UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:

IE TMI INVESTIGATION INTERVIEW

of Howard C. Crawford
Nuclear Engineer, 1

Trailer #203
NRC Investigation Site
TMI Nuclear Power Plant
Middletown, Pennsylvania

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NRC PERSONNEL:

Thomas H. Essig
Mark E. Resner

RESNER: This is an interview of Mr. Howard C. Crawford. Mr. Crawford is employed by the Metropolitan Edison Company at the Three Mile Island facility, and his job title is Nuclear Engineer, 1. The present time is 4:18 p.m., EDT, and today's date is May 22, 1979. This interview is being conducted is being conducted in Trailer 203, which is located just outside of the south gate to the Three Mile Island facility. Individuals present representing the NRC at this interview are Mr. Thomas H. Essig. Mr. Essig is the Chief, Environmental and Special Projects Section with the U. S. Nuclear Regulartory Commission, assigned to Region III. Moderating this interview is Mark E. Resner. I am an investigator with the Office of Inspector and Auditor, Headquarters, with the U. S. Nuclear Regulatory Commission. Mr. Crawford was previously interviewed by the Nuclear Regulatory Commission investigating team at TMI on May 3, 1979. At that time he was given a two page advisement document which explained the purpose, the scope and the authority by which the Nuclear Regulatory Commission is conducting this investigation. This document also apprised Mr. Crawford that he is entitled to a representative of his choice to be present during the interview, should he desire one. And additionally apprised him of the fact that he is in no way compelled to talk to us, if he does not want to. On the second page of this advisement document, Mr. Crawford answered three questions, which were stated for the record on the original interview, May 3rd. Mr. Crawford has indicated to me today that as well as a copy of the tape for this interview, he would like a transcript of this interview. We will provide him a copy of this transcript and tape at the conclusion of the interview. Mr. Crawford also on this May 3rd interview, has provided his

educational and job experience, as related to the nuclear industry. So, with all that, we'll get into the meat of the interview, and I'm sure Mr. Essig has a few questions for us.

ESSIG: Howard, there are a couple of areas that I'd like to go over with you; areas which we have previously discussed. There are a few points that I'd like to just clear up. There's been additional information in the form of additional records that we reviewed, additional people that we interviewed, and as a result of just that additional fact gathering. We're to the point now, where there are a few people like yourself that we're reinterviewing and just trying to pin down or maybe explain some particular confusion that's on the record. So, what I'd like to do to start with, is to talk with you about the source term calculations that were initially performed, and I have in my hand a copy of enclosures to Procedure 1670.4, Revision 2, dated 1/16/78. And I have enclosures 2, 3 and 4 of that procedure. These enclosures are related to the source term calculation, the atmospheric dispersion estimate and the eventual estimate of offsite dose rate. One of the points that I wanted to clarify with you, enclosure 4, which I am now looking at, appears to summarize that as a tabulation of the individual sheets which follow, it summarizes the source terms. One of the source terms or outside dose rates which ... which appears on the summary sheet, but does not appear to be supported by the individual data sheets, is an estimate of the dose rate at location GE-8, which would be an on the island location. And it's for the period ... or for the time of the calculation is 0746, on 3/28. Mr. Crawford could you explain why there isn't an indi-

vidual data sheet for this one, or just explain a little bit about that calculation ... what was done with those particular numbers?

CRAWFORD: That first calculation ... I did have a sheet and I couldn't find it in the records. I looked through the bags and couldn't find it. It was done for West 11, which is Goldsboro, and the reading that we first got back was at GE-8, which is exactly opposite West 11, on the island itself. And I believe at that time, we wanted to see what kind of new source term, we would actually get, since the team was still enroute to West 11 at that time. We recalculated our source term, based on a reading at GE-8, and the recalculated another prediction for West 11 and that one is provided on the third, enclosure three in that set, which predicted to less than 1 mR. And then that is the next calculation on enclosure four. And that number came out fairly well with what we had actually found at West 11.

