0.00539, 0.0194, 0.0228)	chronic	photons E=30-250keV
199	1963	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
200	1964	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
201	1965	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
202	1966	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV

203	1967	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
204	1968	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
205	1969	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
206	1970	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
207	1971	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
208	1972	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
209	1973	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
210	1974	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
211	1975	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
212	1984	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
213	1985	Triangular (0.00728, 0.0312, 0.0365)	chronic	photons E=30-250keV
214	1963	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
215	1964	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
216	1965	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
217	1966	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
218	1967	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
219	1968	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
220	1969	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
221	1970	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
222	1971	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
223	1972	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
224	1973	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
225	1974	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
226	1975	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
227	1984	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
228	1985	Triangular (0.0135, 0.0484, 0.0569)	chronic	photons E=30-250keV
229	1973	Triangular (0.00135, 0.00484, 0.00569)	chronic	photons E=30-250keV
230	1973	Triangular (0.0202, 0.0726, 0.0854)	chronic	photons E=30-250keV
231	1973	Triangular (0.00202, 0.00726, 0.00854)	chronic	photons E=30-250keV
232	1968	Triangular (0.00337, 0.0121, 0.0142)	chronic	photons E=30-250keV
233	1985	Triangular (5.39E-4, 0.00194, 0.00228)	chronic	photons E=30-250keV

Radon Exposure Information:

N/A (applies only to cases of Lung Cancer with Radon Exposures)

Probability of Causation (PC) *

1st percentile	0.10 %
5th percentile	0.20 %
50th percentile	0.85 %

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95th percentile	2.99 %
99th percentile	4.79 %

* NIOSH-IREP is programmed with two different lung cancer risk models. Under current guidelines, each lung cancer claim is run separately using both risk models and the higher PC will determine the outcome of the claim. The results displayed above are derived from the **NIOSH-IREP lung model**, which is the model that produced the higher PC at the 99th percentile for this particular claim. The lower PC at the 99th percentile, derived from the NIH-IREP lung model, is 4.54 %. This lower PC value is reported here for information only and will have no bearing on the claim outcome.

To perform another calculation, please logout and close your browser: End Session

To calculate PC from multiple primary cancers, click here: Multiple Primary

Addendum 2 to Main Report by Dr. David A. Dooley for Payne vs CSX

Introduction

In this second addendum to the main dose reconstruction report for Mr. Payne, several key assumptions have been modified to update and more accurately reflect the facts surrounding Mr. Payne's potential exposures to radiation and radioactivity while performing his duties for the railroad. These updated assumptions stem from information contained in documents obtained via various FOIA requests from the Department of Energy and the State of Tennessee. Similar to Addendum 1, a detailed list of key assumptions, in addition to the general assumptions discussed in the report, are provided to allow the reader the opportunity to follow the logic used to provide input parameters to the dose calculation program IMBA and the probability of causation program IREP. These programs were previously described and referenced in Addendum 1 (Reference 1). The following synopsis lays out the sections of Addendum 1 that did not change and discusses those sections where changes were made to generate Addendum 2.

Sections of Addendum 1 That Have Not Changed

No changes were made to the following dose calculation sections of Addendum 1:

- Direct exposure from the 1963 uranium turnings barrel deliveries to Witherspoon
- All 1983 ORNL Y-12 facility on site dose calculations for direct exposure to Cs-137 contamination on the ground in and around RR yard tracks
- Direct exposure (from 1963 to 1975 and from 1984 to 1985) based on Mr. Payne's activities at the Witherspoon Site

Updates and Revisions to Payne Dose Calculations in Addendum 1

This second addendum to the main dose reconstruction report details the changes made in July of 2009 to the dose calculations compared to those performed in March of 2009 in Addendum 1. Changes were made to the following sections of Addendum 1 as described below:

