JOINT BRH-OSHA PUBLIC WORKSHOP

ON

RADIOFREQUENCY SEALERS, HEATERS, AND GLUERS

9:00 a.m.
Thursday, September 13, 1979
New Department of Labor Building
2nd Street & Constitution Ave., N.W.
Washington, D.C. 20010

UNITED STATES DEPARTMENT OF LABOR

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

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PARTICIPANTS

BRH

Dr. Zory R. Glaser, Moderator

Mr. Mays Swicord

Mr. Howard Bassen

Mr. Paul Ruggera

OSHA

Dr. David Lee

Mr. Frank Tipton

Mr. Robert Curtis

NIOSH

Dr. David Conover

Ms. Cynthia Robinson

Dr. David West

Also Present:

Mr. Angelo Vassallo

Mr. T. L. Wilson

Mr. Frank Hua-Feng Huang

Dr. Maria Stuchly

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P R O C E E D I N G S

MODERATOR GLASER: Good morning. I would hope that those of you who stayed in town, visitors from out of town, had a enjoyable evening in our nation's capital last night. The weather certainly has been cooperative.

We are starting out on day two of our workshop, that, I understand, was quite spirited toward the end, with some comments. I had an opportunity toward the end of the afternoon to chat with a couple of the participants, and it certainly seemed as though our first day had gotten into some meaty issues. I think our second day will also.

I have had the pleasure of introducing Frank Tipton, who you have already seen and heard from. But perhaps you didn't know just how Frank has been fitting into the program. Frank was the co-arranger for this two-day workshop; and without his effort at the OSHA end, we out at the BRH end would have really been in a bind.

Frank Tipton is a safety engineer with the office of physical agents in the health standards programs area of OSHA. And he will review briefly the program of the first day, for those who may not have had the opportunity to hear and participate yesterday.

I see a few new faces. And I will ask you to sign our guest book. I will take the opportunity also to ask you to please step to the microphone and identify yourself with any of your

questions or comments. Thank you.

Frank?

MR. TIPTON: Good morning. My primary purpose up here is to fill in those of you that were not able to make it yesterday on some of things that we did accomplish yesterday, and to fill in those of you that were here yesterday but, like Bob Curtis, slept through it.

Now, of course, he did us sharp public assurances, on the record, that that was due to his official duties. And so he is excused.

I will also take a few prerogatives here and recap a few housekeeping details and other details that you might be interested in.

First, the things that are important to each of us as an individual and not as a professional. The cafeteria in this building is on the sixth floor. There is a snack bar on the fourth floor, approximately straight over ahead from where we are. And there are rest rooms: there's two small ones immediately to the sides of the stage here; and there are also rest rooms past the lobby and through the double doors at the rear of the auditorium, and also behind the stage and past the exterior doors and also through a set of double doors.

I would also very much wish to underscore what Zory has just said about two things. One, we do have a sign-in roster, a sign-in sheet, in the small foyers just in the back of the

auditorium. Please sign in, tell us who you are, who you are with, and the telephone and paper method of getting in touch with you. Sign-in rosters are the things of which mailing lists are constructed. And I have heard more than once complaints about OSHA, or the government in general, about sending out notices, not having nice mailing lists, not letting people know. Help us help you.

Also, we are having a transcript made of these proceedings. And in order for our recorder to know who you are and what you have said, it would be most helpful, almost a necessity, if you were to step to one of the two microphones that are available to you, and then we can all hear you better and the recorder can be sure of hearing you.

There were some questions yesterday about the availability of the transcript. It will be available from two locations. One is the OSHA docket office, which is in room S6210 of this building; and their phone number is 523-7894, and also the three following numbers, -7895, -7896, and -7897. It will also be available from the FDA hearing clerk office, which is up in Rockville; and their telephone number is Area Code (301) 443-1753, and their address is in the notice of this meeting.

There was some mention yesterday of some NIOSH publications. To the extent that they are available in stock from NIOSH, they can be obtained from the NIOSH publications office in Cincinnati. And the phone number for them is Area Code (513) 684-4287.

There was also some discussion yesterday of some BRH publications, Bureau of Radiological Health. They have a publications office. And their telephone number is Area Code (301) 443-3532.

And in case you are not aware of it, if any NIOSH publications -- and I suspect also the BRH -- are no longer in stock at the agency, they can be purchased from the Government Printing Office. They have their own set of stock numbers and procedures, but I can tell you that the order and inquiry desk at GPO is on the following telephone number: 783-3238.

Yesterday's program was started off with very fine welcoming remarks from the director of health standards programs here at OSHA. And this was followed by some remarks by David Lee, speaking on behalf of John O'Neill, who is the director of the office of physical agent standards; gave us a little bit of history about the OSHA standard on RF radiation and a little information about how we got to the present situation concerning that standard and its enforcement.

We next heard about the regulatory authority of the two agencies sponsoring this meeting. Mr. Walter Gundaker spoke about the BRH, their regulatory authority, the acts that give them the power to do their thing, and some of their procedures. And then Mr. Charles Gordon spoke about the OSHA act and some of its provisions and how OSHA goes about enforcing its rules.

We next heard from Mr. Mays Swicord, who gave us some

details about another bureaucratic function called the IRLG. And for those of you not versed in the alphabet soup of Washington, that is the Inter-Agency Regulatory Liaison Group, which was specifically set up to provide some of the coordination that various commentators say the government is lacking, in this case between the four primary regulatory agencies in the health and safety issues. And he described for us some of the committee that functions under these auspices, some of the details of their activities relating to microwaves, radio frequency energy, and RF sealers in particular.

Next Mr. Zory Glaser, who you just saw, detailed for us some of the uses of RF sealers, heaters, and gluers and some of the properties of this radiation and its use that makes it rather convenient for use in RF sealers, such as the ability to provide a deep-heating effect on relatively non-conducting materials, which is much different than the surface application of heat.

We next heard from Mr. Howard Bassen, of BRH, who gave us all a little bit of review and grounding in electromagnetic radiation and some of the frequencies that are used by RF sealers and how this radiation behaves.

From there we moved on to some of the biological effects literature. And we heard from Mr. John Monahan, of BRH, who reviewed several papers as a group that have spoken to the radiation in the three-to-70-megahertz range. And, in fact, by

explanation, he showed some contradictions. He did review what some of the studies have found, where some of the positive effects have been found, where there were some negative effects, and how this did give us some information about the effects of the lower-frequency RF radiation, but at the same time pointed up so that there are definitely some questions left to be answered. If you consider the fact that we have an ANSI standard at ten milliwatts and some study results that show no real effect at considerable levels above that standard and some studies that do show some biological effects considerably below that standard, obviously, there is something left for us to learn.

Then Zory Glaser got back up here where I am and gave us some more details and explanations on some of what we go through to get some of this biological data, went through modeling and scaling, the using of animals to try and get some useful data as far as humans are concerned, and using frequencies other than possibly the RF sealer frequencies and yet trying to extract from that information that would still be relevant. He detailed for us some of the biological effects that have been observed, and although they certainly can't be considered conclusive, did explain how this might lead us to a certain degree of conservatism when it comes to setting standards.

Then we heard from Mays Swicord again, this time not from the IRLG but for a technical discussion on the near field exposure and how, number one, this does apply to RF sealers or,

the broader term, dielectric heaters and what this near field is, how it differs from what we would normally consider in the way of RF exposures, which is the far field, what this near field means in terms of complicating our life as far as biological experiments go and in trying to take some useful measurements, particularly measurements of, well, let's just say, for instance, occupational exposure.

We next heard from Mr. Paul Ruggera, of BRH, who gave us two presentations, which went over some of the techniques that are used to measure RF energy, showed us some slides of some of the equipment that is currently available, gave us some survey findings of his measurements in the field. And he also described for us some of these units, these RF sealers, showed us some pictures of what they look like, showed us some diagrams of this.

Also yesterday afternoon we also heard from several members of our audience. This was not a day devoted only to agency speakers. And we would hope that that would be continued today. One of these individuals, Mr. Holaday, as a manufacturer, a representative of a manufacturer of measuring instruments, issued a call to the users. He said, "How about you folks that use our little black boxes telling us what the little black box should do for you."

We next heard from Mr. Vassalla, who represents one of the companies that is preeminent in the manufacture of dielectric heaters, who highlighted for us the, shall we say, extreme

usefulness of the products of dielectric heaters, at one point pointing out that most of the hospitals in this country might be put out of business if it were not for the results of these machines, and at the same time publicly declared the commitment of his company to the safety of their employees or others that are using their equipment.

Both he and the next speaker, Mr. Wilson, pointed out two realities of our economic life, or one reality of economics and another one that follows right along, that is, all of our companies in this country have one objective and that is to make a profit, but reassured us that none of them are out to do it at the expense of somebody's health and safety.

Mr. Wilson issued a call to come up with some data of direct usefulness, without modeling and without scaling, to the problem of setting standards, namely, to use as a study population those hundreds, or perhaps thousands, of people that have been exposed to the emanations, the radiations of dielectric heaters for some several years. And we might take a look at what has happened to them.

And then Mr. Frank -- I am sorry, next was Mr. Huang, representing the IMPI, that is the International Microwave Power Institute and their RFI committee, in which he gave the institute's position on various aspects of setting standards, such as it would be nice to have some instruments to make it enforceable before somebody like OSHA issues a standard.

And then Mr. Frank got up and told us, well, it is nice to have mice data, but it would be better to have human data, and underscored for us all that most of us would be a lot more comfortable and eagerly await having real numbers that we know the source of -- I suspect he was referring to the fact that a lot of Soviet literature is supported over here only by abstracts -- and said it would be very nice if we had some good, solid numbers in refereed papers from sources that we could examine and that we knew their techniques.

That, I hope, in a nutshell is what we were up to yesterday. It appears that there are some individuals that are not here today that were here yesterday. I am also glad to see that we do have some people here today, that, even if they couldn't make it for both days, have at least made it for today. And in addition to what Zory has said, on behalf of OSHA I would like to welcome you to the second day of our conference.

Zory?

MODERATOR GLASER: Thank you, Frank.

I ran over to one of the nearby hotels to join another meeting that was in process yesterday. And as I pinned on my badge, I noticed that the little card holder was -- you guessed it -- RF sealer produced. For those of you who may not recognize RF-sealer-produced items, I will leave this in the back for you to take a peek at. And I brought down some copies of the report that we, one of the reports that we, mentioned yesterday, the on

entitled "Electromagnetic Fields in Biological Media," by Stan Neuder. Since there were a number of people who requested copies of it, I was able to get about 50 copies; and I will put those in the back for you. But, in order to help me carry it, I took off the shelf my handy government-issue bag here, and that also is RF sealed, so just another example of some of the many items. I will leave that also in the back. It does have my name on it. It is punched into the back. There will be a pox on you if it happens to walk away.

You will get zapped, is that it?

We mentioned yesterday a couple of reports as well. And I didn't have some of them with me. But one of the reports that I would like to commend for your reading pleasure is an excellent report put out by the National Bureau of Standards, entitled "Measurement of RF Power Absorption in Biological Specimens, 10 to 100 Megahertz." It is NBS Technical Note 687. The author or one of the primary authors, I guess, is Frank Greene, G-r-e-e-n-e; and it was issued in November 1976. Says it is available from the Government Printing Office for a price of 75 cents. And there is a lot of good information in that.