ESSIG: O.K. Let's me see if I understand what you just told me correctly. You initially made a calculation of 40 R/hour at GE-8, and while the team was enroute to West 11, which is at the center of your Goldsboro, a team on the island actually measured 1 mR/hour at location GE-8, and you used that then to make revision 1, of the dose rate calculation at the LPZ, which in this case initially was the 10 R/hour?

CRAWFORD: No, if you go two more pages back, I have a ... right there. I have a recalculation at West 11.

ESSIG: O,K. I'm sorry.

CRAWFORD: O.K. Based on the new source term I got by taking my 40 R/hour and my GE-8 reading, and applying the correction factor to come out with the new source term back on the first enclousre four.

ESSIG: O.K. I think I...

CRAWFORD: O.K. And so that gave me a new source term, to again go back and predict what I would see at West 1-1. And then I could compare those two predictions to see which one was the better of the two predictions. And it turned out that the corrected source term for the GE-8 one was the better of the two predictions, based on the actual reading we found.

ESSIG: O.K. Let me ask you a question then about the sheets labeled LPZ. What distance is your LPZ?

CRAWFORD: The LPZ is at one mile.

ESSIG: And since the wind direction is indicated as being from the east, then we're talking about one mile to the west.

CRAWFORD: Correct.

ESSIG: O.K. Would that be fairly close to location W11?

CRAWFORD: No. The X/Q for the LPZ is a standard X/Q no matter which direction the wind's is coming from, since it's a standard set distance.

RESNER: Excuse me, Tom will you go over the X/Q for the typist?

ESSIG: The X/Q is the athmospheric dispersion factor. And it can be designated "X/Q" for the purpose of typing the transcript. O.K. these ...

CRAWFORD: So, I did an LPZ calculation also, based on my first source term of 1325, and then based on my corrected source term on .031, and I did two calculations there at the LPZ based on the two source terms.

ESSIG: O.K. So, this X/Q that you indicated was a standard X/Q, it's 2.5 X 10^{-4} seconds per cubic meter. Is the standard X/Q out of the FSAR or the LPZ?

CRAWFORD: No. It's taken off the map. O.K.

ESSIG: The overlay?

CRAWFORD: The overlay.

ESSIG: O.K.

CRAWFORD: It's taken off the overlays. But it's always that number for the LTZ for the stable overlay that we were using. It's a different number if you go to the neutral overlay. And a different number if you go to this... that one stable overlay.

ESSIG: O.K.

CRAWFORD: But, since that's a constant distance away, the X/Q, because you always find the point LTZ, which is directly downwind. So, you always use the center point of the X/Q.

ESSIG: O.K.

CRAWFORD: O.K.

ESSIG: O.K. So, initially then, our first calculation was...

CRAWFORD: 40 R, which I don't have a sheet on.

ESSIG: O.K. Which we don't have a sheet for and then ... we have ... we went out and measured that...

CRAWFORD: We measured it at GE-8, which is right ... it's on the island, but it's directly across from West 11.

ESSIG: Right. O.K. Then, using the actual to predicted, that is the one tc 40 R/hour we can come up with a correction factor which you've indicated of as being 2.5×10^{-5}. Is that correct?

CRAWFORD: Correct, that's correct.

ESSIG: And since that 40 R/hour was based on an apparent source term of 1,325 curies per second, we simply multiply by the correction factor. Got a new source term of .033 curies per second.

CRAWFORD: Correct.

ESSIG: Then that source term of .033 curies per second, was used in two places then, as I understand it. It was used in the LPZ revision 1 calculation.

CRAWFORD: Correct.

ESSIG: O.K. And it was also used in the initial calculation then, for W 11, which would be Goldsboro.

CRAWFORD: Correct.

ESSIG: O.K. I...

CRAWFORD: It's not the initial, it would be REV-1 also basically... but I ... because the initial calculation was the 40 R at West 11.

ESSIG: I thought you indicated that 40 R/hour was actually for GE-8?