- **Direct Exposures From Rail Cars Containing Contaminated Material** - This change is based on the assumption that no new contaminated scrap metal shipments were received by the Witherspoon Site after July 18, 1972 (Reference 2). Specific direct doses calculated for Mr. Payne received from his work in and around RR cars during delivery of higher, i.e., one of a kind dose rate items found during site inspections by regulatory agencies and others, that were noted in years after 1972 are now all assigned to 1972. The result of this change is that the overall doses calculated in Addendum 1 did not change. In Addendum 1 any direct exposures from these unique materials were assigned in IREP in the year that they were noted in the inspection report. With this addendum, any direct exposures that were assigned in Addendum 1 beyond 7/18/72 from any exposure to these unique items are now assigned to the year 1972 because exposure during shipment must have occurred prior to 7/18/72. **As stated above, this change does not affect the overall dose calculated in Addendum 1 for this activity, only the IREP input information for the total dose received in 1972 was modified.**

- **Average Direct Doses for RR Cars** – These doses were changed only to reflect the ending of radioactively contaminated scrap metal shipments in 1972. The year 1972 was assigned as 0.75 of the annual doses of previous years to account for the portion of the year worked (until October 1, 1972). This higher value is used (compared to the actual fraction of the year at 54.5% based on the July 18[th] date described above) to account for any radioactively contaminated metal scrap inventory that may have remained in the Knox Yard after this date that had not yet been moved to the Witherspoon site. **The overall doses were reduced to 0.488 rem whole body and 0.556 rem to the lung from the previous calculations of 0.750 rem whole body and 0.855 rem to the lung. A decrease of approximately 35% from the Addendum 1 calculated dose.**

- **Internal Doses From Resuspension During RR Car Transport** – This calculation was also adjusted to only occur up to the 7/18/1972 date. In addition, review of the previous Addendum 1 calculations showed them to be in error. This was due to the original assumption that Mr. Payne spent one hour riding on the RR cars as they were transported from the Knox Yard to the Witherspoon Site. In actuality, his testimony (Reference 3) said the ride from the Know Yard to Witherspoon took only one half hour to complete. This change results in a reduction in the total assumed exposure time per year to 50 hours per year (0.5 hr/trip*2 trips/week*50 weeks/year) versus the 100 hours per year used in the Addendum 1 calculations. **The overall doses from this pathway were reduced to 0.015 rem whole body and 0.090 rem to the lung from the previous Addendum 1 calculations of 0.047 rem whole body and 0.280 rem to the lung. A decrease of approximately 68% from the Addendum 1 calculated dose.** The following explains the other significant changes that resulted in this lower calculated dose.

- **Internal Doses Due To Resuspension Of Soil Containing Radioactive Particulates** - The time Mr. Payne spent on the Witherspoon Site delivering and retrieving RR cars has been significantly reduced in Addendum 2. **The overall doses were reduced to 0.016 rem whole body and 0.092 rem lung from the previous calculations of 0.263 rem whole body and 1.558 rem to the lung. A decrease of approximately 83% from the Addendum 1 calculated dose.** These changes in the calculated dose resulted from the following modifications in the Addendum 1 dose calculations:

    - Resuspension of radioactive particulates in the Witherspoon Site soils is now based on the maximum uranium soil concentration of 74 pCi/g. This maximum concentration is taken from a set of 9 samples averaging 31.1 pCi/g of uranium. This 1985 soil sampling was conducted by HMC Inc. and the I.T. Corporation in the area of the RR tracks associated with the Candora Triangle on the Witherspoon Site (Reference 4). This new maximum uranium soil concentration replaces the previous average uranium concentration used in the Addendum 1 exposure calculations of 501 pCi/g. This concentration was based on sampling of soils contained in 55 gallon drums that we now know to be "Rader Dirt" (Reference 5). This dirt was drummed and moved to the 901 Maryville Pike property (aka Candora Triangle) for temporary storage from the other Witherspoon property located at 1600 Maryville Pike. Since this soil was drummed and could not be resuspended into the air by Mr. Payne's or anyone else's activities on the Witherspoon Site, the uranium concentration in soil in these drums is irrelevant to any discussion of Mr. Payne possible historical exposure to radiation and radioactivity. It is also important to point out here that another set of 10 soil samples was collected and analyzed from the Candora Triangle area in 1991 by CRU, Inc. (Reference 6). The average uranium concentration of these samples was 27.2 pCi/g with a reported maximum of 42 pCi/g. These results are in very good agreement with the 1985 sample results reported above.

