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Title: INTERVIEW OF WILLIAM IRWIN

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ADDENDUM/ERRATA SHEET

Page	Line	Correction and Reason for Correction
5	1	delete "and work"
5	17	"entrained" should be "in training"
6	5	"within those" should be "with INDCS"
6	16	"from or to" should be "for"
8	23	"Wide" should be "y-"
9	23	"it times" should be "time"
9	17	"that runs along" should be "the Bremsstrahlung"
10	1	"PCs" should be "Feces"
12	1	"concluding" should be "including"
12	12	"PCS" to "Feces"
12	23	"air" should be "error"
14	9	"an" should be "and the"
18	23	"at 510 approximately" should be "approximately 510"
20	4	"on" should be "one"
20	13	add "due to" between "especially" and "the"
22	20	"PCs" to "Feces"
24	4	"into" should be "from"
25	19	delete "if"

1 UNITED STATES OF AMERICA
2 NUCLEAR REGULATORY COMMISSION
3 + + + + +
4 INCIDENT INVESTIGATION TEAM
5 + + + + +
6 INTERVIEW
7 OF
8 WILLIAM IRWIN
9 + + + + +
10 MASSACHUSETTS INSTITUTE OF TECHNOLOGY
11 + + + + +
12 MONDAY,
13 OCTOBER 23, 1995
14 9:30 a.m.
15 + + + + +

16 INTERVIEWERS:
17 SAMI SHERBINI
18 BETSY ULLRICH

P-R-O-C-E-E-D-I-N-G-S

(9:33 a.m.)

1
2
3 INTERVIEWER SHERBINI: My name is Sami Sherbini
4 with the NRC. It's October 23rd, 9:30, about to start an
5 interview with Mr. Bill Irwin. Before we start, we'll
6 introduce the other members of the group.

7 INTERVIEWER ULLRICH: I'm Betsy Ullrich. I'm a
8 health physicist with the Nuclear Regulatory Commission
9 Region I office.

10 MR. IRWIN: Yes. Bill Irwin, Assistant
11 Radiation Protection Officer at Massachusetts Institute of
12 Technology.

13 INTERVIEWER SHERBINI: Okay. We're going to
14 explain to you what this is all about so that you have a
15 clear picture of what we're doing and why it's being
16 transcribed.

17 We're part of the investigation team here to
18 look at the intake that occurred in the cancer research
19 facility. The purpose of today is to find out what
20 happened and to try and figure out why it happened and if
21 there are any weaknesses that could have contributed and
22 maybe some lessons learned, if possible.

23 The interview is being transcribed partly so
24 that we don't take notes and pay attention mainly to what's
25 being said and partly so we can go back and refresh our

1 memory to just what is said and so forth.

2 When the recording is transcribed, you get a
3 chance to look at the record and see if you agree with it,
4 if this is what you said, if this is what you intended to
5 say. If it isn't, then you get a chance to write on a
6 separate sheet of paper what should have been in the
7 transcript and what you -- if you said something that
8 didn't sound right or wasn't really what you intended, you
9 can correct the statement, "This is not what I intended.
10 What I intended." And both will go into the record. The
11 original plus your correction sheets will go into the
12 record.

13 MR. IRWIN: Okay.

14 INTERVIEWER SHERBINI: And this is just a
15 description of how this process works of the transcription
16 and so forth and the correction errata sheets and so forth.
17 So you can keep this.

18 MR. IRWIN: Okay.

19 INTERVIEWER SHERBINI: It will give you an idea
20 of it.

21 MR. IRWIN: All right.

22 INTERVIEWER SHERBINI: Okay. Now that that's
23 out of the way, the purpose of this talk is to try and
24 understand how you arrived at the intake estimate for Mr.
25 LL. We are going to do an independent calculation to see

1 what we can come up with an estimate, but just to make sure
2 that if there are differences between your estimate and
3 ours we can at least try and figure out why we have a
4 difference.

5 We're probably using the same models, but there
6 might be some variations in how they're applied. We'd like
7 to understand as much as possible how you went about doing
8 that.

9 So if you can tell us from the beginning what
10 happened and how you arrived at the number?

11 MR. IRWIN: Okay. I was on vacation the week
12 that it occurred and my first day back was informed that a
13 number of things had occurred and that my immediate
14 supervisor and -- that's Mitch Galanek -- and Don Haes were
15 attempting to determine an intake. Don was using some
16 references from ICRP. And Mitch was using the NUREG, each
17 dealing with estimating intakes from bioassay data.