CRAWFORD: No. The 40 R/hour was calculated for West 11. O.K. The one mR per hour, actual was measured at GE-8, which is right across from each other, downwind in the plume, but not ... there's a half a mile difference.

ESSIG: O.K.

CRAWFORD: And since we could get to GE-8 faster, than we could to West 11, we just had some time, so we did the calculation to see ... and then we could compare, you know, if we would have seen a higher number at West 11, we would have gone back and used the 40 R/hour number. But since our second iteration showed we were actually closer using that than our first one, we just continued on using that.

ESSIG: O.K.

CRAWFORD: As a source term.

ESSIG: Would you be able to ... if you had to ... actually be able to predict as close in as GE-8, if you needed to? Or do you have X/Q numbers for that close in?

CRAWFORD: No, we don't have X/Q beyond ... in closer than West 11 going to the west.

ESSIG: O.K.

CRAWFORD: O.K. We could do something in the river, but, you know ... if you get inside the boundary of the island, we don't have X/Q's. Their essentially meaningless, because you know, you don't have any wind type of dispersion...

ESSIG: Right.

CRAWFORD: ...patterns that you can get.

ESSIG: Right. O.K. I think that that clarifies the questions that I had on these ... these source term calculations sheets, I just wanted to get a better appreciation for ... for the types of adjustments to the day that you were making them.

CRAWFORD: It's confusing, though. It took me a little while to sit down and think about exactly what I did to reproduce.

ESSIG: O.K. I note here on this summary sheet, you say, after there are two calculations entered for GE-8 and W 11, you have a new source term back fit, and then you have a ratio now of 1.5, as opposed to a previous .033?

CRAWFORD: That's correct.

ESSIG: O.K. Now how does that come about?

CRAWFORD: The SE 11 was still based on a .03; we had a wind shift.

ESSIG: O.K.

CRAWFORD: Actually the wind shift shifted the 320 coming from 321 to 140.

ESSIG: O.K.

CRAWFORD: So we redid the calculations still using our old source term. And then the wind shifted again, and was blowing due east, O.K., and we had people at the Observation Center to give us immediate readings.

ESSIG: O.K.

CRAWFORD: So we got immediate reading then of 3 mR, and we backfitted that to find a new source term.

ESSIG: O.K.

CRAWFORD: And that gave us our most recent source term, then. And that's where this comes in to say new source term.

ESSIG: O.K. I'm with you.

CRAWFORD: So, at that point it was hard to follow the wind shifting around with the teams we had out since it was on the west shore. And so we used our best reading, since we did have someone at the observation center.

ESSIG: Yes. So, then you used the 1.5 curies per second, then for the east 01, and then you have another calculation of ... for north ... for N31, which I believe would be Middletown. Correct?

CRAWFORD: Correct.

ESSIG: And that's at 1430 in the afternoon, now that doesn't use the same ... you apparently made another revision for the source term then ... from one and a half to .45 curies per second.

CRAWFORD: That's correct. We had another ... another wind shift, and that showed on the Hill Island one here.

ESSIG: O.K.

CRAWFORD: And we did a backfit calculation when the wind shifted towards ... right over Hill Island. We got a reading from a helicopter setting down Hill Island, and the we backfitted to find a new source term.

ESSIG: O.K. Now there's a sheet in here labeled above Unit 2 stack. Time 1410, 3/28/79.

CRAWFORD: This was from ... this again was a backfit based on the reading the helicopter got over the Unit 2 stack ...

ESSIG: O.K.

CRAWFORD: At an attempt by the curies force coming out of the stack.

ESSIG: O.K.

CRAWFORD: You know, you can only guess at a X/Q to get a backfit.

ESSIG: O.K. So at this power... this sheet here, probably isn't terribly meaningful?

CRAWFORD: No. It's probably not meaningful at all. It's just somebody who is interested, so we did our best to try to give him a backfit.

ESSIG: O.K.

RESNER: Excuse me, Tom. Mr. Benson, the other individual who was scheduled to be interviewed with Mr. Crawford, but was unable to make it on time, has called and wanted to know whether or not you still wanted to talk to him at this time?