- The air concentration was calculated by assuming the OSHA dust nuisance level (Reference 7) for the respirable fraction of inert or nuisance dust of 5 mg/m^3. This assumption remains a very conservative approach since the EPA and others (Reference 8) give mass loading averages for urban environments of 0.1 mg/m^3 as being a reasonable assumption. This approach simplified the air concentration calculation to multiplying the dust level (mg/m^3) by the soil concentration (pCi/g).
- The radionuclide breakdown from NCRP 141(Reference 9) and the rain reduction factor of 0.655 were not changed.

Summary

All of the above changes to the Addendum 1 calculations result in an overall whole body dose of 1.263 rem and lung dose of 1.431 rem. The lung dose used in IREP to determine PoC is actually 1.437 rem due to a slight difference due to rounding errors associated with various calculated doses. The IREP calculated PoC at the 95th percentile now calculated at 1.29% (compared with 2.99% in Addendum 1) using these Addendum 2 modifications to Mr. Payne's exposure pathway analysis.

It should be noted here that the relationship between dose and the resulting PoC is not linear. For example, the dose to give 50% PoC is not 5 times the dose to give 10% PoC. In the present Addendum 2 calculations, increasing the doses assumed to be received by Mr. Payne by a factor of 38.75 (derived from 50%/1.29%) will not yield a PoC of 50%. A quick calculation using this factor of 38.75 only increases the PoC at the 95th percentile to approximately 33%.

IMBA and IREP Assumptions Used for Addendum 2 Calculations:

Witherspoon Internal Dose (Onsite and Rail Cars)
For the intake rates for all airborne potential at the Witherspoon site and on the gondola cars, the following assumptions were made:

- Total alpha contamination was assumed to be 100% total uranium.
- The NCRP 141 (Reference 9) report breakdown of radionuclides was then applied to this intake rate based on U-234/5/8 being 100% of the total uranium rate calculated from the airborne hazard.

- For the intake of the radionuclides, the ICRP 66 lung model was used with the ICRP 68 parameters applicable to each radionuclide and a 5 micron AMAD. The lung solubility types were selected to maximize the dose to the lung (most insoluble recognized ICRP 68 solubility type for of each was selected as shown below).

Nuclide	Activity	Lung Solubility Type in IMBA
Tc-99	55%	M
U-234	43%	S
U-235	1.4%	S
U-238	0.5%	S
Pu-239	0.01%	S
Np-237	0.001%	M

- Annual lung doses were calculated for each radionuclide from the beginning of exposure through the date of cancer diagnosis (October 28, 2005).
- These annual lung doses were entered into IREP as chronic doses, using a radiation type of "electron>15keV" for the Tc-99 and "alpha" for the rest of the radionuclides, and a constant distribution (based on this being an upper bound of the exposure, no distribution lower than the calculated doses was assigned). The calculated doses are entered into the parameter 1 column. Some doses may appear to be 0.000 rem, but the input file only shows the dose down to mrem; these rows actually contain values that are smaller than 0.5 mrem (and were rounded down to 0.000 in the display).
- In the IREP input sheet (see Appendix 1), exposure# 1 – 43 represent the alpha dose from resuspension onsite.
- In the IREP input sheet, exposure# 44 – 86 represent the electron dose (Tc-99) from resuspension onsite.
- In the IREP input sheet, exposure# 87– 129 represent the alpha dose from resuspension in the rail car.
- In the IREP input sheet, exposure# 130 – 172 represent the electron dose (Tc-99) from resuspension in the rail car.

Y-12 Switch Yard Internal Dose

For the intake rates for all airborne potential at the Y-12 switchyard (1983), the following assumptions were made.