18 And having familiarity with INDOS from my
19 graduate school work, I volunteered to see what I could
20 come up with using that computer software.

21 INTERVIEWER SHERBINI: Maybe at this point you
22 have to tell us about your background just to put this in
23 perspective. You did graduate work at Lowell?

24 MR. IRWIN: Yes, yes. I have a Master's of
25 Science degree in radiological health physics there. And

1 I'm currently in a doctoral program and work in
2 environmental engineering at Lowell.

3 And my work experience is primarily in nuclear
4 reactors. I started in Newport News Shipbuilding in 1981.
5 After two and a half years there I went on to commercial
6 nuclear power plants, traveling around working outages.

7 Then I settled down into training at Palo Verde
8 Nuclear Generating Station. And there I worked until five
9 years ago, when I moved here to New England, and I started
10 working at Seabrook Nuclear Station.

11 INTERVIEWER SHERBINI: Okay.

12 MR. IRWIN: And I was entrained there as well,
13 health physics training or engineering training.

14 INTERVIEWER SHERBINI: When did you leave
15 Seabrook?

16 MR. IRWIN: I left Seabrook in July of 1990 --
17 or excuse me -- September of 1992.

18 INTERVIEWER SHERBINI: I must have inspected
19 you at some point or another.

20 MR. IRWIN: Yes. It is very likely.

21 INTERVIEWER SHERBINI: Yes. I was at Seabrook
22 at one time.

23 MR. IRWIN: Yes.

24 INTERVIEWER SHERBINI: Okay.

25 MR. IRWIN: And came here in October of '92 and

1 have -- I worked part-time while I was finishing graduate
2 school and then became full-time in November of '93. So
3 I'm about two years full-time work here.

4 Yes. So I started with some calculations
5 within those. We thought it might be good to have three
6 separate evaluations occurring at the same time.

7 INTERVIEWER ULLRICH: Is the noise outside a
8 problem?

9 INTERVIEWER SHERBINI: No, no. Frank Masse is
10 there talking with --

11 INTERVIEWER ULLRICH: Okay.

12 MR. IRWIN: So all I got from or to my
13 assessment was the data from the urine counts and whole
14 body counts. And I worked independently of the rest.

15 INTERVIEWER SHERBINI: Okay.

16 MR. IRWIN: The first few calculations were
17 indeed my very first uses of this software for a real case.
18 I use the software in education, where you're really given
19 a whole lot more than is given in this scenario. But I put
20 the information into the software and started to come up
21 with my own estimates of intake.

22 And there are details about the software and
23 the whole process. I can explain them to you kind of by
24 looking at some records that I have assembled for that.

25 INDOS is a program that I think is exceptional

1 in that it's based on the ICRP 30 retention function and
2 the ICRP 30 digestive tract and respiratory tract models.
3 It goes beyond estimating an intake from those models based
4 on bioassay data to -- essentially through reiterative
5 linear regression model, smooth line of best fit so that it
6 can take the error in multiple data observations and really
7 give the user precise and what would appear accurate number
8 from the data.

9 INTERVIEWER SHERBINI: What does it smooth, the
10 data itself or --

11 MR. IRWIN: No, it doesn't adjust the data. It
12 adjusts the expectation value based on the data. You put
13 the data in, and there is an error associated with each
14 observation.

15 And it has actually three modes of output. It
16 can give an unweighted fit, which is just purely
17 determining the slope and plotting that line.

18 INTERVIEWER SHERBINI: Yes.

19 MR. IRWIN: Then it can give a weighted fit
20 which plots that slope, but based on a mathematical
21 manipulation of error in each individual data point; and
22 then, third, what's called an iteratively weighted fit,
23 where it will do the weighted fit once, and that will
24 smooth the curve one time.

25 It will then look at the error that has been

1 regenerated mathematically from that first fit and perform
2 a second linear regression on that line. And it will do
3 that until the fit is equal from the current slope of the
4 line calculated and the most recent one before that.