ESSIG: I think it would probably be beneficial to have him here just for a short while. Some of these sheets and some of the other questions I have, which he may be able to shed some light on ... so, if he's coming and you wish to ... I'm sure there would be appropriate ways proper to terminate the ... the tape or do we keep going until he arrives or ...

RESNER: If h on't miss too much by you continuing on with Mr. Crawford, why don't we continue till he comes in. O.K.?

ESSIG: O.K. Now we have a calculation sheet in here for Foxes ... and what location is that specifically?

CRAWFORD: That's a grocery store in Middletown.

ESSIG: O.K. So this would be Middletown.

CRAWFORD: Right.

ESSIG: I'll make a note of that.

CRAWFORD: N-31, north 31 is the square of Middletown.

ESSIG: O.K.

CRAWFORD: And then we came a little bit closer to the island at Foxes which is closer than the square, and took some more readings.

ESSIG: O.K. So that... Foxes doesn't show.

RESNER: We have to take care of a minor problem. The time is now 4:37 p.m. Let's stop for a minute.

ESSIG: What happened?

RESNER: The time now is 4:39 p.m. A brief interuption was to resolve whether or not Mr. Michael Benson, who was scheduled to be interviewed with Mr. Crawford could make it. Apparently, he could not make it for this for this dual interview, so we will continue on with the interview with Mr. Crawford.

ESSIG: I believe we were discussing, before we went off the tape momentarily, the additional source term calculations that were made on the afternoon ... now the afternoon of the 28th, and we were presently looking at the calculation that was made for 1430, on that date, and it's location N-31, and now we have a source term of 6 curies per second.

CRAWFORD: Again, that was a backfit calculation.

ESSIG: O.K.

CRAWFORD: We did a good one ... oh, I'm sorry, that's isn't a backfit calculation. We did do one that predicted .075 and got one.

ESSIG: During this entire time, the ... you were using HPR 214, the dome monitor, for the estimates of source terms. Is that correct?

CRAWFORD: No, we weren't using any radiation monitors procedure. After you use the radiation monitor to get your initial one ... you just keep correcting your source term, based on all the offsite actual readings you keep getting back. And you don't go back to your radiation monitors to get ....

ESSIG: O.K. I understand.

CRAWFORD: You keep using what you actually seen out in the field.

ESSIG: O.K. But in effect your estimating an apparent source term.

CRAWFORD: Yes.

ESSIG: Which would give you whatever the radiation level was that you were measuring offsite then?

CRAWFORD: Right.

ESSIG: O.K. So the only time that the dome monitor was actually used, as I understand it, was that initial estimate of 1,325 curies per second. Is that correct?

CRAWFORD: That's correct.

ESSIG: And to obtain that 1,325 curies per second, we will refer to enclosure two of the same Procedure 1670.4, and I believe that this one indicates that the HPR 214 at the time you read it ... there's no time indicated on the sheet, but I think you had indicated to me that it was

CRAWFORD: 6:55 ... 7 o'clock in the morning

ESSIG: You had arrived on site at about 6:55, you actually got in the Control Room, and I think you indicated that at that time you looked at the HPR 214, and your recollection at the last interview, was that it was reading 80 to 100 R per hour. And now I believe were're ... are we, in fact, correct in that?

CRAWFORD: We had corrected that to 300 R/hour.

ESSIG: 300 R/hour. I'd like to ask you, just a question about the actual reading itself. Now, as I understand it, that HPR 214 monitor ... the actual readout that the scale on it runs from .1 to 10^7 mR/hour, that is milli R/hour, is that correct?

CRAWFORD: I believe so.

ESSIG: And that is the actual monitor reading, which is actually shielded the detector.

CRAWFORD: Correct. So the actual reading would be 100 times that.

ESSIG: The actual radiation level in...

CRAWFORD: In the building.

ESSIG: In the containment.

CRAWFORD: Yes.

ESSIG: O.K.

CRAWFORD: A 100 times that.