- The U-234/5 and U-238 intake rates from the Y-12 environmental TBD were used (Reference 9). The 95th percentile of the intake rates for 1983 were corrected from a 2000 hour exposure year to 150 hours.
- These intakes were entered into IMBA and IREP in the same method and using the same parameters as the uranium discussed above except the fact that only U-234/5 and U-238 were considered per the TBD.
- In the IREP input sheet, exposure# 173 – 195 represent the alpha dose from this exposure.

Y-12 Switch Yard External Dose

For the external potential at the Y-12 switchyard (1983), the following assumptions were made.

- The annual ambient external exposure for the years 1948 – 2002 had been compiled and combined into a distribution of dose rates (Reference 10). The 95th percentile of these values was used for this assessment (129 μR/hour). This value was used to assess the total dose based on 150 hours onsite.
- The full annual Cs-137 direct exposure dose was assigned for this year although it was calculated based on 200 hours per year and there was actually only 150 hours of exposure in this case.
- Both exposures were adjusted to lung dose from whole body dose based upon dose conversion factors (DCF) used in conjunction with IREP (Reference 11). For this exposure scenario, the isotropic DCFs (Hp(10) doses to Organ doses) were used since the source dose is already in Hp(10) whole body form and the source is not unidirectional, but the exposure would be isotropic (all directions). The min/average/max DCFs for each energy range (30-250 keV photon for the uranium exposure and >250 keV photons for the Cs-137) were applied to give minimum, average, and maximum lung doses.
- These min/average/max doses were entered into IREP as a chronic exposure, triangular distribution (with those values in parameters 1, 2, and 3 respectively). The Y-12 ambient was assigned as 30-250 keV photons and the Cs-137 was assigned as >250 keV photons.
- In the IREP input sheet, exposure# 196 represent the Y-12 ambient direct dose from this exposure.
- In the IREP input sheet, exposure# 197 represent the Cs-137 direct dose from this exposure.

Witherspoon External (1963 Delivery of Uranium Turnings Barrels)

For the external potential on the gondola cars delivering the uranium turnings barrels in 1963, the following assumptions were made.

- Ten total trips with exposure to the barrels (4 mR/hour).
- Exposure was adjusted to lung dose from whole body dose based upon dose conversion factors (DCF) used in conjunction with IREP (ref OCAS-IG-0001). For this exposure scenario, the DCFs (Exposure (R) to Organ Dose (HT)) were used since the source dose is in Exposure form and the source is unidirectional.
- Since it was unknown which direction the worker was facing, it was assumed that he would be facing forward or backward (away from or toward the source) for 75% of his time and in the midst of twisting and turning during the other 25% of his time (based on the fact that he needed to be aware of the train's surroundings at all times).

DCF geometry

AP	37.5%	anterior to posterior - facing source
PA	37.5%	posterior to anterior -facing away from source
ROT	25.0%	rotational - twisting and turning

100.0%

- The min/average/max DCFs for the energy range (30-250 keV photon for the uranium exposure) were applied to give minimum, average, and maximum lung doses.
- These min/average/max doses were entered into IREP as a chronic exposure, triangular distribution (with those values in parameters 1, 2, and 3 respectively) assigned as 30-250 keV photons.
- In the IREP input sheet, exposure# 198 represent the 1963 barrel delivery direct dose from this exposure.

Witherspoon External Dose (Onsite)
For the external potential while working onsite at the Witherspoon site, the following assumptions were made.

- 100 hours of annual exposure to the area source term (400 μR/hour) for 15 years of work.
- Exposure was adjusted to lung dose from whole body dose based upon dose conversion factors (DCF) used in conjunction with IREP (ref OCAS-IG-0001). For this exposure scenario, the rotational DCFs (Exposure (R) to Organ Dose (HT)) were used since the source dose is in Exposure form and the source is generally unidirectional (assumed mainly from the barrels on the other side of the tracks). The rotational exposure geometry was selected since the worker was assumed to be in constant motion while flagging, signaling, walking, coupling/uncoupling, setting/releasing brakes, etc.
- The min/average/max DCFs for the energy range (30-250 keV photon for the uranium exposure) were applied to give minimum, average, and maximum lung doses.
- These min/average/max doses were entered into IREP as a chronic exposure, triangular distribution (with those values in parameters 1, 2, and 3 respectively) assigned as 30-250 keV photons.
- In the IREP input sheet, exposure# 199 - 213 represent the direct dose while working onsite at the Witherspoon site from this exposure.