5 It's a process that I've used by hand
6 frequently, particularly in error sampling data. And I
7 have great confidence in it. The ICRP models I have
8 reasonable confidence in as well based on their acceptance.
9 So --

10 INTERVIEWER SHERBINI: So to get the intake,
11 you plot the actual data versus the expected numbers --

12 MR. IRWIN: Yes.

13 INTERVIEWER SHERBINI: -- and then draw a line
14 through these?

15 MR. IRWIN: Yes. That's essentially the
16 method. You have the data that is actually reported.

17 INTERVIEWER SHERBINI: Yes.

18 MR. IRWIN: For example, this is whole body
19 count data here.

20 INTERVIEWER SHERBINI: Right.

21 MR. IRWIN: And with all of the points that are
22 plotted of the actual data, a line is fit. The line, of
23 course, has some wide intercept where it times zero exists.
24 And the software will use the ICRP 30 retention function,
25 the decay that is occurring radioactively, as well as the

1 individual data points and their respective error to
2 calculate what amount would have led to these measurements
3 from the whole body.

4 And also the same sort of values occur when you
5 plot, instead, urine concentrations. And it will do it as
6 well for incremental urine measurements, where you take the
7 total amount of activity in the urine for a 24-hour period.
8 And I feel good about the software as well because we had a
9 lot of data points. I used from 10 to 50 days. So we had
10 40 data points.

11 INTERVIEWER SHERBINI: That's a lot.

12 MR. IRWIN: Yes. If I use it with fewer, the
13 estimates are not that good. In addition, I feel good
14 about it because I use essentially two collections of
15 activity measurement. One is what is coming out of the
16 body in urine. And, second, is what remains in the body
17 and that runs along photons from that. And I get
18 remarkable agreement between the two.

19 I think that had we had some lower energy beta
20 emitter and no capability to get the whole body data, that
21 there would be less support for these estimates.

22 INTERVIEWER SHERBINI: Did you change any of
23 the standard model or --

24 MR. IRWIN: Well, you're allowed to. You can
25 change the fraction that goes to urine, the fraction that

1 goes to PCs, the fraction that goes to uptake from the
2 gastrointestinal system. You can adjust volumes of urine
3 that are excreted, et cetera. It would --

4 INTERVIEWER SHERBINI: But you actually used
5 the standard man, basically; right?

6 MR. IRWIN: Yes.

7 INTERVIEWER SHERBINI: Do you know what Mr. Li
8 weighs? I may have asked him that, but I forgot.

9 MR. IRWIN: Yes. Actually, I've never been
10 told that, but I've seen him many times. And I wouldn't
11 suspect he weighs much more than 140 pounds, --

12 INTERVIEWER SHERBINI: He's probably -- yes.
13 Okay.

14 MR. IRWIN: -- which is not too far off --

15 INTERVIEWER SHERBINI: No, no.

16 MR. IRWIN: -- from the 70 kilograms of
17 reference man, but very far off on reference man urine
18 volume excreted. The reference man is 1.4 liters per day.
19 And he averaged over the 50 days of urine collection almost
20 3 liters per day. About 2,750 milliliters per day is the
21 average. Some of those days were from 2,205 milliliters to
22 5,400 milliliters.

23 INTERVIEWER SHERBINI: So you say he averaged
24 about three liters?

25 MR. IRWIN: Yes. 2.75 liters of urine a day

1 was the average I used for the urine concentration
2 activities.

3 INTERVIEWER SHERBINI: Was that even after you
4 asked him not to hydrate himself?

5 MR. IRWIN: Actually, I never did ask.

6 INTERVIEWER SHERBINI: Or somebody asked him.

7 MR. IRWIN: The actual -- yes. There was a --
8 I am aware that there was a time where they said, "Wait a
9 minute. You can't possibly be urinating that much." And
10 he admitted that he was attempting to purge himself, as I
11 think a lot of people would. And they questioned or the
12 request was made to avoid the excess, I think, but that's
13 just --

14 INTERVIEWER SHERBINI: But the 2.75 liters per
15 day was throughout the period?

16 MR. IRWIN: Yes. The time that it was most
17 dramatic was before the 24th of August. That would have
18 been about 10 days post-intake. In fact, the 10th day was
19 a 5,340-milliliter elimination volume.

20 After that point the actual values range from a
21 high of, let's see, 3.68 liters to a low of 2.15 liters.
22 Those were the values that I used as an average because
23 those were the only amounts of activity that I had used. I
24 didn't use any data from the first 10 days because of the
25 volume concerns and having a sufficient number of data

1 points without concluding those.