ESSIG: O.K. So the HPR 214 reading shown in this table of enclosure two, Procedure 1670.4, to get those readings you actually have to take down the HPR 214 response, divide it or intepret it in terms of R/hour, that is divide the reading by 1,000 in order to get the dose rates in the table here.

CRAWFORD: Correct.

ESSIG: So if, you were using a value of 300 R/hour, that would mean that the monitor was actually reading at about ... let see ... at 0 ...

CRAWFORD: 3×10^5

ESSIG: 3×10^5, and that would have been shortly then after you came into the Control Room?

CRAWFORD: Somewhere around 7 o'clock in the morning.

ESSIG: O.K. 7 to 7:15, somewhere in there.

CRAWFORD: More around 7.

ESSIG: More around 7.

CRAWFORD: Yes.

ESSIG: You went to that right away?

CRAWFORD: I went to that as soon as I got into the Control Room.

ESSIG: O.K. O.K. And that 300 R/hour should ... that should correspond to ... in order to get the 1,325 curies per second, you indicated previously that you had performed a linear extrapulation of these data, so that this simply should be 30 x 44?

CRAWFORD: I initially was going to do that. That's why it's circled. Then, I decided I'd try to get a little bit better, and what I actually did, I took the 53, divided it by 12, and then multiplied it by 300.

ESSIG: O.K.

CRAWFORD: Which brings it up close to the same.

ESSIG: I notice here in the ... that you actually have a lower value written down, and scratched out. If I read it correctly it's either 440, or 140. Is it 440?

CRAWFORD: Yes. It's 440.

ESSIG: Is ... oh, I see what happened there. That was ... you apparently took the 44 curies per second and multiplied by 10.

CRAWFORD: Yes.

ESSIG: O.K. And you apparently caught that error, and changed it to 1,325.

CRAWFORD: Correct.

ESSIG: Is that correct?

CRAWFORD: That's correct.

ESSIG: O.K. And now there's one more question that I wanted to ask you. On the summary sheet, there appears a date, near the top of the page of that sheet of March 30th, 3/30.

CRAWFORD: Yes.

ESSIG: Do you believe that date to be correct?

CRAWFORD: I do not believe that date. I believe it to be 3/29, or so.

ESSIG: O.K. But you had not actually ... it's not in your handwriting on that page.

CRAWFORD: No, sir.

ESSIG: O.K.

CRAWFORD: But, I believe those numbers were 3/29.

ESSIG: That appears to be supported by a number of individual sheets which are dated 3/29. And there are no sheets in this package dated 3/30.

CRAWFORD: Those sheets that are dated 3/29 in this package, were dated by me.

ESSIG: O.K. So this does show that you have location S 01 at 0840, location S 01 at 0845 on 3/29. You also have S 11 at 0840, 0845. O.K. So I, for the record, I will change that date then from 3/30 to 3/29 as being the correct date. O.K. I think that takes care of my questions on this ... on

this particular compulation. One of the other questions I wanted to explore with you, is on this procedure, again referring to Procedure 1670.4. In the calculation ... let's go back to enclosure 2 ... sorry, enclosure 3. The calculational process shows ... indicates that we start with a source term, which we previously estimated, and we get an athmospheric dispersion estimate, which we indicated in the previous interview that we get from the overlays. We multiply the two, and end up with a concentration in terms of microcuries per cc, and then we divide by the wind speed. My question is, do you know if the calculation until tnat point, has a wind speed already in it? I mean, is it based, for example, on wind speed of 1 mile per hour for those X/Q isopleths?

CRAWFORD: I believe the X/Q's are based on a 1 mile per hour wind speed.

ESSIG: O.K.

CRAWFORD: I'm not 100% certain. Sid Porter is the one that designed X/Q. But it is my understanding that they are based on one mile per hour.

ESSIG: O.K. We have another interview scheduled with Mr. Porter, so we'll ask him that question then. I did have one question, I wanted to ask you about the use that is exactly how ....

CRAWFORD: North, northwest direction towards Harrisburg, which is where the wind was originally going. Their vehicle broke down in Middletown.