Witherspoon External Dose (On Gondola Cars)
For the external potential while working on the gondola cars between the Witherspoon site and the Knox yard, the following assumptions were made.

- 50 hours of annual exposure to the area source term (1 mR/hour) for 15 years of work and various special direct exposures based on equipment found during investigations at the site.
- Exposure was adjusted to lung dose from whole body dose based upon dose conversion factors (DCF) in the same manner as for the uranium turnings barrel deliveries outlined above (based on the scrap being in the gondola car in the same manner as the barrels).
- The min/average/max DCFs for the energy range (30-250 keV photon for the uranium exposure) were applied to give minimum, average, and maximum lung doses.
- These min/average/max doses were entered into IREP as a chronic exposure, triangular distribution (with those values in parameters 1, 2, and 3 respectively) assigned as 30-250 keV photons.

- In the IREP input sheet, exposure# 214 - 223 represent the direct dose while riding in the gondola cars during routine deliveries.
- In the IREP input sheet, exposure# 224 - 228 represent the direct dose while riding in the gondola cars during the special cases.

Overarching IREP Information

- Since IREP is a Monte Carlo calculation tool, it requires a starting value for the random number generator used in the calculations (the random "seed" selected was 99) and also the number of iterations for each calculation. The number of iterations was selected to be 2,000.
- The IREP lung dose/risk tables take into account the smoking history of the individual. Since Mr. Payne reported quitting smoking in the late 1980's, he was considered a former smoker for IREP calculation purposes.

IMBA, IREP and Probability of Causation

The probability of causation (PC) (Reference 12) is calculated as the risk of cancer attributable to radiation exposure (RadRisk) divided by the sum of the baseline risk of cancer to the general population (BasRisk) plus the risk attributable to the radiation exposure, then multiplied by 100 percent, as follows:

$$\frac{\text{RadRisk}}{\text{RadRisk} + \text{BasRisk}} \times 100\% = \text{PC}$$

This calculation provides a percentage estimate between 0 and 100 percent, where 0 would mean a 0 likelihood that radiation caused the cancer and 100 would mean 100 percent certainty that radiation caused the cancer.

Scientists evaluate the likelihood that radiation caused cancer in a worker by using medical and scientific knowledge about the relationship between specific types and levels of radiation dose and the frequency of cancers in exposed populations. Simply explained, if research determines that a specific type of cancer occurs more frequently among a population exposed to a higher level of radiation than a comparable population (a population with less radiation exposure but similar in age, gender, and other factors that have a role in health), and if the radiation exposure levels are known in the two populations, then it is possible to estimate the proportion of cancers in the exposed population that may have been caused by a given level of radiation. If scientists consider this research sufficient and of reasonable quality, they can then translate the findings into a series of mathematical equations that estimate how much the risk of cancer in a population would increase as the dose of radiation incurred by that population increases. The series of equations, known as a dose-response or quantitative risk assessment model, may also take into account other health factors potentially related to cancer risk, such as gender, smoking history, age at exposure (to radiation), and time since exposure. The risk models can then be applied as an imperfect but reasonable approach to determine the likelihood that the cancer of an individual worker was caused by his or her radiation dose.