2 So even to October 3rd, we were getting 2.5
3 liters of urine a day. So higher urinary excretion rate is
4 consistent with this individual for certain.

5 INTERVIEWER SHERBINI: The other parameters
6 were the same? They didn't change, the other standard
7 parameters?

8 MR. IRWIN: Not in the documents or the intake
9 estimates that were used officially. I did, however, do a
10 lot of sensitivity analysis, seeing what it would do to the
11 intake if you increased or decreased the fraction that go
12 to PCs, the fraction that will go to urine, the volume, way
13 you would adjust for these fluctuations in volume; for
14 example, normalizing to three liters or just using an
15 average of all of the volumes and making that the default
16 value for each measurement.

17 But the big thing that I did was I discounted
18 the urine concentrations in favor of the incremental urine
19 values because that was everything his body put out,
20 regardless of volume.

21 And when you put all of that together for the
22 40 days of bioassay data, it is better to use. There's
23 less air -- or there's less fluctuation, rather, between --
24 because of the -- due to the volume changes that occurred.

25 INTERVIEWER SHERBINI: Before we get off the

1 data, --

2 MR. IRWIN: Yes.

3 INTERVIEWER SHERBINI: -- Frank Masse had
4 pointed out -- and I saw it in my plots of the data -- two
5 blips on the urine curve that seemed to be out of the trend
6 for the rest of the data. Do you know something like this?

7 MR. IRWIN: Yes.

8 INTERVIEWER SHERBINI: What do you make of
9 that?

10 MR. IRWIN: Well, you can see them here
11 graphically, where about 25 days and perhaps 35 days and
12 near 45 days, let's just say, at those estimates of the
13 days, that there was an actual increase in what we would
14 have expected.

15 And we did some evaluation of this to try to
16 make sure that there were new intakes occurring. We,
17 frankly, had a concern that, for some reason or another,
18 additional activity was being taken in and that was the
19 cause of these increases, estimating, for example, that
20 there may have been something that occurred a couple of
21 days before these blips.

22 And that evaluation essentially looked at what
23 was occurring in the roughly 20 days before the little
24 rises and falls started showing up and then looking at what
25 was occurring during each of these little humps and seeing

1 what that indicated to us. And we figured that it was
2 possible that those humps could be because of some
3 additional intake.

4 It was at that time, actually, that I began to
5 use the whole body data. It was before this that all I
6 used was urine data because I was not familiar with the
7 whole body data and I had plenty of urine data. Everybody
8 else was doing everything on urine data because that's what
9 the NUREG uses, an ICRP 30 model that Don Haes was using.

10 So when I plotted the data and manipulated it
11 with INDOS for the whole body, I felt better that indeed
12 what was occurring at these humps was due to statistical
13 fluctuations in the person's metabolism.

14 Maybe over weekends he drank more and he would
15 eliminate more activity just on the days that were -- that
16 this was occurring in the whole lifetime of this event. In
17 other words, it was -- there were other changes going on in
18 his body that would force more elimination out and also
19 because there was a lot more error in the data relative to
20 the data itself because the measurements were getting
21 smaller.

22 Essentially, the error in all of this data is a
23 conservative measurement of error, and that is just taking
24 the square root of the measurement. And when you get down
25 to days 35, 40, and 50, the error is greater than the

1 measurement. And so there's a little bit that's associated
2 with that, a lot of different factors.

3 But I after doing the whole body data felt that
4 there weren't additional uptakes and that --

5 INTERVIEWER SHERBINI: Was he working with
6 anything that might have caused anything at that time?

7 MR. IRWIN: Not that I'm aware of. From my
8 knowledge of the event, since it had been reported to
9 Radiation Protection Office, he was not allowed to work
10 with radioactivity.

11 INTERVIEWER SHERBINI: Okay. How about the
12 time of intake? Could you tell us a little about how you
13 arrived at what intake estimate --

14 MR. IRWIN: Yes. I used the information that
15 Mitch and Don provided me. And theirs was based on
16 physical evidence, eliminations found in underwear and
17 things of that nature and recollections of what the
18 individual did in the laboratory on that day.

19 I know that in the first month afterwards we
20 had a problem in all of our evaluations in that we did not
21 appropriately count days post-intake. We were saying,
22 "Okay." Let's say the 14th is the beginning.