Another report that we referred to is one entitled "Measurement of Power Distribution at Resonant and Non-Resonant Frequencies in Experimental Animals and Models." And that is by Arthur W. Guy and others, University of Washington School of Medicine, in Seattle, Scientific Report No. 11, March 1978. It

is a final report prepared for the School of Aerospace Medicine, Brooks Air Force Base. And I think there is some excellent information in there.

We have some measurements, some surveys, some results of plant visits which we thought you might be interested in seeing and hearing about. There are, to my knowledge, only about five or six separate groups that have been doing these sorts of measurements. I think we have four of those groups represented here today. And I will mention something about the fifth group at the end.

Our first speaker in this session, or this section, is Dr. Maria Stuchly, who is a biophysicist with the non-ionizing radiation section, Radiation Protection Bureau, Environmental Health Center, Health and Welfare, Canada. Maria will review with us some of the results of survey of RF heaters in Canada.

DR. STUCHLY: Thank you, Dr. Glaser. Good morning, ladies and gentlemen. May I have the first slide, please.

During 1979, surveys of dielectric heaters in Canada have been conducted. Information on design and operation of about 200 devices has been collected. And the intensities of the electric and magnetic fields have been measured for 81 devices. The results of the surveys will be summarized and some related problems outlined during this presentation.

That always happens whenever a speaker arranges the slides. I am awfully sorry. I will try later on to make up for

the time. And I hope I will keep within the allocated time. Sorry.

They were upside down, all right, except that the wrong face, the wrong side was facing the screen. So if you just turn them around without flipping, it will be fine.

We can go to the second in order.

Okay, thank you. On this slide is listed the instrumentation which has been used during the surveys. We used several Narda meters; two of them were those newest, less sensitive high-range meters about which Paul Ruggera talked yesterday. Then we used one probe IFI meter, which again was described yesterday by Paul Ruggera. And then, there on the lower right-hand side, the Narda meter is the more sensitive standard meter, which has been available for quite some time.

When we looked at the variety of the designs, we thought maybe it would be worthwhile to divide the devices into some sort of subgroups that would allow us to deal with them better. On the next slide, I -- well, I am sorry, that is not the next.

Anyway, let's keep the slide, then. What we decided, that is, depending on the design of those machines, we can divide them into following types.

The sewing machine type, basically, because it resembles and this is an example, it resembles very much a standard sewing machine.

The next kind we thought would be representative, and

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in this case we, I think, managed to use even the manufacturer's designation, is a turntable type.

Is there any -- all right, you have come to the right order.

Then we also thought that we would have a shuttle tray, which is, I don't have an illustration for the shuttle tray, another kind of, but quite a number of shuttle tray designs you were able to see yesterday.

Then we found sealer that, sealer type that was quite different from all the rest. Basically, it is illustrated on this slide, and I am not sure how well you can see from it, but we called this kind of sealer a pressure-sealed applicator type. The die, the electrodes are inclosed inside another applicator, which before the power, the RF power, is turned on, this external shield is enclosed under pressure. So that the electrodes are inside the box.

We thought that was quite a distinctive device. We identified quite a number of those sealers. However, they were used only in one industry.

Then a separate class of dielectric heaters would be edge glue dryers, as one example is shown on this slide. Dr. Glaser showed other examples yesterday.

Let us look at some of the typical operating conditions of the sealers.

The power ranges from a fraction of kilowatts to about

90 kilowatts.

As you can see, we arranged the sealers here, the heaters here according to those categories. And there are certain distinctions.

If you look at the sewing machine type of sealers, maximum power is only 12 kilowatts. And I am not sure, I think I will learn from speakers who will follow me if they found greater powers in those devices. But I think it is pretty close to the maximum what one can expect.

I don't think our data for turntable sealers is representative at all, because the sample size was far too small.

However, those pressure-sealed applicators, you can see that they are rather powerful devices. And as I will show the survey results, we will also learn that surprisingly, well, not really surprisingly when one considers how they are designed, but without knowing how they are designed one would be surprised to expect rather low low leakage from those devices.

And then looking at the frequencies, the range is quite broad, from about four megahertz to over 50 megahertz. I am pretty sure there are devices that operate at higher frequencies, as well.

Characteristically, and again I can't be absolutely sure, but it seems fairly representative edge glue dryers operate generally at lower frequencies than plastic sealers.

Let's look at typical duty cycles. Average duty cycle

varies from about .11 for unautomated operation to, typically, about 50 percent for automated operation. However, in some, I call it in the worst case, we will see later why it is called worst case, the duty cycle may even approach 75 percent.

On the next slide we have indicated the intensities of the electric and the magnetic fields measured in close vicinity of the electrodes for the sewing machine type of devices. This data on the slide represents mean values for 16 devices.

The measurements were made with the operator as far as possible from the tested device. However, in order to turn the power on and accomplish the sealing process, although it wasn't perfectly sealing because the operator wasn't really sitting in his/her normal position and wasn't handling the material properly, probably those were the rejects, anyway, the operator was about two feet from the device, which we did realize caused some perturbation to the field, as Mays Swicord explained yesterday.

However, on the other hand, we think that this data could be useful in some further modeling studies and dosimetry studies.

From the practical point of view, what is worth underlining here? On the vertical axis, we have the equivalent power density for both fields. For all the devices tested, 16, or there were even about 20 devices tested, for some of the devices the reading was too high for the instrumentation we used, one can notice that always electric field has greater intensity than the

magnetic field. I don't think that this is really surprising when one considers the type of electrodes used.

This may be not so for other types of dielectric heaters.

This is, from a practical survey point of view, an indication that one really can't use just one meter and measure either E or H field. Both have to be measured.

We also have to develop way of dealing with those results. How do we then evaluate the energy deposition and hazard.

This data is also useful in evaluating in finding out what is the exposure to the hands of the operator, as very frequently the operator keeps his or her hands very close to the die.

On the next slide there is a summary of the field intensities measured during the survey. This data is not corrected for the duty cycle. So those are the maximum values measured during the few seconds the power is on.

And here I think I would like to go in a bit more detail through this table. For the sewing machine type of devices, which we measured 33 of them, the mean value of the E fields expressed in the equivalent power density units was 28 milliwatts per centimeter squared. In brackets you can read this 325 volts per meter. The maximum value was 124 milliwatts per square centimeter.

The intensities of the H field were the mean value about 11 milliwatts per square centimeter and the maximum value about 74 milliwatts per square centimeter.

The part of the body that was exposed maximally was the operator's chest. In this case, I excluded the hands. Practically, the hands are exposed to much higher values than those shown in this table if the operator keeps the hands very close to the die. And in some manufacturing processes that seems to be the practice.

Shuttle tray devices we surveyed 16 devices. And the mean value of the electric field equivalent power density was around six milliwatts per square centimeter, the maximum value was 19 milliwatts per square centimeter. The magnetic field intensities were about five milliwatts per square centimeter mean value and maximum intensity of 28 milliwatts per square centimeter.

We found for this type of devices that the part of the body from which we got the highest reading was the head.

I would like to underline at this point that the data for the maximum exposure, the part maximally exposed for sewing machine was rather consistent: it was always the hands whenever they were close to the die and the chest when the hands were disregarded. However, for shuttle tray devices we got quite a distribution of the parts which were maximally exposed. And here, just for the greatest number of the devices, the head was

maximally exposed.

The data for turntable was, the magnitudes of the fields were of the same order as those for the shuttle tray. But here again we need more data.

The pressure-sealed applicators were found to have very little leakage. Here I just noticed on the slide that the sign "less than" is missing from the table. So the field intensities for the electric field were always less than the equivalent of 1.5 milliwatts per square centimeter and less than four milliwatts per square centimeter for the magnetic field. This was the limit of the instrument, the sensitivity of the instrument which was used for this particular survey.

For the edge glue dryers we tested only seven; that were as many as we were able to locate in the country. I am rather doubtful if they are very representative, because, as I previously learned, there were some edge glue dryers found in this country that have produced much greater stray fields. In those specific locations we measured the leakage fields where the operators were standing were very small.

On the next slide it is just another summary of the data previously shown, just simply the number of the devices for which the maximum fields exceeded equivalent of five milliwatts per square centimeter and were less than ten milliwatts and in other categories.

For the sewing machine type we found that 11 devices

had E fields exceeding 25 milliwatts per square centimeter. And those of you who are familiar with the Canadian exposure standard are not surprised why this particular number was selected for comparison. It is simply one of the absolute limits of exposure allowed by the standard for short-time exposure.

On the next slide the survey data corrected for the duty cycle is shown. In this case we used typical average duty cycle and calculated again how many of the devices produced exposure fields exceeding one milliwatt per square centimeter, which is what is allowed for continuous exposure under the Canadian standard, and how many of those devices exceed ten milliwatts per square centimeter, which is the limit of the U.S. ANSI standard.

For the sewing machine type of devices, we found that a substantial number of devices exceed those limits. Accordingly 58 percent of the devices exceed one milliwatt per square centimeter and 39 percent of the devices exceed ten milliwatts per square centimeter.

For the shuttle tray devices, 63 percent exceed one milliwatt per square centimeter, while 6 percent exceed ten milliwatts per square centimeter.

I think we shouldn't really pay too much attention to the turntable devices, due to the very small number that was tested.

The sealed type applicator and edge glue dryers did not

produce exposure levels that were exceeding averaged one milliwatt per square centimeter and ten milliwatts per centimeter squared.

In conclusion, the survey of dielectric heaters in use in Canada has indicated that there is a large variety of devices and that some of them may pose health hazards due to high intensity leakage fields. While some types of heater do not expose the operators to RF fields greater than those permitted by the Canadian standard, for some other types, like the sewing machine type, nearly half of the devices exposed the operator to the fields greater than the permissible.

The results of the survey are indicative of a serious problem regarding potential health hazard which must be addressed. However, this data alone is not sufficiently comprehensive for a conclusive analysis. Only a very limited number of units in some categories has been surveyed. For some units, only one parameter has been measured, due to quite serious instrumentation problems which we have had experienced during the tests.

Further surveys should be performed. The effect of the perturbation due to the operator's presence on the RF field intensities should be determined. Guidelines and/or regulations on performance of dielectric heaters should be considered, to protect the workers from excessive exposure.

I also would like to reiterate some of the problems that already were addressed yesterday. We think that there is a number of general and frequently difficult problems related to

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dielectric heaters that require further study.

First of all, the rate of the energy deposition in the human body exposed to the near field of an RF heater should be analyzed. Biological effects of exposure to the fields having relatively low average power densities but very high maximum power densities have not received sufficient attention and should be studied in addition to all those areas which Dr. Monahan indicated yesterday.

Some of the sealers, as you noticed from the table on which duty cycles were shown, operated with the duty cycle around 10 percent. Therefore, the instantaneous field intensities were quite high, while the average intensities, when accounted for the duty cycle, could have been even within the limits of the standard.

Until the above problems are solved, there is going to be considerable uncertainty in the safety factors incorporated in the possible future performance standards or guidelines for the exposure of the operators.

The last, but not the least important, I would like to underline again that reliable, accurate, and reasonably inexpensive survey instrumentation is very badly needed for routine surveys of dielectric heaters.