Probability of Causation Calculation for Mr. Payne

Appendix 2 to Addendum 2 shows the output from the IREP program which calculates the probability of causation (PoC) for Mr. Payne based on the conservative estimates of radiation doses he may have received as a worker for CSX. These radiation doses have been discussed in detail in the main report on this topic prepared by Dr. Dooley and the additional assumptions pertaining to these calculations are explained in this document. The dose estimate is used to determine the Excess Relative Risk (ERR). The probability of Causation (POC) is determined directly from the ERR. The relationship is: PoC = ERR/(1+ERR)*100%

From this equation it can be seen that an ERR of 1 is required to yield a PoC of 50% (this means that the risk due to exposure is the same as the risk naturally). For a given scenario, of time since exposure, age at diagnosis, type of cancer, type of radiation, etc., the ERR varies essentially linearly with the dose. Thus, the PoC is actually a curve that would technically never reach 100% since that would mean that there is no chance the cancer was natural, but it approaches 100% as ERR increases.

Based on the estimation of radiation dose while employed by CSX, Mr. Payne's smoking history and reported type of lung cancer and its related history, the calculated ERR was 0.0131 and the associated PoC for Mr. Payne's estimated radiation dose as the cause of his lung cancer is 1.29% at the 95th percentile.

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Appendix 1 – IREP Input Information

See attached file "Appendix 1 to Addendum 2_July 2009 IREP Input Payne_1.pdf"

Appendix 2 – IREP Output Information

See attached file "Appendix 2 to Addendum 2_July 2009 IREP Output Payne_1.pdf"

Addendum 3 to MJW Corporation Attorney Work Product

Payne Case Radiation Dose Estimate

Errata: Main Report dated 3/27/09: Section 3 (d) second paragraph, last sentence. "2 mrem" should read "3 mrem" This error is corrected in updated Table 3 below.

Errata: Addendum 1 to Main Report dated 3/27/09: Page 7, 1st paragraph: ICRP2 which was the guiding document for worker exposures at the time Mr. Payne was potentially exposed had a 15 rem/year limit for critical organs for workers and that limit should have been used as the point of regulatory comparison to the calculated lung doses. However, it should be noted that the NRC annual limit to any organ (excluding the lens of the eye) for the sum of deep-dose equivalent and committed dose equivalent is now 50 rem (10CFR20.1201(a)(1)(ii)).

Addendum 3 changes: to 3/27/09 report Section 3 (d), second paragraph, end of the first sentence should read: "..., results in a whole body dose of 19.35 mrem." The following sentence is added after this sentence as, "The corresponding lung dose is 10 mrem."

Addendum 3 changes: to Table 3 found in Section 5 from original March 2009 is updated to reflect the changes in Addendum 2 dated 7/24/09:

Table 3. Lung Dose Summary for Various Exposure Scenarios (Updated)

Scenario	Lung Dose (mrem)*	IREP Exposure Line(s)	Original Table 3 Values (mrem)**
Direct Exposure - Gondola (routine)	555	214-223	854
Direct Exposure - Gondola (non-routine)	116	224-228	116
Direct Exposure - Uranium Turnings Drum Transport	23	198	22.8
Direct Exposure - DWI Site	547	199-213	540
Direct Exposure - Oak Ridge (Cs-137)	3	197	2
Direct Exposure - Ambient (Y-12)	10	196	10
Internal Exposure - Ambient (Y-12)	1	173-195	1
Inhalation - Gondola	90	87-172	280
Inhalation - DWI Site	92	1-86	1560

* Total doses rounded to nearest mrem
** For comparison purposes to 3/27/09 Report

Answers to Specific Questions

Resuspension of on Site Soils:

It has been a year and a half since we thought about this and it's coming back slowly. Because there were no routine general airborne measurements to speak of, except for a few what we think were "low vols" taken in and around the metal processing areas, we used the following scenario for Mr. Payne's routine airborne exposure while working on site. We assumed that he was in a dust cloud at the OSHA respirable nuisance dust level of 5 mg/m^3 (29CFR1910.1000, Table Z-3). The highest concentration found in the site soils of 74 pCi/g would then translate to an airborne concentration of 0.37 pCi/ m^3. We believe our approach is exceedingly generous given Mr. Payne's walking on the site likely didn't disturb the soil all that much, likely not as much as the fugitive dust created by the movement of the train cars and lastly that in his own testimony he often complained about having to walk in the mud to get his job done, a condition where soil resuspension is not a possibility. This is discussed at the bottom of page 2 and the top of page 3 of Addendum 2.