ESSIG: I see.

CRAWFORD: I don't swear to that that was the exact time that it happened, but I do seem to recollect that. I don't know how we could verify that. We didn't write it down anywhere. I don't know if it was written down at the Observation Center, or Met Ed transportation would have a record of it. But, I do know that we had a vehicle break down in Middletown for a few hours that evening. We to had send a maintenance team up to repair the vehicle.

ESSIG: Is there any standard procedure in that case, where a maintenance team would be dispatched to the scene?

CRAWFORD: Yes.

ESSIG: Now, you indicated that they were ... the locations ... gee, I think most of these locations are

CRAWFORD: Up towards Harrisburg.

ESSIG: Or thereabouts ... towards Harrisburg.

CRAWFORD: Let me ... I don't know if it's the exact situation, but I know when the vehicle broke down, they had been up towards Harrisburg taking readings. They came through Middletown, and their vehicle broke down in

Middletown. Whether there was another time that we had them setting up there, I'm not saying it broke down, I can't say if this was the exact time. But I do know that it was one time when we had them up along the east shore into Harrisburg.

ESSIG: O.K.

CRAWFORD: If we can find another time that that happened. I can't say.

ESSIG: O.K.

CRAWFORD: Now I couldn't swear to it. But just from my memory.

ESSIG: O.K.

CRAWFORD: That might be a possible reason. I guess the best bet would be to check with the Med Ed Transportation Department. See if they have a record of sending anybody up to fix the vehicle.

ESSIG: O.K. We'll do that.

CRAWFORD: Might be a path to pursue. I guess that's not a statement I really want to be held to. I just said I...

ESSIG: Yes, I understand.

CRAWFORD: Just a vague memory.

ESSIG: Yes, I understand.

CRAWFORD: Other than that I don't know why we wouldn't of had somebody on the west shore, when the wind shifted like that. For that long amount of time.

ESSIG: O.K. Because I ... it just occurred to me ... just from looking at the wind data that since it appeared to persists so very long up in the ... well, let's say in the quadrant from west to northwest, to north-northwest, up in the general direction of the quadrant from Goldsboro to Harrisburg. It would seem like it would be appropriate to be making a number of surveys in there. And that may be, as you say, if the vehicle had broken down, and they were out of commission for awhile. So, we'll ... we'll attempt to ascertain whether that was actually the case.

CRAWFORD: That's the only explanation I could give you. In other words, I don't see why we wouldn't of had a team there.

ESSIG: O.K.

CRAWFORD: And, I believe, this is before we really made effective use of the helicopter, too.

ESSIG: O.K. The survey log, to which we were referring earlier ... the lack of a better name ... I'll term it the ECS survey log, appears to have been started after the fact. That is, you had made a number of surveys, and I believe in my interview with Bev Good, she indicated that she had actually set ... drawn up this whole form that's being used here.

CRAWFORD: That is correct.

ESSIG: Now I notice here that the first entry on this form is ... the earliest entry I should say, is for 0842 at Goldsboro, and then west, southwest 11.

CRAWFORD: I believe a lot of those were backfitted. In other words, the sheet was made up some time after that time.

ESSIG: O.K.

CRAWFORD: And those numbers were written in from what we had written down.

ESSIG: I think we also know that there were a number of surveys actually made on the island, prior to 0842. The first teams were out on the island quite early. Do you know where the original survey sheets that the teams

actually prepare not ... the sheet that the team member would perhaps have been looking at when he was radioing in the measurements. Do you know where that might be at this time?

CRAWFORD: The only thing that I know of is when the information was relayed from first off the ECS up to the ECC, it was written down on sheets of paper, which we have up in the Unit 1 Control Room right now. And then that sheet of paper was given to us. Later on when ECS and ECC were combined and moved to Unit 1 Control Room, those sheets of paper came directly from the radio to us. And all those sheets are in the Unit 1 Control Room. And most of this was basically a copy from those slips of paper.