Thank you.

Will we have the --

MODERATOR GLASER: Yes.

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DR. STUCHLY: -- questions after our four presentations or --

MODERATOR GLASER: Why don't we take time, if there are one or two questions, for that.

DR. STUCHLY: Are there any questions?

DR. CONOVER: David Conover, with NIOSH. First, I want to commend you for that very useful data you have collected. I just want to clarify a couple of things.

Were your measurements made in the absence of the operator? Or was the operator there? I am little confused. You mentioned --

DR. STUCHLY: The data shown on the graph which showed E field and H field intensities were done with the operator as far as possible from the test area, which in this particular case was about three feet, two or three feet.

The remaining data was taken with the operator in his normal operating position. The probe was located about 15 centimeters, half a foot, in front of the operator, towards the dielectric heater tested.

DR. CONOVER: What anatomical locations did you measure?

DR. STUCHLY: Pardon me?

DR. CONOVER: Where did you measure on the body? You obviously --

DR. STUCHLY: The measurements were done on the level

of the head, the chest, waist, and gonads.

DR. CONOVER: Thank you.

MR. BASSEN: Howard Bassen, from BRH. I have two questions. One is a technical detail: which instruments did you use? I may have missed the mention of those.

DR. STUCHLY: We used for most of the data presented, and specifically the data for the three field measurements without the operator, those two new probes manufactured by Narda. We were fortunate to have them loaned to us, the prototypes for evaluation.

For the operator exposure, in most cases we used H field Narda probe, the one which is, I think, up to 100 milliwatts per square centimeter, and IFI one-dipole meter and we rotated the metering to three positions, which was rather a cumbersome process.

MR. BASSEN: The other question was: did you get any reports while you were at these plants of injuries or medical complaints?

DR. STUCHLY: This is a very important question. We really wanted to get the answers to this question. We were not able to get them for various reasons and it was rather, in some cases, difficult to ask those questions, in other cases we didn't get the answers. So my answer is, no, we don't have any data on this.

MODERATOR GLASER: Howard, I would respond to that by

saying we have received some reports of injuries. And the injuries take two types of categories. One is burns from contact with hot metallic surfaces. Nothing really unusual about that, I would think. However, there were at least two reports of people who had been treated for what was described as an RF burn. And these were, in one case, someone had backed into a sealer, an edge gluer, and received burns that looked like they had been made with the tip of a pencil, in the largest muscle of the body, the gluteus maximus; and that these were treated by a local physician over a period of a couple of weeks, they were long in healing but did heal.

I think, if I may say, if you gentlemen wouldn't mind, let's hold some more of the questions until after we hear some more of the presentations. Perhaps there will be some more general comments.

Thank you, Maria.

The next speaker is Robert Curtis. Mr. Curtis is industrial hygienist with the division of technical support, the OSHA health response team located in Salt Lake City, Utah. And Bob will review with us some of the techniques that he has used for gathering his data.

MR. CURTIS: Thank you, Zory. I do represent the OSHA division of technical support. And basically, we provide technical support to any OSHA inspector anywhere in the country when things come up that are a little bit out of the ordinary or where

we do not have standard survey procedures. And our group, working with other groups, help develop some procedures for future compliance activities.

We also, of course, as being part of OSHA, we represent that agency, which will provide a free survey of your plant, under compliance, of course, but we will do that, at our convenience at this point. It is difficult to, we do have a number of requests, we have very few people doing the surveys at this time.

The first slide. I would like to say that -- why don't we start with the first slide -- I would like to say that we are developing survey techniques. We are doing this in cooperation with the BRH as the lead agency, and NIOSH. BRH specifically will be working with instrumentation and will come up with a survey procedure which will be finalized and tested by OSHA and NIOSH, hopefully, early next year. In the meanwhile, we have enjoyed their cooperation, along with, again with, NIOSH's.

At this point we are using instrumentation built by Narda, the E field and H field probes. And as we have seen a number of times already, the high powered electric field probe, and here in this case I am using the 100-milliwatt equivalent. And I will when I say "milliwatts per centimeter squared" or "milliwatts" I am talking about the far field equivalent. Here I am using the probe, the medium H field probe, which I have found for most situations is sufficient, and, you know, as long as you are slow, you will not burn out this meter very often with RF

heat sealers. Not very often.

Okay, and the next slide.

MODERATOR GLASER: Bob, why don't you comment on the frequency meter in the (UNINTELLIBLE).

MR. CURTIS: Okay. Why don't we turn back for a sec' there. Zory has asked me to comment about this frequency meter. It is down, this one here, it is, we are investigating the possibility of using such meters, because of the proposed standard as a draft in the NIOSH criteria document at this time and as the ANSI proposal at this time are both frequency dependent, so it may be necessary in the future for compliance officers to have some kind of frequency analyzer. This one is a rather inexpensive one and seemed to work fine. It is a digital readout.

There is a lot of problems with most of these kind of meters because of the terrible interference of other machines going on at the same time and this kind of thing. This one seemed to work fairly well. And again, this evaluation will be continued by BRH.

I do have both probes working at the same time here. We are using the larger Narda meters. We have gone both ways on deciding whether or not to have a readout in volts squared per meter squared or milliwatts per centimeter squared. We have about come full circle, just because when I go into a plant the people invariably want to know, "Well, how does it compare to the existing OSHA standard?" and so at this point I have about come

full circle and do give measurements in equivalent milliwatts per centimeter squared.

Now, one of the problems that, you know, Paul mentioned one of the disadvantages with the Narda probes is that we do not have individual readouts on the three antennas, either the H field loops or the dipoles, and so it is difficult, well, it is impossible with the Narda probes, to determine polarization.

Now, we felt that the polarization measurements are, indeed, important, assuming the information we now know, that in terms of the -- I am sorry, the relationship between the position of the man and the polarization of the field, maximum coupling, of course, occurring when they are parallel, so that we did feel it would be important to determine just what the polarization would be for some of these machines.

In order to do this, we just put a dipole, for electric field we just put a dipole antenna into, actually, a Nerf ball; we did this a couple of weeks ago and tested it at Solidyne. Basically, the only reason it is inside the ball is to hold the center of that dipole in the same position. We tried to do this without that centering type device, and it is extremely difficult to wave a probe and get the direction that finally hits maximum. When you do hit maximum, you know that the E field is going along that direction.

And the next slide. And so here is our two ninety-eight Nerf ball with a magnetic field probe, again single antenna

And again we can, we will put this inside the ball, turn the ball.

The next slide. Here I am doing that with the probe standing on a tripod and it is just insulated from the tripod because most tripods have metal in them. And again I am just watching for the maximum voltage. I go back, turn the probe in a little bit different direction, and look for a maximum. I am just, basically, searching for a maximum.

It, surprisingly, does not take as much time as we were afraid that it might. And also we have found out that, unfortunately, the maximum would be expected in that the electric field is vertical at about the waist position. You basically have between the two plates, the edge of the two plates, you have an E field looping back and around. So at the operator position, again in this particular machine, and it appears to be the general case, is vertical at about the waist level.

Okay, next. So we are actually doing, when we come to your door and invite ourselves in or ask to be invited in, we will start an investigation, a compliance inspection, with screening measurements with the operator in position. Now, we do this because, you know, we realize that the operator can be a problem, can influence the field, and because he does influence the field, may result in spurious data. However, we have found that for screening purposes it is a proper technique, it certainly helpful for the manufacturer, because we can be doing our

screening while the manufacturing is in process; we don't have to stop the operators.

Basically, we will screen the area around the body, staying at least three to six inches away from the body. These probes do seem to be sensitive as you get really close to a person and also any metal object. So we are, with that criteria, keeping away from the person a little ways and keeping away from metal, screening the area.

If we have a high field, then we will come back to that machine and do a more detailed survey. We can do 14, 15 machines in a fairly large manufacturer, a moderate size manufacturer, 14, 15 machines, we can screen those easily within, you know, in an afternoon with both electric field and magnetic field. So, hopefully, the inspector will not be imposing himself too long on you or disrupting business too long.

Okay, next slide. Now, one problem after we have, again, identified machines that are potentially above the standard, we want to go back and make detailed measurements. It is hoped that the next inspector, or your consultant if you are a manufacturer, will be able to obtain similar readings as we have. And the only way you can do that is if you take your readings in the same position.

To do this, we have developed a little stick man. Basically, it is just a, well, we originally were going to make him out of Tinkertoys, but I couldn't get myself to take a bunch

of Tinkertoys into the plant. So we have made, just out of wood and blocks, a stick man that has the different anatomical positions marked for both sitting and standing. That is why he has two sets of arms. He can be turned around, so if he is standing would face in, of course, one way, and he can turn around the other way and he sits down.

This has been, this is to demonstrate -- why don't you take the next slide -- another point on this. We did, just for ease of construction, the parts are basically either ten inches or six inches, and there's only a few that are not six or ten inches. And it worked out pretty well for building purposes.

And here we can see Paul Ruggera, this is at Solidyne, standing next to a little stick man and, again, holding the probe in a particular block or position on the stick man, allowing us to make comparable measurements.

Okay, next. Like any bureaucratic agency, we have to develop our own forms for the survey. This is the form that we are now currently using. And I think it will help if we switch to the next slide and we can see sample results. You purposely cannot see the employer name and contact. This was an actual survey result we did, I guess it was, last month.

Basically, besides the identification information at the top, we have the identification of the plant, we also have identification of the source itself, the power output, although, as seen by Conover and other people, the size of the machine does

not seem to have, is not directly correlated with the actual exposure. The frequency, whether it is measured or not, or whether we are just based on the tagging of the machine itself. And the application: in this case it is the sealing of plastic medical supplies. These are blood bags that Angelo mentioned yesterday, about the hospital supplies being made by RF heat sealers, and indeed they are. The operator position and location in this case it is a flat line, automatic feed flat line, and the operator is basically standing in front of the press to make sure that the material doesn't get caught somewhere or to make sure that the sealing is sufficient and we are not getting burned spots, hot spots, and that kind of thing.

The duty cycle, on and off. Because we have at this time a six-minute average exposure, whether that will be true in the future or not, we are averaging. And in this case, two seconds on, four seconds off, that means the RF is only generated for one-third the time. And so the standard for this particular machine, or that particular duty cycle is 30 milliwatts per centimeter squared.

The survey equipment used. And the results of the exposure, separated left and right results, E field and H field, and for the different positions.

Now, the idea, let's bring this -- oh, you can't do that. Can we bring that up a little bit? So they can, I think they can't see down here at the bottom. The kind of measurements

we are getting, I realize it is difficult for you to see, but basically -- it would be a little bit easier if it holds still, okay -- basically for electric field we do take our measurements in, you know, volts per meter squared, and then I convert them to milliwatts per centimeter squared to report to the plant manager.

This is a pretty typical heat sealer, in that the electric field dominates, and this is what Maria came up with also, electric field seems to be the one that is going to be above the standard more often than the magnetic field. In this particular case, the electric field dominates above the plane of the table. And it switches, the H, magnetic, field dominates below the plane of the table. We can see that because below the plane of the table, at the knee and calf position, the H, the electric field is five and, you know, less than ten milliwatts per centimeter squared, and that is where the H field is still 11, 15, 20 milliwatts per centimeter squared.