Solubility Types Used for Nuclides of Interest:

We assumed type S both for the fact that it would yield the largest lung dose and since it would be the most likely type due to the material considered and oxidation (although I believe we only mentioned the largest lung dose in the report).

This was discussed on the second page of Addendum 1:

- For the intake of the radionuclides, the ICRP 66 lung model was used with the ICRP 68 parameters applicable to each radionuclide and a 5 micron AMAD. The lung solubility types were selected to maximize the dose to the lung (most insoluble recognized ICRP 68 solubility type for of each was selected as shown below).

Nuclide	Activity	Lung Solubility Type in IMBA
Tc-99	55%	M
U-234	43%	S
U-235	1.4%	S
U-238	0.5%	S
Pu-239	0.01%	S
Np-237	0.001%	M

RADIATION RISK IN PERSPECTIVE

HEALTH PHYSICS SOCIETY

POSITION STATEMENT OF THE
HEALTH PHYSICS SOCIETY*

Adopted: January 1996
Revised: July 2010

Contact: Richard J. Burk, Jr.
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http://www.hps.org

In accordance with current knowledge of radiation health risks, the Health Physics Society recommends against quantitative estimation of health risks below an individual dose[1] of 5 rem[2] in one year or a lifetime dose of 10 rem above that received from natural sources. Doses from natural background radiation in the United States average about 0.3 rem per year. A dose of 5 rem will be accumulated in the first 17 years of life and about 25 rem in a lifetime of 80 years. Estimation of health risk associated with radiation doses that are of similar magnitude as those received from natural sources should be strictly qualitative and encompass a range of hypothetical health outcomes, including the possibility of no adverse health effects at such low levels.

There is substantial and convincing scientific evidence for health risks following high-dose exposures. However, below 5–10 rem (which includes occupational and environmental exposures), risks of health effects are either too small to be observed or are nonexistent.

In part because of the insurmountable intrinsic and methodological difficulties in determining if the health effects that are demonstrated at high radiation doses are also present at low doses, current radiation protection standards and practices are based on the premise that any radiation dose, no matter how small, may result in detrimental health effects, such as cancer and hereditary genetic damage. Further, it is assumed that these effects are produced in direct proportion to the dose received, that is, doubling the radiation dose results in a doubling of the effect. These two assumptions lead to a dose-response relationship, often referred to as the linear, no-threshold model, for estimating health effects at radiation dose levels of interest. There is, however, substantial scientific evidence that this model is an oversimplification. It can be rejected for a number of specific cancers, such as bone cancer and chronic lymphocytic leukemia, and heritable genetic damage has not been observed in human studies. However, the effect of biological mechanisms such as DNA repair, bystander effect, and adaptive response on the induction of cancers and genetic mutations are not well understood and are not accounted for by the linear, no-threshold model.

Radiogenic Health Effects Have Not Been Consistently Demonstrated Below 10 Rem

Radiogenic health effects (primarily cancer) have been demonstrated in humans through epidemiological studies only at doses exceeding 5–10 rem delivered at high dose rates. Below this dose, estimation of adverse health effect remains speculative. Risk estimates that are used to predict health effects in exposed individuals or populations are based on epidemiological studies of well-defined populations (for example, the Japanese survivors of the atomic bombings in 1945 and medical patients) exposed to relatively high doses delivered at high dose rates. Epidemiological studies have not demonstrated adverse health effects in individuals exposed to small doses (less than 10 rem) delivered in a period of many years.

Limit Quantitative Risk Assessment to Doses at or Above 5 Rem per Year or 10 Rem Lifetime

In view of the above, the Society has concluded that estimates of risk should be limited to individuals receiving a dose of 5 rem in one year or a lifetime dose of 10 rem in addition to natural background. In making risk estimates, specific organ doses and age-adjusted and gender-adjusted organ risk factors should be used. Below these doses, risk estimates should not be used. Expressions of risk should only be qualitative, that is, a range based on the uncertainties in estimating risk (NCRP 1997) emphasizing the inability to detect any increased health detriment (that is, zero health effects is a probable outcome).