23 INTERVIEWER SHERBINI: That's the date you
24 used, the 14th?

25 MR. IRWIN: Yes, that from whatever, say 8:00

1 p.m. on the 14th to 8:00 p.m. on the 15th, that's not a day
2 post-intake. That's the day of intake. So every day after
3 that, then, would be one day, two day, three day.

4 So we put day -- August 14th as day zero. So
5 all of our early calculations were based on a day short
6 because we came to the realization that what all of the
7 documents that we used in evaluating internal dosimetry
8 were referring to as days post-intake was best arrived at
9 by saying the measurement was done at such and such a date
10 and time. And that is exactly, say, 424 hours from 8:00
11 p.m. on the 14th.

12 We divide that by 24 to come up with days
13 post-intake. And from approximately the 15th of September
14 on we then used that --

15 INTERVIEWER SHERBINI: So you're saying
16 essentially that your first calculations were using an
17 intake that occurred a day earlier than it had actually
18 occurred. Is that what --

19 MR. IRWIN: Actually, it would be an intake
20 that occurred a day later.

21 INTERVIEWER SHERBINI: A day later.

22 MR. IRWIN: And that made our intake estimates
23 less than what they are today; in fact, less than what they
24 were from about the 15th on.

25 I've also done some sensitivity analysis with

1 time, attempting to see whether 8:00 p.m., 12:00 p.m. on
2 the 14th was a better day than -- and time than others. If
3 you use INDOS, you can hold all other values constant and
4 change the time and see if you get better or worse relative
5 error.

6 And I did all of that, and I found that there
7 was too much fluctuation in the incremental urine and urine
8 concentration data to see any significant changes in
9 relative error if you said that the intake actually
10 occurred at noon on the 14th or at 8:00 p.m. on the 14th or
11 the 15th or the 16th or even a week or 10 days before.

12 But I did find, which I thought was quite
13 interesting, that if you adjusted the time on the whole
14 body data, that you could get better error by adjusting the
15 time closer to you and you get worse error by adjusting it
16 away from you.

17 In other words, the best errors I found in the
18 INDOS calculations were actually on August 16th. And they
19 progressively were higher relative errors as you went to
20 the 15th and then to the 14th and that they were
21 progressively higher relative errors if you went to the
22 17th and the 18th, not that there is any real credibility
23 to that because it's purely mathematical manipulation, but
24 it was an effort to try and see if there was any way to
25 better hone down the time of day that this occurred because

1 I know that there are a number of estimates for noon and
2 for 8:00 p.m. And with a short half-life radionuclide,
3 that eight hours is substantial change on the intake.

4 So I can't find any way to significantly
5 question the other evidence that it occurred at 8:00 p.m.

6 INTERVIEWER SHERBINI: When did you find out
7 that you were entering the dates inappropriately when you
8 were --

9 MR. IRWIN: Yes. I kept a lot of the records
10 that I have generated. I've generated hundreds of INDOS
11 calculations literally and probably spent an average of 20
12 hours a week for the past 10 weeks just on this.

13 I did calculations on the 12th of September
14 that were adjusted from the incident essentially occurring
15 on the 14th of August to the incident occurring on the 15th
16 of August.

17 INTERVIEWER SHERBINI: How big a change in
18 intake did that result in when you changed it by one date?
19 Do you remember? Do you remember the intake history before
20 that change and after that change?

21 MR. IRWIN: Yes. One example, though there
22 have been other changes that have occurred besides just
23 changing for time, is that at 510 approximately microcuries
24 based on the incorrect date and 573 on the correct date.

25 INTERVIEWER SHERBINI: So the intake estimate

1 changed on September 12th to go out to 573?

2 MR. IRWIN: Yes. It was about that day.

3 INTERVIEWER SHERBINI: Just trying to tie it
4 down with other accounts of what happened and so forth to
5 make sure. Okay.

6 The time input in INDOS is time post-intake or
7 date?

8 MR. IRWIN: It is purely days post-intake.

9 INTERVIEWER SHERBINI: Okay.

10 MR. IRWIN: So that was a very important
11 factor.

12 INTERVIEWER SHERBINI: You have to figure out
13 what time.

14 MR. IRWIN: Yes. And I ended up with those
15 dose estimates that were used for official purposes using
16 8:00 p.m. on the 14th as the start of day one. And that is
17 quite allowable in the program. You can use fractions of
18 day down to several significant digits of -- you have great
19 flexibility in the timing.