The other conclusion you might see is that it is a rather smooth curve. This was nice to find out, because it does aid in our dosimetry experiments. It is smooth in that the, you know, the eye, starting at 53, dropping down a little bit closer to the neck, 80, the chest, you know, 106, 173. In other words, you are not getting -- well, to continue, you know, waist 173, gonads 40, you know, down to less than ten. We have a nice, it is a smooth curve. And that was really helpful, again, for our dosimetry experiments.

It does, however, vary considerably for position. But it is not erratic. It is not a random sampling. And if we, as I say, we do have, we have real concerns about the fact that, in this particular case, the chest, which is 100 or 173, depending on which side of the chest you are on, exposures compared to the upper and lower arm, as you can see, the upper arm were already, were still around 100 but when we get to the lower arm we immediately jump to 1200 and 1400 milliwatts per centimeter squared. That is a difference of about, that is a differnce of ten inches on the little stick man. And so in that ten inches we have, you know, we have gone from 100 to 1200, which demonstrates the importance of having some kind of standard sampling position, particularly if the new OSHA standard, or the ANSI standard, whichever we are working with at the time, as far as OSHA is concerned, it will be the OSHA standard, assuming the partial body versus whole body is not addressed in the new standard. At this point if we consider the lower arm as being the exposed part of the body, we could issue a citation of, basically, almost 100 times the standard. Now, if we go back to whole body, well, maybe we are back down to 40 milliwatts per centimeter squared or, you know, four times the standard. So it is extremely important that we realize this difference between partial body versus whole body and either address it in a standard or realize that if we assume that any part of the body is exposed above the standard, then we are talking about shielding to a level that is

extremely low, particularly for the hands and upper arm.

Just a final remark. And that is that it is proposed that we summarize the inspections that we have done on a yearly basis. We will do that, assuming the proposal goes through, in cooperation with BRH and NIOSH. And also that we are doing these inspections as enforcement and, at this point, have had very little, basically no resistance on the part of the plants we have gone to in accepting the measurements as being credible and in taking corrective actions as necessary.

Thank you.

MODERATOR GLASER: Thank you, Bob. I will take two questions, if there are any. And I didn't mean to give the impression before of cutting questions off at a time when representatives from industry wanted to ask them. Unfortunately, the first two questions were from representatives of the agencies So if there are questions, Mr. Wilson, you had a question before, would you care to take the first one?

MR. WILSON: I am Wilson, private consultant in dielectric heating. In the paper before, I just wanted to comment, for those who are charged with making regulations, that there is a good reason why the automotive trim, or what I think was termed the pressure sealer is shielded and the sewing machine is not.

And one reaons is that the material can be pre-cut and put into a small area, which is then relatively easily confined.

And that is the way it usually is handled. Whereas in some of the garments and where they use a sewing machine type thing, the material has to be rolled or it is very difficult to get into the area where the activity is going to take place.

So that whereas shielding is a great thing, it isn't always practical to do.

MODERATOR GLASER: Thank you. Another question? Yes, sir?

MR. YODER: Yes. I am John Yoder, Y-o-d-e-r, from ITT. In relation to measurements that are made around the body of the operator when the operator is in position, as Bob Curtis discussed, in screening surveys, and the measurements that are made with the stick figure, it is not clear to me. It would seem to me that more accurate measurements, as far as determination of exposure of the operator is concerned, would be made with the operator in position. Is this not true? Or are we getting more accurate measurements when the operator, or when a body, is not in position?

MODERATOR GLASER: I was going to say perhaps Maria and Bob might want to address that. Maria, would you care to first?

DR. STUCHLY: At this stage there is quite a lot of uncertainty under what circumstances we really should do the measurements.

From the dosimetry point of view, the more meaningful would be the measurements where the operator is not at his norma

position, where we can determine what is the unperturbed field.

However, as Bob Curtis mentioned, in practical situation when an inspector goes into a plant, it is very difficult to stop production for any length of time and carry on measurements on every single machine with a stick man. Therefore, whenever the levels are low there is no need for going into measurements without the operator in position.

I think unless substantial developments have taken place recently, and here I would expect some additional comments from Dr. Conover, that at this stage we really have to do both measurements. And after the dosimetry is developed sufficiently then we can decide either one kind of measurement or the other would be sufficient.

MODERATOR GLASER: Bob, would you care to say anything about our experience of two weeks ago, where we left the probe in position and the operator moved in and out of the field?

MR. CURTIS: I would like to just, on that, mention that we have, unfortunately, data going both ways. It would be nice to say, well, you know, if it is always, the operator in position is always, you know, 20 percent lower, or something like that, then that would be useful to know that. However, we are getting data going both ways. Sometimes it is higher with the operator in position, sometimes it is lower with the operator in position.

We were trying to demonstrate that again at Solidyne a

couple of weeks ago. And it is still not decided.

Basically, I am of the opinion that part of the problem is, the probes themselves are sensitive to how close they are to the operator and that they may, in essence, be getting reflection. I say that because you can take some of the probes and touch them and they will always go off scale. And some of the probes don't seem to be nearly as effective.

But I do think that the direction we are headed is in terms of determining the standard absorption rate, or the dosimetry. And so that is why we are doing that without the operator in position.

MODERATOR GLASER: Thank you. The next?

MR. FRANK: Robert Frank, consultant. I would like to know, in all these various discussion you talk about the E and then you talk about the H, each contributing heat, if any, to the body. When we go out to take field measurements I don't believe we are interested in the E as such and the H. We are interested in a total figure as creating possible heat damage to the body.

And the fact that E is so and H is so, I think we need either a summation, either geometrical or mathematical, and come up with a single number that we have to adhere to, rather than two obscure numbers.

MODERATOR GLASER: That is a very good point. And I have struggled with that concept. We have asked people in various positions. In my role at NIOSH working on the criteria

document on RF and microwave, we went to some of our consultants, including people at the University of Utah, and asked that question particular: how do we treat the two components?

For the worst case situation, it seems that we could add the E and the H, add the -- of course, you can't add volts per meter and amps per meter, or even volts square per meter square or amps square per meter square. But by using the concept that has been proposed of the effective, or plane wave, power density you can convert the E component to power density, the H component to power density, and then, assuming the worst case, add the two.

So that, in one sense, if you had a component of 50 milliwatts per square centimeter from the H component and 20 milliwatts per square centimeter from the E component, you could think of that as a 70 milliwatt per square centimeter field.

Now, there are some problems with doing that. But that is my, one of my responses to your question.

Perhaps we can get to that a little bit later in the program. But I am glad you raised that.

The next speaker we have is Dr. David Conover, who is a research physicist with the physical agents effects brach of the division of behavior and biomedical sciences at NIOSH, in Cincinnati. And Dave will review some of his studies and findings on RF sealers and heaters.

DR. CONOVER: Thank you, Dr. Glaser. Could we have the

first slide, please. Could we lower the, dim the lights back there. Can you begin to see now, maybe, a little bit clearer?

Dr. Glaser asked me to talk -- you have to excuse my voice, I caught a cold, a head cold, at an inopportune time -- Dr. Glaser asked me to particularly concentrate on the NBS-developed equipment that we have sponsored. I would like to also give credit where credit is due: and the U.S. Air Force Brooks School of Aerospace Medicine did also sponsor a considerable amount of work on development of this probe that you see here and also an electric field strength probe that you will see in a few minutes.

This is the magnetic field strength probe. And it is tripod-mounted. In the very front, closest to you, you see the loop. And it is mounted on the probe axis and you can rotate the probe handle into three orthogonal positions. The plane of the magnetic field loop is skewed at an angle of approximately 57 degrees to the probe handle, and when you rotate the handle in 120-degree positions then the plane of the loop will describe three orthogonal planes and, thus, you can get three orthogonal measurements and also all the magnetic field components.

Next slide, please. This is just a close-up of the loop. And you see that we have a piece of glass filament tape taping the loop to the probe handle, so that it will maintain this orthogonal position when it is rotated.

Next slide, please. This is the handle portion. There are three detents as you rotate the probe handle. And the

detents are separated by 120 degrees.

We do have two separate loops. And we can cover the range from approximately .05 amps per meter up to 50 amps per meter. We also had this developed for some experimental work, and we have a facility which will generate those types of fields. You may be wondering why we went to 50 amps per meter.

This has been a very durable and very useful probe. It does have some limitations. One is that it is tripod-mounted, and as such it is difficult, or impossible at times, to locate the loop in a particular anatomical position and still have the tripod mounted in some free area around the RF sealers, or dielectric heaters, as some prefer to call them.

Next slide, please. This is a new probe. It is a different probe that the National Bureau of Standards also developed for us and many other individuals also, including the U.S. Air Force again. It is the so-called EDM-2, the second model that they made. And it goes from ten to 500 megahertz in frequency. And it will go approximately from 26 to 2600 volts per meter. And again, probably 2600 volts per meter sounds high, but, as you will see in subsequent data, we have frequently pegged this meter -- not inferring there is a definite problem here, I am just reporting facts. So, as a matter of fact, in some of the subsequent probe developments that we tried to encourage, we also told them that we thought perhaps 3000 volts per meter would be a better design parameter, the reason being

very simple: we get very tired of burning out probes.

Next slide. Also notice on the bottom right-hand side that there is a spacer ball that we use. And we put that on the tip of the probe.

In the next slide you will see another feature that the EDM-2 has, which is very nice, which the Narda does not have and we have been encouraging them to add it but it hasn't quite occurred yet, for numerous reasons. As Bob Curtis and others will tell you, it is very difficult sometimes to find in a plant location in the field a location which is free of fields, i.e., where you can zero a meter with assurance that, indeed, there is zero field. So the EDM-2 we have taken the ploy of adding a shield and this makes it very convenient to zero the meter.

Next slide. Apologize for that one, but you can see the point, and that is where the spacer ball fits. This is important because, as many know, if you do touch an RF, dielectric heater with a probe like this you can easily burn out the probe.

Next slide.

MR. CONOVER: This is a calibration facility again, which, the Brooks Air Force Base also has a similar facility. It operates nominally from ten to forty megahertz. On the outside, some of you may notice the high-powered linear amplifier on the right side, extreme right-hand side, and next to that is some forward reflective power monitoring equipment, some reflectometer equipment, and a signal small, low-level signal generator that puts out about a milliwatt, and then it is amplified by the linear amplifier, so we get about a kilowatt out.

This facility is quite useful in that there is a resonant cavity inside. May we have the next slide, please?

As you can see, we have an animal holder there. We also do animal experiments in this facility. It is a dual purpose exposure and calibration facility. This particular facility has the advantage that for a fairly low input power you get a maximum generated field strength in the cavity area. The copper loop that you see approximately in the center of the slide is the inductor loop for the magnetic field, and will generate a field, again, with relative ease up to 50 amps per meter.

You can just barely see in the upper righthand side of the slide, in the lower part of the slide, beneath the styrofoam support material, parallel plates, and they generate the electric field, and that is also a resonant type situation, and we can generate with that approximately 5,000 volts per meter.

Next slide, please.