Impact on Radiation Protection

Limiting the use of quantitative risk assessment, as described above, has the following implications for radiation protection:

(a) The possibility that health effects might occur at small doses should not be entirely discounted. The Health Physics Society also recognizes the practical advantages of the linear, no-threshold hypothesis to the practice of radiation protection. Nonetheless, risk assessment at low doses should focus on establishing a range of health outcomes in the dose range of interest and acknowledge the possibility of zero health effects. These assessments can be used to inform decision making with respect to cleanup of sites contaminated with radioactive material, disposition of slightly radioactive material, transport of radioactive material, etc.

(b) Collective dose (the sum of individual doses in a defined exposed population expressed as person-rem) has been a useful index for quantifying dose in large populations and in comparing the magnitude of exposures from different radiation sources. However, collective dose may aggregate information excessively, for example, a large dose to a small number of people is not equivalent to a small dose to many people, even if the collective doses are the same. Thus, for populations in which almost all individuals are estimated to receive a lifetime dose of less than 10 rem above background, collective dose is a highly speculative and uncertain measure of risk and should not be used for the purpose of estimating population health risks.

Footnotes

[1] Dose is a general term used to express (quantify) how much radiation exposure something (a person or other material) has received. The exposure can subsequently be expressed in terms of the absorbed, equivalent, committed, and/or effective dose based on the amount of energy absorbed and in what tissues.

[2] The rem is the unit of effective dose. In international units, 1 rem=0.01 sievert (Sv)=10 mSv.

References

National Council on Radiation Protection and Measurements. Uncertainties in fatal cancer risk estimates used in radiation protection. Bethesda, MD: NCRP; NCRP Report No. 126; 1997.

* The Health Physics Society is a nonprofit scientific professional organization whose mission is excellence in the science and practice of radiation safety. Since its formation in 1956, the Society has grown to approximately 6,000 scientists, physicians, engineers, lawyers, and other professionals representing academia, industry, government, national laboratories, the Department of Defense, and other organizations. Society activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information. Society members are involved in understanding, evaluating, and controlling the potential risks from radiation relative to the benefits. Official position

statements are prepared and adopted in accordance with standard policies and procedures of the Society. The Society may be contacted at 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101; phone: 703-790-1745; fax: 703-790-2672; email: HPS@BurkInc.com.

IN THE CIRCUIT COURT FOR KNOX COUNTY, TENNESSEE

WINSTON PAYNE,	§	
	§	
Plaintiff,	§	No.: 2-231-07
	§	***Jury Demand***
vs.	§	
	§	
CSX TRANSPORTATION, INC.,	§	
	§	
Defendant.	§	

AFFIDAVIT OF LARRY R. LIUKONEN, CIH, CSP

STATE OF TEXAS
COUNTY OF JOHNSON

PERSONALLY APPEARED before the undersigned, an officer duly authorized by law to administer oaths under the laws of the State of Texas, this day came Larry R. Liukonen, CIH, CSP, who after being duly sworn, on oath deposes and states as follows:

1. **Personal Background Information**. I am over the age of eighteen and make this Affidavit on behalf of CSX Transportation, Inc. ("CSXT"). I am a Certified Industrial Hygienist and Certified Safety Professional. I have 40 years of industrial hygiene experience including 33 years in the railroad industry. My comments, opinions and conclusions as stated herein are based on my personal knowledge and observations, my education, my knowledge of and experience with scientific retrospective analysis, my continuing review of pertinent scientific literature dealing with testing and evaluation of asbestos-containing materials, diesel exhaust and diesel combustion products[1], research and investigation relating to asbestos and diesel exhaust, and my professional experience and training in industrial hygiene. I have been qualified as an expert in industrial hygiene in numerous state and federal courts, including the State of

[1] Unless otherwise noted herein, references to "diesel exhaust" are intended to refer inclusively to any exposures to diesel-based agents, including but not limited to diesel combustion products.