20 INTERVIEWER SHERBINI: Okay. Yes. Does INDOS
21 give an error estimate in the final intake number?

22 MR. IRWIN: Yes.

23 INTERVIEWER SHERBINI: How much did you get for
24 the whole body and the urine?

25 MR. IRWIN: Yes. I have a -- for whole body I

1 am using an iteratively weighted fit, which I think is the
2 most conservative and actually most precise. I have 578.9
3 microcurie intake plus or minus 4.1 or 4.414 microcuries.

4 INTERVIEWER SHERBINI: This is on standard
5 deviation?

6 MR. IRWIN: Yes.

7 INTERVIEWER SHERBINI: Okay. And the urine?

8 MR. IRWIN: For urine concentration, at 8:00
9 p.m. And the whole body is actually for noon, not 8:00
10 p.m., because all of the body counts were decay-corrected
11 to noon, rather than adjusted, which I could have. I just
12 kept it all at noon. I got 556.1 microcuries plus or minus
13 25.78. And it's especially the great fluctuation's in
14 total volume urine that was excreted.

15 Then my incremental urine data that was 24-hour
16 increments was 547.7 microcuries plus or minus 18.07
17 microcuries.

18 INTERVIEWER ULLRICH: That was also intake at
19 8:00 p.m.?

20 MR. IRWIN: Yes, that's correct.

21 INTERVIEWER ULLRICH: Okay.

22 INTERVIEWER SHERBINI: So where does the 573
23 come from? Is that an average of --

24 MR. IRWIN: Five seventy-three. I'm not sure
25 what that number --

1 INTERVIEWER SHERBINI: You said after you
2 changed the dates, you got 573 microcuries.

3 MR. IRWIN: Oh, that was actually an estimate
4 that was done September 12th. These --

5 INTERVIEWER SHERBINI: Okay. So these are the
6 final numbers?

7 MR. IRWIN: Yes, my calculations that were used
8 in Frank Masse's letter to Yuqing Li, the results of
9 internal doses. So that was about the 11th of October.

10 INTERVIEWER SHERBINI: And what was that
11 number? The formal, I guess the formal, number was?

12 MR. IRWIN: There were three calculated intakes
13 provided by Mr. Masse to Dr. Li.

14 INTERVIEWER SHERBINI: Yes.

15 MR. IRWIN: One was urinary excretion. That's
16 incremental urine, 8:00 p.m., 547 microcuries; urinary
17 excretion at noon, again incremental urine, of 564; -- and
18 I have a copy of that -- and then a whole body of 579
19 microcuries.

20 And then my data since the software I'm using
21 is because I was a student at University of Massachusetts,
22 Lowell, I was given a copy of the software, though I'm not
23 licensed for it.

24 All of my calculations were sent to Dr. Joe
25 Ring at Harvard, who is licensed to use the INDOS software.

1 And we asked him to verify our data. And that was the
2 method that was recommended by the people that write the
3 software, Skrabble Enterprises.

4 I talked to them. I said, you know, "I'd like
5 to use the software that I got from school for doing some
6 work on this intake. I'd also like to buy the software for
7 our university."

8 And they said, "Well, until you actually do buy
9 it, you can't use it legally unless you were to have a
10 licensed user verify your calculations." So that was done
11 through Dr. Ring.

12 INTERVIEWER SHERBINI: But the programs are
13 identical?

14 MR. IRWIN: Yes, yes.

15 INTERVIEWER SHERBINI: Dr. Ring, did he support
16 your calculations?

17 MR. IRWIN: Yes. When we used the same
18 parameters, which were reference man parameters and NUREG
19 parameters; for example, fraction of urine of .9, fraction
20 PCs of .1.