I would like to get now into just a summary of some of the results that we have. This is not all the measurements we have, but it is certainly the majority of them. As anyone can tell you who has actually made these measurements, there is quite a bit of effort involved, going to various geographical locations, and we have a fairly limited staff, so we have looked at 12 plants, and looked at various manufacturers, nine in number. We made 1,075 measurements, and you might notice at the bottom of the slide that we have made much more electric field measurements than magnetic field measurements, the reason being very simple. In some cases prior to the arrival of the nardo(?) magnetic field strength probe, we couldn't set up realistically, practically, the NBS tripod arrangement to make the magnetic field measurements. Just geometrically we couldn't locate the tripod in the area. That is the reason for increased number of measurements of the electric field.

Next slide.

Here is an actual situation where Bob Curtis is using the EDM-2 with a spacer on, looking at a very typical type application. Notice how close the operators do sit to the RF sealers, and I noted with interest that Dr. Stuckley's measurements were made with the operator approximately two foot away. I am not sure how far away Bob had his operate away, but I think that is a factor of great importance.

I am not convinced that you have a perturbation-free situation there, and I think there is a lot of additional investigation that needs to be done there possibly with a rig to trip the two buttons simultaneously to bring the press down with the operator, say, what, ten foot away or something like this. I think you are maybe still getting some scattering there.

On the left, you will also see sneaking in the NBS magnetic field strength loop. Next slide, please.

Here is a very typical application also, and you will note, for those of you unfamiliar with the RF sealers, maybe a few, one or two, one characteristic thing is the fluorescent bulb simply tells them that, sure enough, the field is on. Next slide.

Here is a very excellent set-up, and excellent example of what Sheila and Jan do, and I realize there are some limitations This is a machine that we encountered, and even though our instrumentation is fairly sensitive, we couldn't get any evidence of the field for the electric or the magnetic field, and they have a very excellent shielding set-up here. Next slide.

You can see they have the phosphor bronze loops here that are making contact with the bottom portion of the press, as I think Mr. Wilson brought out. That is quite convenient to do when you have a pre-cut product which is smaller than the press, and then there is, of course, the aluminum box, which is attached to the top portion of the press, but of course electrically

isolated from the top part of the press, and it is really quite effective, relatively simple to construct, and really quite cheap. It works very, very well. Next slide.

Here is another very useful situation. I believe that Dr. Stuckley was also talking about just the sheer fact of increased distance from the sealer head, of course, will reduce the radiation levels, and it also allows the production process to be speeded up considerably. Next slide.

This is a summary of the data, the frequency data that we have taken, and as you can see, there is a cluster of unit around 27 megahertz, and I don't think there is much of a mystery of why this is. Looking at the frequency band width allowed by the FCC, it is 160 kilohertz, it is the widest point, and thus you can more easily design from an engineering standpoint a unit which will operate within that ISM band, and then at least from the FCC standpoint you don't have to be concerned about the fundamental power which is radiated. Next slide, please.

I am assuming that Paul Ruggera and Dr. Stuckley and also Bob Curtis are defining duty cycle as I am, and that is the total on time divided by the sum of the on and the off time. Is that right? Okay. Okay, we are all talking the same language. I apologize for those people who are familiar with radar duty cycles. I guess I really shouldn't call it the duty cycle. Maybe a duty factor, as Paul Ruggera said, is a better term to avoid some confusion.

You notice here that we do have a cluster in the duty cycles approximately from a tenth oh, on down to two-tenths in duty cycle, 10 to 20 percent. That is typical of what we have found. What we did determine when we first walked into the survey, we didn't say anything at all, we just stood and watched the operator. We tried to really get a good idea of the duty cycle, the undisturbed duty cycle, not when they were talking to us or anything like that. Next slide, please.

Sorry the top of that is cut off, but the essential information is there. Notice there is quite a distribution in the power output of the sources we surveyed, and I don't think you can really make any telling statements concerning the table other than there is a tremendous distribution, there are a few clusters around three, four, five kilowatts, and then there are also quite a few above ten kilowatts.

As was brought out, and quite accurately, I don't really see much correlation between the nominal output power of the RF dielectric heater and the field strength which you measure. Next slide.

This is the current ANSI standard. It is, of course, soon to be revised, late fall, 1979, I assume, maybe early 1980. This is a 1974 standard. It gives you some reference for the values we are talking about before we actually look at the values that we have measured. Again, this is a reference, just some frame of reference that I would like to start with. It doesn't

necessarily infer that there is a hazard or that there is not. Next slide.

We have tried to summarize the data in some useful way. Of course, since we are putting together and rapidly coming to the end of the development of the criteria document at NIOSH, we wanted to relate our measurements to this development, and also to some of the other standards. Of course, the reason for listing -- these are all compared -- these are all concerning electric field measurements, by the way. We compared these to the measurements, the percentage of the measurements which are greater than 200 bolts per meter. The reason for that is obvious.

Fifty volts per meter, at the time when we made this up, there were several proposals. There were several around 60 volts per meter, so this serves as a useful reference point, and also 25 is considered one of the lower values which may or may not be adapted.

So, again, if you go all the way to the righthand side, you can see the most definitive data. That is for duty cycle corrected, but even when you look at that, and you look at the measurements which exceed 200 bolts per meter, you note that, oh, what would you say, roughly a third of the measurements in the top part of the anatomy, the eyes, the neck, the chest, and the waste, do exceed the current ANSI standard. That is not to infer that there is or is not a problem. It is to say if these measurements are representative at all, that is what will occur.

That is the percentage of the sources which, you know, may be affected if a value like this was adopted. Next slide, please.

You can't see it, but this is concerning the magnetic field strength values, and again, the most interesting data to me and the most useful here, I believe, is the extreme righthand colume, extreme righthand side of the slide, and again somewhere roughly around a third of the RF measurements, now, this is a percent of the measurements, not a percent of the units, percent of the measurements which exceeded .5 amps per meter, and I believe that numerous standards are contemplating adopting .15 or .16 amps per meter, so you have roughly a half of the measurements will exceed that particular value, and again, that these are representative, and they may or may not be. It is a sample look at reality. Next slide, please.

We also looked at just the average field strength values, the arithmetic average for all the RF sealers by anatomical location. You can still see, even with the average for the electric field, the average electric field strength, you can see for the duty cycle corrected column that if 60 volts approximately 60 volts per meter were adopted, it looks like a considerable number of the sources would exceed that value. Also, on the extreme righthand side of the slide, if .16 amps per meter were adopted, it looks like quite a few of the units as they now stand would not be in compliance.

Then, the final slide, I think this is really very

useful. There are several things that are noted here. First of all, we have noted the number of sources which meet certain criterion, and also the percentage. On the extreme lefthand side you have the electric field strength in volts per meter, and the values there for reference purposes are 25 volts per meter, 50, and 200 volts per meter, particularly at the number of units, first of all, in the very bottom part there, corrected for duty cycle, and those, the number of units exceeding 50 volts meter meter, 77 units or 96 percent of the units measured did exceed 50 volts per meter.

Moving over to the magnetic field strength side, I note again if you were to look at the number of units which are duty cycle corrected, and which exceed .15 amps per meter, it is 52 units or 80 percent of the units exceeded the particular value of .15 amps per meter. It gives you some look at what may occur if various values are adopted by OSHA, BRH, whomever, if there is no shielding, and I want to also emphasize that these measurements were made with the operator in position so that it is very difficult to compare those with the measurements made in the absence of the operator, as I think was suggested by Dr. Stuckley and Bob Curtis. I think it would be useful to make measurements with or without the operator at this point.

Thank you very much.

MODERATOR GLASER: I would like to make a suggestion, that if there are one or two burning questions for Dr. Conover,

we go ahead and look at those questions now. Since I see no one rushing to the mike -- all right, please. While you are going to the mike, what I will suggest is, after one or two questions, we might take our coffee brake, and with Mr. Ruggera's permission, we will hold his presentation until after the coffee break.

Yes, sir?

MR. FRANK: Robert Frank. After taking probably 200,000 or 300,000 readings on the various manufacturing units I have witnessed, and watching these operators sitting at the machine in operation, the numbers shown as duty cycle or duty factor, whatever you want to call it, time on, time off, that would be a manufacturer's dream. Would he love to have that kind of production. If you watched him in action, you find the following. They stop in the morning, when the machine is cold. It takes them probably half an hour before they get to a point where the product coming off the press is acceptable, some rejections throw aside.

They talk to each other, getting familiar. There is a coffee break, the toilet break. There is the five minutes it takes to take the unproduced material, the product, to be brought to the machine, when she is finished or he is finished producing the item, sealing it. He has to count them, move them. Some are on a piece basis, some are on a batch basis, and they have to be moved away. This takes time.

I would say that all these duty cycles over an

eight-hour period, if they work eight hours, taking out coffee breaks, taking out toilet breaks, taking out all the varis breaks, if they average half of that, I think the manufacturer would be very happy, and that should be taken into consideration. Walking into a plant in the afternoon, everything is humming along pretty well, and watching somebody work for 15 or 20 minutes, there is no indication of the productivity.

Count the number of items they made, divide it by the number of hours plus the time it takes to seal them, and you will be amazed at the small percentage of time the operator is subjected to these so-called high levels.

MR. CONOVER: Your observations are correct. I agree with you. We did sample -- via the technique as advised by ANSI, the six-minute average. Now, if you quarrel with that technique, that is your prerogative, but that is the way in which we did sample, since some of these standards which may be promulgated may include, and appear that they will include that six-minute average. Again, if you quarrel with that, that is your prerogative. That is the way we took it. I agree with your observations. That is what I have seen also. These are the duty cycles during actual operation.

Of course, there is quite a difference, too, whether there is incentive work. In many of these plants, there is incentive work when they reach greater than 110 percent of their so-called expected production, then the amount that they make

increases rapidly above that 110 percent, so that has to be considered, too.

MODERATOR GLASER: I would add to that that I have observed in a number of places where the person operating the sealer does not move the material, that someone else brings the material to be sealed to them, and takes away the finished product, and I guess in two cases that was a mechanized system where they sit along a conveyor-type belt and a basket or a bin of material is deposited to them as they send off the finished material, but your point is well made. I don't think the duty cycle was meant to imply productivity as much as the ratio of the on time to the total time in the process.

Yes, sir. One more question?

MR. HUANG: Hank Huang, H-u-a-n-g, of DuPont Company. So far the survey reports we have heard concern radio frequency heat sealer, but we also at the same time emphasize both electric field and magnetic field measurements, presumably because we are measuring near field exposure. Has there been any report on actual physical damage by magnetic field exposure - and if so, has any plan in any of the agency to survey magnetic field exposure for people working around high frequency induction heater, working between one to ten megahertz? There are two questions.

MODERATOR GLASER: Mays, would you like to respond?

MR. SWICORD: The difficulty that has been suggested

with the magnetic field at these frequencies is due to the induction of an electric field within the body, and that induced field causes currents within the body and absorption of energy. It is not a direct interaction with the permeable materials of the body that we are concerned about. No one has really studied direct interactions of magnetic fields in the sense that you are implying, I don't think.

I shouldn't say no one but it is far less studied, but the emphasis that we have been placing on the magnetic field in this particular workshop has been due to the induction of an electric field within the body inducing currents and causing absorption.

MR. HUANG: So therefore, if any of the so-called combined standards that Dr. Glaser mentioned about combining E_2 plus H_2, probably need to, since we are talking the same phenomenon, probably would need to scale down by half or something, isn't it?