ESSIG: O.K. These ECS log sheets, that I've termed them, then are actually a summary, sort of after-the-fact summary, yet an ongoing summarization of the smaller sheets of paper, which I believe, each contained a measurement at a single time. Is that correct?

CRAWFORD: That's correct. And I hate to say, I don't think the early ones had dates on them.

ESSIG: Yes. I can verify that. I looked at them and they don't have dates. O.K. Then back to my original question, are you aware of the current dispostion of the original survey sheets that were supposedly filled out by the person actually performing the survey?

CRAWFORD: No, sir.

ESSIG: O.K.

CRAWFORD: I can see that as a big deficiency. I guess I know the procedure about not having dates. Procedures were written up for 2 to 5, or a 10 hour type thing. Not, I guess, 14, 20 days.

ESSIG: Right. And that's a comment that several individuals had been making. The girls have never lasted this long.

CRAWFORD: I can see now that trying to go back and reorganize data that the date is lacking on all our sheets.

ESSIG: Yes. I think there is just one last question that I wanted to ask you, Mr. Crawford, and that was, do you recall who it was that was in charge ... I'd sort of like to ... in charge of the ECS? What I'd like to do is put together ... what we're trying to do is, we have names of individuals that were designated as ... I don't think the position is defined in the emergency procedure, but they are designated as ECS Coordinator. And on the second and third day, we have Mr. Cegaris and Mr. William Potts as being so called ECS Coordinators and they were, as far as I know, they were working approximately 10 hour, I'm sorry, 12 hour shifts relieving one another. And we also know from interviews, that Mr. Tom Mulleavy served as the initial person in charge of the ECS. And I think that you had indicated

that you were ... you came on board at approximately, we'll say approximately 7 o'clock in the morning on the 28th. And you were there for approximately 24 hours initially?

CRAWFORD: 30 hours.

ESSIG: 30 hours.

CRAWFORD: 30 or 32 hours.

ESSIG: Do you recall when either Mr. Cegaris or Mr. Potts ... when they might of taken over as ECS Coordinator?

CRAWFORD: I believe it was sometime in the evening on the 29th.

ESSIG: What did they do the 29th?

CRAWFORD: Because when I left, it was still

ESSIG: Mulleavy?

CRAWFORD: Mulleavy.

ESSIG: O.K.

CRAWFORD: Well, actually, it was ... when I left both Dick Dubeil and Tom Mulleavy were as beat as I was, I guess. Because they had been there about the same amount of time as I was. And they were in the process of turning it over to other people, but it was not Mr. Cegaris at that time.

ESSIG: O.K. But when you came back in, then ... when? That evening?

CRAWFORD: When I came back in that evening around 9 o'clock, I believe Mr. Potts was on duty then.

ESSIG: O.K.

CRAWFORD: I believe in that time period, late 29th and 30th that Mr. Cegaris and Potts took over.

ESSIG: Did Mr. Benson relieve you when you went home right after approximately 30 hours?

CRAWFORD: Yes, he did.

ESSIG: I believe from the earlier interview, we had established that he had gotten some sleep over the Observation Center or something like that?

CRAWFORD: That's correct. He had gotten some sleep through the night, and came in and relieved me in the morning. And I left somewhere around 12 o'clock noon time.

ESSIG: O.K.

CRAWFORD: On the 29th. At that time we had other people in from the Salem plant, and other Health Physics people were arriving. Whom, I don't know, but Tom Mulleavy and Dick Dubeil knew. And they were in the process, I believe of turning over to them, so that they could get some sleep.

ESSIG: O.K.

CRAWFORD: But that's when I left. I just heard some chatter about that.

ESSIG: O.K.

ESSIG: I believe that that takes care of all the questions I had for you. And, so as far as I concerned we can terminate the interview at this time.

RESNER: I assume you don't have any comments Mr. Crawford concerning this. Observations that you would like to share with us?

CRAWFORD: No, I think I said most of my observations in my first interview.

RESNER: O.K. Thank you very much. The time now is 5:21 p.m. And this concludes the interview of Mr. Crawford.