21 INTERVIEWER SHERBINI: Oh, you used .9 for your
22 --

23 MR. IRWIN: Yes, yes, though I've done all
24 different kinds of fractions to see what changes they make.

25 INTERVIEWER SHERBINI: Is that .9 because of

1 what you got from ICRP or is that --

2 MR. IRWIN: No. I actually got it from the
3 NUREG.

4 INTERVIEWER SHERBINI: Oh, NUREG.

5 MR. IRWIN: Yes. I'm not sure of the number.

6 INTERVIEWER SHERBINI: Is that the default in
7 INDOS or did you change the default?

8 MR. IRWIN: No. You can make all of your
9 parameters what you would like and --

10 INTERVIEWER SHERBINI: But the default was .8?

11 MR. IRWIN: No. That's F1, F1, which is the
12 fraction that --

13 INTERVIEWER SHERBINI: I thought FU was also
14 .8.

15 MR. IRWIN: No, no. It's .9. In fact, I have
16 it here if you'd like to see it.

17 INTERVIEWER SHERBINI: No. It's okay. So that
18 is the number you --

19 MR. IRWIN: Right. Now, here this is from
20 NUREG Page BE722. It's .9, FU. And FF is .1. That's what
21 we used. And talking to the authors of the software, they
22 said, "It's really not necessary, nor is there a strong
23 foundation to change from these reference man and NUREG
24 variables."

25 INTERVIEWER SHERBINI: Well, I guess -- yes.

1 ICRP 13 uses .8.

2 MR. IRWIN: But that's a different value.

3 That's not FU. That's F1, which is the fraction that goes
4 into the gastrointestinal --

5 INTERVIEWER SHERBINI: Yes, I know.

6 MR. IRWIN: -- tract that goes into the
7 systemic whole body.

8 INTERVIEWER SHERBINI: They also use FU of .8
9 at one place. It doesn't matter. You used --

10 MR. IRWIN: I looked for it. I just never
11 could find it in ICRP 30.

12 INTERVIEWER SHERBINI: Okay. Who is Joe Ring?

13 MR. IRWIN: Joe is a -- health physicist I
14 believe is his title at Harvard University in the
15 Environmental Health and Safety Office.

16 INTERVIEWER SHERBINI: Is he the equivalent of
17 Frank here or --

18 MR. IRWIN: No. The actual equivalent of Frank
19 is Dr. Jacob Shapiro. And Joe might be moire the
20 equivalent of Mitch in that he works for Dr. Shapiro and
21 really will probably take over when Dr. Shapiro retires.

22 INTERVIEWER SHERBINI: You went to Joe because
23 he's a licensed user of INDOS?

24 MR. IRWIN: No.

25 INTERVIEWER SHERBINI: No?

1 MR. IRWIN: From my understanding, -- and I was
2 never a part of the conversations -- Joe Ring was selected
3 only because he was from Harvard. Apparently when the
4 Biology Department and our office met, there was a request
5 for an outside independent evaluation of the intake and
6 people from the Biology Department asked for our
7 recommendation of who might be perhaps one of the best in
8 this.

9 And I believe our office suggested Dr. Ken
10 Skrable at the University of Massachusetts, Lowell. And
11 that was not accepted as a recommendation. So someone from
12 Biology --

13 INTERVIEWER SHERBINI: Who did not accept
14 Skrable? It doesn't matter.

15 MR. IRWIN: Yes. Someone there did. My
16 recollection might not be correct. So I don't really want
17 to say.

18 But, instead, someone from the Biology
19 Department said, "Well, what about if the people or someone
20 from Harvard Radiation Safety was to do it?" And that was
21 deemed acceptable.

22 So he was not ever picked by name. He was
23 really picked by institution, an institution nearby that
24 had a Radiation Safety Office and people like us but was
25 independent.

1 INTERVIEWER SHERBINI: Why the Biology
2 Department? Why did they make the selection? How does the
3 Biology Department fit in all of this?

4 MR. IRWIN: The only way you can really get
5 that answer is to talk to people that were there.

6 INTERVIEWER SHERBINI: Okay.

7 MR. IRWIN: Obviously the Biology Department
8 employees were as the intermediate employer of the
9 individual for MIT.

10 INTERVIEWER SHERBINI: Oh, I see.

11 MR. IRWIN: They were helping to make some of
12 the decisions, some of the support, et cetera.

13 INTERVIEWER SHERBINI: Okay. I think that's
14 all I have. Betsy, do you have any questions?

15 INTERVIEWER ULLRICH: No. I think we've been
16 through pretty much everything about INDOS that we had
17 questions about.

18 INTERVIEWER SHERBINI: I wonder if I could look
19 through your notes if it's all right with you.

20 MR. IRWIN: Sure. No, I don't have any problem
21 with that.

22 INTERVIEWER SHERBINI: Great.

23 MR. IRWIN: One other thing I wanted to tell
24 you about, I knew that there was going to be a question
25 about INDOS. And so I've been really trying to test it

1 hard to feel comfortable about it myself.