MR. SWICORD: Well, what I was indicating was one of the possibilities that could be done with the E and the H field data. I didn't mean to imply that that is the way it will come out. As a matter of fact, that is not the way it is being looked at right now.

I would like to save that for later, but in response to the first part of your question about studies on any reports on the operators and injury and so on, we have a little bit later

on in the program a presentation which will address some of those considerations, so if I can hold off on that, I will do so.

Frank, did you want to make your point before we take a break?

MR. TIPTON: I just wanted to make a couple of short announcements. I mentioned the signing roster earlier. If during the break you could make an effort, all of you, to make sure that you have signed in, I will attempt to get this list duplicated so that you can have a copy of it this afternoon. If I am outstandingly lucky, I can get it typed.

Also, I would invite you to give us any sort of evaluation comments on the workshop that you would like to. I have some sheets in the ante rooms in the back, or after the meeting, after you get home, you could send them in to either myself or to Zory at the addresses in the notice. The things I am talking about are in the sense of a critique, things like the value of this type of meeting, this meeting in particular, and comments about the topics and our agenda on these two days, and anything else that you think might be relevant.

Thank you.

MODERATOR GLASER: Let's take about a 15-minute break and then resume promptly at ten minutes after the hour.

(Whereupon, a brief recess was taken.)

MODERATOR GLASER: Continuing on, we will return to the session

on the review of RF measurement results from field visits and plant surveys with Mr. Paul Ruggera, special products engineer with the Electromagnetics Branch, Division of Electronic Products, BRH. Paul?

STATEMENT OF PAUL RUGGERA, BRH

MR. RUGGERA: Thank you, Zory.

Before I get started, and before it slips my mind, I mentioned that we are trying to update our information as much as we can on these, like the survey that we did yesterday, you know, contact me, and if you do wish to volunteer some information my assistant's name is Billy Nesmith, and he is probably the one who called you people and got the information. THat is N-e-s-m-i-t-h, and the same phone number as mine, which I guess will appear on the record, 443-3840, Area Code 301. If you have any information that you wish to share with us in this process.

Concerning the surveys we have done, I essentially elected to select one particular plant, well, actually, two plants. I haven't been around as much as Dr. Conover has and some of the others, but when we have gone, we probably did a few things a little differently, and tried to get a little different measurement, sort of to compliment the other people in their endeavors.

You sort of saw a smidgeon of that yesterday. All I want to do on that data is not delve on it too much, but to show you that all machines do not look as bad, for example, in the spectrum. The amplitude modulation is different for different

machines, and a few other points. I hope this won't take too long, as I know I have been up here before, and you may be getting tired of looking at me, but if I could have the first slide, this is the production of the oil boom slicks, the barriers to hold them in, just keep them off-shore. I think at this time they had contracted for 15 miles of this stuff. You talk about a high production rate. I noticed that these people worked literally from the time they came in in the morning, from 7:30 to 10:00 continuously, and the duty factor there was real. I had no problem at all finding an hour period that they did not even break.

But what I want to emphasize here is something that has been brought up. It is certainly not resolved. It is my attempt to see what I could see different in taking a measurement with the person there, as I am showing you with my Southwest Research, and if you could flip to the next side quickly, with the person backed off a little bit. Granted, he wasn't too far away, but then I couldn't get too much further away. The one disadvantage to the instrument that you see there is that it weighs about 12 pounds, and I just can't balance too much better than what I am trying to do there, so granted, there will be a variability, but let's see what the fields look like. Next slide, please.

This is the comparable E field plot to the magnetic field you saw yesterday. I will show you the magnetic field next,

but right now let's just look at this for a minute. Just taking two positions along the height of the person, roughly at eye level and roughly at waste level, so we won't clutter up the slide, I will show you a distribution along the body later, but we are talking in the range of 670 volts per meter by 50 volts per meter.

Maybe at this point, since all my readings are in volts per meter and amps per meter from here on out, we will -- Roughly 500, 600 volts per meter, we are talking about electric field. So we are talking somewhere between -- well, almost near 100 milliwatts per square centimeter equivalent. Now, remember from the slide these people were not positioned where most of the measurements reported today were positioned, that is, dead center of the machine. These people are standing alongside of a machine with a large bar on it.

The next slide, the current, the amps per meter values, five amps per meter, 6.6 amps per meter. Again, with the oeprator removed, I got an increase. I guess I didn't point that out beofre, but it went from about 600 volts per meter to 800 volts per meter when the operator went away. This is the variability we have been seeing that Bob Curtis mentioned. I happened to have observed a higher level when the operator is moved back somewhat.

But in any event, what does 6.6 amps per meter look like on our scale referring to the ANSI standard? Well, it goes off

the graph. As you can see, 5.15 is the highest value I have. That corresponds to 1,000 milliwatts per square centimeter. Calculated out, I think it comes to about 1,650.

Okay, the point I am trying to make is that I think that with operators in different locations in front of the machine, we may find that indeed the E field may not be the high one, it may then be the magnetic field. It could have a lot to do with the applicator, with the die, with the material being sealed, certainly.

This was a machine that was located, essentially the only machine in the plant, and it was a warehouse building, a very large building.

If we could go to the next slide, this is the distribution I found on the female operator. I have go components for all these things, but this is a summary, this is the kind of data you would get if you added everything up. As you can see, the variation in the field is not very great, 600 volts per meter down to about 400, 6.2 peaking to about 7.5 down to 5.6.

Essentially, the fields around each operator were about the same, is what I am saying. The first two slides were for the male, this is for the female. I really saw no difference between the two. They were symmetrically positioned about the machine, and everything sort of fit into that category.

Okay, so let's look at the next slide. This is sort of

a summary of what we saw. Let's just pick not the highest levels we saw, but let's pick, let's say, 550 volts per meter, and the 6.6 amps per meter, and see what happened. As you can see, there is a mistake in that first one, and we squared 550, and we should have volts squared per meter squared, times the duty factor, which is as we defined before, the time on over the time of a complete cycle, 1.25 for this machine.

As you can see, the 550 volts per meter then ends up as a volts squared per meter reading, volts squared per meter squared reading of 37,812, which is below the ANSI modulated E field standard. However, the magnetic field applying the same criteria to, and here you get a feel for the numbers of the magnetic field we are talking about, 6.6 amps per meter squared becomes 43 amps squared per meters squared, same duty factor. We now end up with 5.44 amps squared per meters squared. The ANSI standard is .25 amps squared per meters squared.

Let's do the same thing with another company, this time on I guess what we are calling today the sewing machine type sealer. Next slide, please.

This is Company B. In this case, I get the same results that have been reported before. t he E field substantially higher, or at least higher than the H field, .5, the standard level. The same criteria. This was a smaller machine. The duty factor is a little bit higher, .23. This time, going through the same thing, we see that the E field is the one that exceeds

the ANSI standard, or as the H field comes nowhere near it, just to point out the variability of the things that we are faced with right now, trying to determine where, how, other things.

Okay, so much for the magnitudes of the data. This is the very graph you saw yesterday. I must tell you that this is not a manufactured defect as far as I was able to determine. The plant operator -- not plant operator, the plant manager, the owner of the place, told me that some objects in the screening were getting hot, metal objects that were laying on the table, for example, across the room, so he fixed it, he returned the machine. The objects did not get hot any more but this is the spectrum I got. This is the one that you saw yesterday. Essentially, it puts out more field strength, at least electric field strength at around 200 megahertz than it does where it is supposed to, in the 20 megahertz region. Is that what it is, well, seventh and eleventh, okay?

Again, we are talkkng about approximately six feet from the table edge of the machine. Just one polarization is all it took. Did this on a spectrum analyzer corrected for antenna factor. This is the way this looked as best as I can determine.

Let's compare that with two other machines. This one centered at 29.94 megahertz, I think much more typical of what you would see in the field, field strength, still the harmonics are up there, but certainly not above the fundamental, and the next slide, please.

This is what they call a stabilized or -- well, a unit that is supposed to stay on frequency. I am afraid to say terms that I have been using now for fear someone from the audience will say, no, no, no, but that is all right. I called it a stabilized unit here, and as we see, this does show a higher fundamental in comparison to any of the harmonics.

All right, let's move on. The other test we did, of course, was with the modulation-- you saw this before also -- in which we determined the duty factor. I want to talk a little bit more about this duty factor variation, even within this six-minute monitoring period.

We find that, as was mentioned earlier, that indeed, there is a warm-up, a body warm-up period for these people to get moving in the morning, and as they have one process, you get more familiar, things just click a lot easier. They can learn to pick up the material quicker, and this sort of thing. So, by taking a stopwatch around and viewing it, we got anywhere from .12 to .2 duty cycle.

At the particular point in time that I had it on the ossiliscope and was looking at it from an engineering viewpoint, I guess, I ended up with a duty factor of .23. So yes, there is some variability, even within this six-minute period.

The 360 hertz modulation we mentioned. I am sure that is just a function of the power line frequency and the halfway rectification that occurs. Sixty hertz, same type thing. We

see that -- I guess this is as good a place as any. This is a storage scope I am using. In the upper lefthand corner you will see that it looks like the picture gets white sort of all the way up. Well, what this is showing is that the machine does not come on to full power nor stay at full power all the time when it is on. We have observed this. If you look at the fields around the machines, and I am sure others have, too, it doesn't necessarily go up there, stay in, and wait. I mean, as the plastic heats, the dielectric changes, the fields change. This is not a steady state process, as shown by the blanked-in version.

Okay, let's compare these general modulation patterns to other machines. In this one, we didn't see the heavy half-wave rectification that we saw before. In fact, the best we could say is, it's got a ripple on it of about 360 hertz. We didn't see the half-wave 60 hertz on this particular machine.

Again, duty factor on this one by the stop watch is .09 calculated from the picture of .11, much shorter. The figure on the lower left is not a very realistic thing. I really did this with a frequency counter, and the output of the spectrum analyzer tied to a tracking signal generator. All I was trying to show there is that yes, we can determine frequency, and therefore, if you try to compare this Unit 1 with the other Unit 1, you will say, well, gee whiz, he is way off on frequency. This is not true. This is just an example that I threw in.

The actual frequency for Unit 1 is 29.94 megahertz. If you look on that, it looks more like 29.2. I just mention this as one of the grahpical oddities. Now, let's go to the stabilized unit again. Here we again pick up the halfway rectification, th 360 hertz ripple. This particular machine had lower duty factors, stopwatch anywhere from .08 to .18. From the scope presentation, .14.

Okay, one other thing that I will mention since Bob Curtis brought it up is that we have tried to do a little polarization sensing to try to figure out if we could map these fields. Mr. Swicord touched on this the other day by drawing his curves around these two plates and this sort of thing, the fringing field. Can we do this? Bob sort of wanted to test out his idea of using a dipole and the Nerf ball, is it, and see if it worked. I wanted to see how close I could come with my orthoginal IFI instrument. The fact that I can get component fields still leaves it a little bit unresolved, because if I draw two vectors like this, I could sum them to add like this, or like this, for that matter like this and like this.

So, there is a little discrepancy or a little unknown. With Bob's method, it proved out well. What are the combined results of the two? I just sort of grew a little viewgraph here of what we found. The heavy arrows there are actually the way that the dipole ended lined up. They checked very closely with what I calculated, giving a little added piece of information that

Bob's dipole was able to provide, that is, throw the vector in that direction. But as you can see here, the fields appear -- I see those little dash lines don't show up too well, but that is one conceptual way that it could be happening. Of course, the arrow heads could be turned the other way. All you have to do is weigh to half a cycle, and you end up going in the other direction, and you could conceivably draw lines going down through the bottom, have the dual type thing, but it looks like at least it is possible, and it makes a little sense, and it sort of matches up, if you pick up the general curvature of the field with what Mr. Swicord was showing you one would expect around one of these receivers.

And I suppose that is a good summary of what I wanted to say. Thank you.

MODERATOR GLASER: Thank you, Paul.

Comments? Yes, sir.

MR. WEINER: Yes. I would like to know if he tried to do the same thing with the magnetic field.

MODERATOR GLASER: Would you identify yourself, please?

MR. WEINER: I am sorry. I am Sheldon Weiner, and I am with OSHA.

MR. RUGGERA: I would ask Bob to respond to that.

MR. CURTIS: As a matter of fact, Zory was working with that. He got them put together, but no, we did not get it to work, but the reason we didn't get it to work, we didn't get it

to respond at all, we've got a problem with our lead, so we had instrumentation problems.

MR. WEINER: Okay. I am interested if you have any conjecturesor if anybody else in the room, for that matter, does as to what the real effect of antenna size of these machines would be and whether in fact it really appears to look like a small linear dipole as it seems apparent from some of the things I have heard and even from those half-baked little lines that you drew, but even that seemed to have that character, and I would like to know if anybody else has any feelings about that.

MR. CURTIS: I was just going to say, I mean, it appears to me that you have got two parallel plates. That is the dominant part of the machine, and you would predict that same kind of field pattern from two parallel plates.

MR. WEINER: The reason I ask the question is because it has been -- I have heard a lot of conversation in recent months about the fact that the antenna shape itself as well as the antenna pattern is very poorly defined in these machines because of the complexity of the circuitry and what have you inside, and I have assumed that that is probably true, but from what I have seen here so far today, and I wasn't here yesterday, it seems to appear that that may not be true, which means the problem is somewhat simpler if that is true than I anticipated.

MR. CURTIS: Yes. Just a quick response on that. I know Dave will probably contradict me on this, but yes, I am

very much more relieved about the complexity of the problem than I was two years or a year ago, and I am hoping that this will really be helpful in our dosimetry. We expect to -- with the help of the RH probes that they are making available for us, and some work with the University of Utah people, we will -- we are modeling, assuming that it is a pretty simple field, as I said before, it seems pretty smooth, and hopefully the probes that the RH is providing us will be able to verify that in fact we can calculate SAR based on a kind of simple parallel plate model.

MR. CONOVER: I am encouraged by Bob's data. However, it is a limited sample size, and when you look at the units physically and you begin to realize how the power gets from the power supply in these units, I have noticed quite often that it is two annodized pieces of aluminum angle iron, and Mr. Frank and others can comment on this, but I have noticed it comes up the back of the machine. It is unshielded. Then it goes up to the top of the machine, where there is like a phosphor bronze loop which goes to the movable top plate, and of course there will be some fields generated by this linkage, and they are talking primarily about the dielectric plates,so I would expect some variation in the electric and the magnetic field of polarization with how close you are relative to the field strength available, relative to your field strength sensitivity of your probe.

MR. WEINER: And relative to the size of all these --

MR. CONOVER: Right. So I don't think it is quite as

simple as we are seeing. Part of it is, and we would expect that, as Bob said, looking at the parallel plates, and classical and well accepted and well proven intent or theory and so on, but I think there is a lot more there. There is more complexity, and I think we are seeing a portion of the total reality.

MR. WEINER: Okay. I have one other question. That is, has anybody made any measurements while these machines may have been in operation, without the material that they were designed to fuse?

MODERATOR GLASER: Yes, we did do that. We put a piece of wood in between the plates, realizing that -- well, let me tell you first what happened. We had some plastic film, heavy gage film that we were sealing, and we found that we had to move the film or we were moving the film for each measurement. We were finding some variability so that we decided, well, it could be because the piece being sealed, the die is moving also, so we said, okay, what we will do is leave the film in the same place, not move the die, just allow the die to cool down.

Well, that was sort of a time consuming situation, so -- but we tried it, but we found that each seal, of course, the plastic material got thinner and thinner. We were flowing the plastic out from between the jaws of the press. So, someone suggested, well, why not use a material that will not flow, and there happened to be a piece of wood handy,and that is what we put between the jaws, and the values became much more constant

at that point. Of course, the thickness of the wood was quite a bit different than the film, so the values were different, but I think there was some stabilization. Of course, the dielectric constant of wood is not nearly what it is of vinyl film.

MR. FRANK: For the past 20 years, we have been running FCC tests under that very condition, but far from using wood. The voltage gradient from the upper plate to the lower plate varies from five to 50,000 volts, the further you open it.

It may shock you, and I recommend for those of you who haven't had any real extensive field experience to stay away from two-grounded, so-called, parts of a 10KW press. One of our test pieces of equipment is a piece of ignition wire. The ends of the ignition wire are taped to two pieces of wood. The ends are cleared, and we can touch the base plates at various points, depending on the various wave forms, and another point two or three feet away and draw a one-inch arc.

Now, you may say, how is it possible for a big, heavy steel base plate bonded, grounded, nut, bolt, screw, whatever you want to call it, to the back plate, to the side plate, to the chassis enclosure. Believe me, you can draw a one-inch spark in many, many of these machines because of the poorness of the return path from the base to the oscillator circuit. It does not take the shortest 60 cycle or 60 hertz path. It takes whatever path it feels like. Maybe it is the operator. If you put a piece of wood in there, forget it. You are drying the wood. That is

what our big drying machines do. And we test our equipment, and this is what it says in our certification papers. The equipment is tested with open press conditions, approximately an eighth of an inch or somewhere where it doesn't arc. Air is the only dielectric between the upper and lower plate. We get constant output, constant frequency, and extremely high radiation patterns, but in spite of that, the theory is, if we can pass FCC requirements under those adverse conditions, there is no way an FCC inspector can ever find one of our machines in production producing a greater output than our sheets call for or show, our data, our charts, our graphs.

The point that you made of the material welding, the press is sinking. As the press sinks, your voltage goes down. Your scope should show a very high peak the moment the power comes on and gradually decrease rapidly in fact to some relatively constant point just before it shuts off. If you continue it longer than that, you have an arc, a burnt out, and a destroyed piece of equipment.

This is the result of many, many hundred thousands of results, and this is the way it is being done in our field. We have a 40-watt fluorescent bulb attached to the side of the machine which comes on, not a two watts but a 40 watts, and when we see that on, that is when we take our measurements from outside the screen, if it is a screen room, or if it is from some distance, if it is a fixed frequency, stabilized, whatever you

want to call it, 27.12. But you cannot depend on wood in that joint because you have created a condition which is fantastically wrong; 20,000, 30,000, 40,000, 50,000 volts impressed across the two plates as compared to five, eight, or ten, what you should be doing when you are operating.

MODERATOR GLASER: Since you are at the mike, if I may ask a question, you mentioned the fluorescent bulbs which we have seen so often on machines. How much power does it take to ignite that bulb in free space with no electrical connections to it?

MR. FRANK: Well, about six weeks ago, in a very big room holding some 40 units out in Rhode Island, we had the amazing fact come up where one eight-foot tube about 20 feet away from the machine we were testing, and only that one machine out of 40, ignited that tube in the ceiling, that one eight-foot tube. None of the other 20 or 30 tubes in the room came on. No other machine of higher or lower power ignited that tube. Why? A combination of pickups, inductnesses(?), wire lengths, antenna lengths, wave lengths of that particular piece of tubing, transformer, the starting, whatever you want to call it. Something does it in every -- I was testing that machine by watching that particular tube. It was closer to where I was.

Does that answer your question? I have no idea how much power it takes to write that little two-watt unit you have.

MODERATOR GLASER: The point I guess I was wondering was if there is enough power to light the bulb, then perhaps that much

power is also being,or the operator of the euqipment is also absorbing that much power, and I just wondered if we could quantify through that --

MR. FRANK: I think I can answer. You made your comment yesterday, somebody did, where they showed a whole rack of dies on the wall. That was a very small rack, a very small number. Some of my clients have literally hundreds of dies, and if you want to be theoretically correct, since the 10KW machine may operate anywhere from half a KW to the full 10KW, you should really take an infinite number of tests to be able to come up with a concrete answer.

Most of the machines that you have taken, there is no question in my mind that we are operating at less than half power. There may be one or two above that, but 90 percent of the machines I have tested running at normal power is at probably about 50, maybe 60 percent of the actual capacity of that machine, and each and every die would have a different pattern, and strangest of all, the building itself has its own common pattern.

The reflection on the ceiling, the wires, the walls, the vertical beams, the floor beams, whether you have a wooden floor, a steel floor, whether you have great big curved roofs made of metal or aluminum, all have a bigger effect, I think, on the radiation in the actual machine itself.

MODERATOR GLASER: I had an experience with an eight-foot

fluorescent tube, since you mentioned that also, in one of the plants, a furniture plant that we went into, where the operator said that a maintenance man had come through one day to put some tubes up in the ceiling, and while the guy was on a ladder a couple of feet away, suddenly the tube lit up, and it scared him, and I said, well, do you think maybe we could try to duplicate that again?

So, we piled up about a half a dozen boxes so that I could climb up and stand on top of them and take a tube out of the ceiling fixture. This was an eight-foot tube. It was removed from the light fixture in the ceiling. I was holding it in my hand, and as I was climbing back down off the boxes, without a climbing harness --

(General laughter.)

MODERATOR GLASER: Again, the tube lit up, and someone took a picture of it. I have it with me, if anyone would like to see what a tube glowing in my hand looks like.

MR. FRANK: Well, you were the body, you were the antenna. You may not realize. If you hung that on two pieces of wood, it would go out. However, this is a rather funny story, and I think it is worth telling. Several years ago an electrician went out to connect the fluorescent light, and the way an electrician works, he stuck his pliers with half of them in his back pocket, and he hung a coil of wire over that plier, climbed up to the top.

As he was doing it, a machine came on. He jumped, and he said, who in the heck burnt my great big muscle? And boy, did he have a burn.

(General laughter.)

MR. FRANK: The coil and the pliers worked too imperfectly for that frequency.

(General laughter.)

MODERATOR GLASER: Bob, did you have another comment?

MR. CURTIS: Yes, just a quick comment on this. As far as the wood, by the way, that was what happened to be convenient. It would have been nice to have masonite or something else, but it was for the purposes of looking at the electric field pattern, and it is not something you can use for doing personnel exposure, nor could you use air, because we do need to know the magnetic field, and of course, when you separate your plates and there is no current flow, you don't have any magnetic field problem, and that would be misleading if you were a manufacturer and trying to protect your employees.

We are looking for some kind of something that can be kind of standardized so we can put between the jaws, a standard piece of plastic that we can take both E and H guild measurements, and it would be nice if it didn't change. Now, that may mean we have to do a water-cooled die that -- Solidyne -- that they recommended or some other media, but that would be something that would be helpful input.