2 And I found out a very interesting thing about
3 INDOS, as I was attempting to break it, and that is that if
4 you use INDOS, one of the menu items is to generate an
5 intake retention fraction. And if you use the standard man
6 variables, reference man variables, and attempt to use
7 INDOS to generate an intake retention fraction for the days
8 of your bioassay data, days, in particular, for us days 11
9 through 50, you get the exact to 3 significant digits
10 intake retention fractions from the NUREG.

11 So I thought that substantiated what the
12 software was doing because if you then put in Dr. Li's
13 actual urinary excretion, it will generate an intake
14 retention fraction for Dr. Li that is specific to him. And
15 that is what ends up getting used in the calculations for
16 Dr. Li on his specific bioassay data.

17 So I thought it was a really remarkable
18 capability that it had to take the metabolic information,
19 purely without any radioactivity associated with it, just
20 based on a stable chemical and give you not only the
21 retention fractions for reference man which were quoted in
22 the NUREG but also to substantiate how you get your
23 calculations in INDOS. And so I thought that was very
24 good.

25 INTERVIEWER SHERBINI: Yes, yes. It sounds

1 like a good program. I've heard a lot of good things about
2 it.

3 MR. IRWIN: Yes. And, of course, Dr. Skrabble
4 and Dr. French, who worked on this, they also participated
5 in the writing of the NUREG. They're listed as authors of
6 that.

7 So what I have in here is the final results,
8 essentially, perhaps intake estimates, the actual numbers
9 of reviews, and then Joe Ring's dose estimate, Frank
10 Masse's dose estimate, some information about reference
11 man, some retention fractions. Then this is historical
12 data that was kept over the months of this work.

13 INTERVIEWER SHERBINI: Very good. I'll look
14 through it and bring it back to you.

15 MR. IRWIN: I also have an INDOS manual, if you
16 have an interest in that.

17 INTERVIEWER SHERBINI: Very good.

18 MR. IRWIN: There's a hand calculation in the
19 manual that can be used to verify the data or the
20 calculations. It shows you both the method of coming up
21 with the intake estimate for a particular day of
22 observation.

23 If you have 5 compartments, it's 40
24 calculations required for that. Then it also gives the
25 model for the iteratively weighted fit and explains inside

1 the text all of the good uses of that.

2 INTERVIEWER SHERBINI: We probably need to look
3 a bit more closely into the urinalysis data and quality
4 control and so forth. Who would we talk to about this? We
5 want to know how the liquid scintillation counting was
6 done, what quality controls --

7 MR. IRWIN: Yes. That would be Mitch.

8 INTERVIEWER SHERBINI: Mitch?

9 MR. IRWIN: Yes.

10 INTERVIEWER SHERBINI: Okay. Is there anything
11 else you think we should have talked about in this area and
12 we didn't mention that might help us clarify your position
13 or something like that?

14 MR. IRWIN: No, not that I can think of. I
15 don't know what perspectives you have specifically related
16 to my work. I assume that those were fulfilled.

17 INTERVIEWER SHERBINI: Yes, yes. I think I
18 understand. I just want to make sure that if we do get
19 very different answers from you, that we will be able to
20 trace the cause of the difference.

21 MR. IRWIN: Yes. I'm very interested in it.
22 I'm attempting to -- I mean, this is the first internal
23 dose case of this magnitude that I've ever worked on,
24 either real or in an educational format, with all of these
25 nuances. And I attempted to do the best that I could.

1 And I'm very interested in finding out other
2 ways of doing it because it seems quite apparent to me that
3 unless you have some sort of what's called a commercial
4 package for doing this, the federal guidance for doing it
5 can lead to very different answers from one day to the
6 next. And there's inadequate --

7 INTERVIEWER SHERBINI: It's very tedious, yes.
8 It's hard to do this kind of thing by hand.

9 MR. IRWIN: Yes, yes.

10 INTERVIEWER SHERBINI: Okay. Well, it's 10:20
11 now. We'll end the interview and go off the record.

12 (Whereupon, the foregoing matter was concluded
13 at 10:22 a.m.)

C E R T I F I C A T E

This is to certify that the attached
proceedings before the United States Nuclear
Regulatory Commission in the matter of:

Name of Proceeding: INTERVIEW WITH WILLIAM IRWIN

Docket Number: --

Place of Proceeding: Cambridge, Massachusetts

were held as herein appears, and that this is the original
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