For instance, maybe teflon might work for us.

MODERATOR GLASER: Yes, sir?

MR.HOLADAY: Yes, Reed Holaday. I just wanted to, I guess, make a comment or a request or however you want to put it. We are hearing about a lot of complicated measurements with many artifacts due to the rooms. We are doing a lot of measurements in near fields that may extend out to 40 feet or more. As one does instrument evaluation to determine its worst case errors, let's keep a reasonable amount of practical integrity perhaps is the word. Let's not overmeasure for something that is going to be a half a percent near field to fore field or be it 10 percent.

Keep in mind, I think, that what we are measuring here, you can't expect too much from an instrument manufacturer in some ways when we are measuring in these near fields. Keep in perspective, I guess, is the word I am requesting.

MODERATOR GLASER: Thank you.

Yes, sir.

MR. MAW: Yes, Jim Maw, of Mann Russell, in Tacoma, Washington.

I would like to back up with Dr. Stuchly if I could on the edge gluer information and find out where the probe was located, was the press open or closed, and where was the operator?

DR. STUCHLY: There were two kinds of results I

presented. There was a graph which was taken with the operator as far as possible from the normal operating position. The processed material was between the jaws. When I say as far as possible, this practically means between about two to three feet. Those were the kinds of machines where the operator is normally seated and has to depress either a pedal or a button to start the machine.

The other results which were summarized as the operator exposure were taken during normal working operation of the machines with the operator located at the normal position, which again there is always certain ambiguity. The operator can be half a foot to the right or to the left, and to just try to take the measurement and say the position closest to the machine in which the operator was frequently standing.

The measurement was performed by positioning the probe about 10 to 15 centimeters from the operator's -- at four different places, the head, the chest, the waist, and the gonads. Does this answer your question fully?

MR. MAW: Okay. Did the press have openings, or did you have doors on the opening of the press where it can be closed for any RFI or anything?

DR. STUCHLY: The presses were operating as they normally do, so we didn't ask -- in each case I realize that there are hundreds of dials. The places which we visited, I guess they were smaller places. They usually had not more than a few

dials, and with this measure, a couple of machines would say two different dies and linkage, as expected, was different with different die. It was a standard operating procedure. Nothing that normally is there was removed or added.

MR. MAW: Okay. Thank you.

MODERATOR GLASER: I indicated to you that there were only about five groups that were really involved, at least only five that I was aware of that were making these sorts of measurements. You have heard from four of them. The Bureau of Radiological Health, NIOSH, OSHA, and Health and Welfare, Canada. I am aware of one other group that has made some measurements of this type, and it is a gentleman from Sweden who I met in Seattle at the Bioelectric Magnetic Symposium in June, although I have met them previously and have corresponded with them.

His last name is spelled M-i-l-d, and I think it is Mild, and I just don't know how to pronounce his first name, K-j-e-l-l.

In any event, he has made some measurements on sealers and has summarized his results in a report which he made a copy of for me. It is due to be published in a special issue of Proceedings of the IEEE. I believe it is the January, 1980, issue, which will be on RF and microwave biological effects, and exposure situations, and so on.

I mention that because I think his values and his results are similar in many respects to those that you have heard

this morning.

Incidentally, there is also a picture of him holding a fluorescent lightbulb near a radiating device in there.

Well, I would move along to our next session, which is entitled Report on Studies of Operators of RF Sealers, and we actually have two groups that will be talking to us. The first is Ms. Diane Byrne of the Univeristy of North Carolina, who has been involved in a study, and I will not steal any of her thunder. I will welcome her up to the podium.

While she is coming, I will say that there are some copies of the Federal Register notice entitled Radio Frequency Sealers and Electromagnetic Induction Heating Equipment Manufacturers' Applicability of Record and Report Requirements, which was mentioned yesterday. There are some copies up in the front, if you didn't get a copy of it, and we will also have some other copies announcing this workshop in the event you didn't happen to get one but would like to have it. I think after lunch we will have those and we will put them up in the front.

STATEMENT OF MS. DIANE BYRNE, UNIVERSITY OF NORTH CAROLINA

MS. BYRNE: Let me mention that I represent the Occupational Health Studies Group of the University of North Carolina. We are associated with the School of Public Health of UNC in Cbapel Hill, North Carolina.

Several of you have mentioned that there has been a great need for epidemiological studies on humans that are exposed to radio frequency feelers, and we have done such a study. I have to say that we have done half of the study. We have looked at an exposed group of workers. We have completed health data, and we have taken RF measurements on the exposed group. What we are looking for now is the control group. We are in a unique situation where we have the exposed and not the control, and I would encourage any of you here who represent either industry or unions to possibly volunteer to serve as a control group for us.

We are looking for people who would have a similar age distribution, race, and sex distribution as our workers, so that we could perform the same methodology which I am going to describe to interview and determine the health status of unexposed workers so that we can compare them to our exposed group.

The Occupational Health Studies Group is rather unique in that we have a contract with several companies of one industry and the union that represents workers in the 48 plants that are covered in our contract. When we complete a study, we do publish the results in the scientific literature. At this point, since this study is only half-complete, I cannot give results. I can only tell you the methodology that we used, and unfortunately, cannot tell you what the readings were or what our

health results are, but as soon as we have a control group, which we hope is in the near future, we will be able to publish our results.

The plant where we took the measurements is a midwestern plant that opened in the mid-1940's. It is a rubber manufacturing -- rubber, nylon, and plastic plant that manufactures outerwear. This is usually rainwear, such as heavy raincoats, ski jackets. The work force characteristics, the plant was 83 percent female, 99 percent white, and the age distribution was rather unique in that about a third of the workers were around 46 or olders; two-thirds of the workers were in their early 20's.

This actually represented hiring characteristics of the plant. They had hired a large number of people in the mid-forties and early fifties and then had recently in the seventies starting hiring some more younger workers.

The plant had three production operations. One was called a conventional line. Here women were standing on either side of a conveyor belt and were applying solvent cement to fabric which had been pre-cut and placed on a conveyor belt. They were applying the solvents and then would attach two pieces of fabric. This is the means of sealing the facbric together.

A second production line had sewing machines, and the women here for the most part finished up the operations. We

would use either stitching that served as decorations, or they would actuall seam garments with the sewing machine. The third production line was the one that used RF heat sealers. There were approximately 25 machines that we took measurements on. The machines were located in one section of the plant, and this section was separated from the rest of the plant by a copper screne to meet with FCC regulations. The screne was intimately referred to as the cage by the people who worked there.

The measurements that were taken were taken by Dr. Conover of NIOSH, and although I cannot mention the readings, they were included in the report that he gave today in the total of the readings that he mentioned.

We did take near field measurements. They were E field and H field measurements taken at the seven body sites that Dr. Conover mentioned, which were eyes, neck, chest, waist, gonads, knees, and ankles.

The machines in this plant varied in a few ways. The frequency range was from six to 32 megahertz. The power ranged from .25 to 25 kilowatts. The on time ranged from one to three seconds. The off time ranged from six to 30 seconds. Some of the machines were operated by one person. Some were operated by two, and a very few of the machines actually had three operators. The third operator, however, usually served to hand fabric to the two operators who actually positioned the machine.

The die shape and the die area were considerably

different on the 24 machines. The dies were circular, rectangular or either strip dies, parallel strip, or they had what we just call miscellaneous, which was a very odd shape, and it was hard to define. The die area was also considerably different on the machines.

The machines were manufactured by two separate manufacturers. The press dimensions were considerably different, and the year of purchase of the machine varied over about a 20-year period. In our analyses we are looking at all of these characteristics that are different for the machine so that we can see if anyone can function as a predictor to tell us what kind of readings we might expect to get.

I would like to go into a little more detail about the actual determination of the health status of the people who were working in the plant. This is the important part of what we have done and can report on. In March of 1977, we -- pardon me. In October of 1975, we visited a plant for the first time for this study, and we conducted self-administered questionnaries. The questionnaires for the most part, the questions that we had were taken from other standardized health questionnaires such as Cornell Medical Index, which has questions that refer to a subjective health status of the person.

It is actually asking the person to answer yes or no to various health status questions to see how they see their own health status. We also used the British Medical Resource Council

questionnaire which asked questions about respiratory symptoms. We used the Rose questionnaire, which is mainly cardiovascular symptoms. We also used questions from the National Health Survey, and these questions mostly dealt with acute disability: how many times the person had visited a physician in the last year or the last several years; how many times they had been absent from work.

In March of 1977, we went back to the plants and repeated the same self-administered questionnaire. At that time, we also had personal health interviews with only the female workers in the plant. We covered various questions that initially we had listed several areas that we wanted to ask questions concerning. These areas for the most part we related to reproductive history, and for every woman who had been pregnant, we gave one major health interview and we gave a separate health interview for each of the pregnancies that the woman had had, so the woman who had been pregnant five times had a total of six separate interview forms.

We were interested to know the outcome of each one of the pregnancies, whether it did result in a live birth, whether there was a miscarriage, a spontaneous abortion, or a stillbirth. The questions were concerned with reproductive history, any congenital malformations that the children of these workers had experienced, any bleeding problems of the workers themselves, either menstrual bleeding or any other type of bleeding problem.

We asked about birth control methods that were used by these people. The reason for this was, we wanted to see if some of them who had had either no children or just one or two children possibly, we were trying to get an idea of whether they had chosen to use birth control methods, and that is why they had not had additional children or no children, or whether there was a possibility of sterility. And we did ask if they knew what -- if they had a problem, if they knew what it was.

We asked questions about central nervous system disturbances. This was a rather lengthy part of the questionnaire, and asked just various types of symptoms that could relate to things such as nervousness if the person felt irritable, various questions that again would be subjective.

We asked about the occurrences of cataracts, since the lens of the eye is known to be affected by heat. We asked about medications used, whether the women were taking tranquillizers, for example, as well as about 10 or 15 other types of medications that they might be using, and we left ample room for them to suggest any other medications that we did not cover that they had been taking.

We asked questions about smoking and drinking, so that we could get an idea again of anything that might act as a confounding variable when we analyze the results.

Then, when we returned to the plant -- this was in March of 1977, and we returned in May and copied job histories on each

employee in the plant. We went back to the beginning, 1940's, when the plant first opened, copied complete job histories on every employee who had worked in that plant from the beginning until that current time. The reason for this was to distinguish the groups who had been directly operating RF machines. If there was a possibility that some perhaps had just operated sewing machines and could sort of serve as the control, we did not find that to be the case.

Most of the women did -- although some did pretty much only operate the sewing machines, these unfortunately were the older women. This was considered a skilled position, and these were the women who had been there for a number of years, and who were in their forties to fifties. The younger women were the women who were operating the RF heat sealers. These women were in their early twenties and had only been working for a year or two years, and could not really serve as a control group for the sewing machine operators.

Also, we have been collecting death certificates on anyone who had worked in the plant and has died since 1963. We perform an annual mortality study for all the 48 plants that are covered in our contract, and this is one of them, so we continue to get death certificates each year and consider the cause of death that is listed also in looking at our analyses.

At this time I can't, as I said, give any results. What I wanted to do was just tell you the methodology that we used

to determine the health status, so that if anyone else is considering such a study, they may look at what we have done, and we would like comments from any group that may consider doing such a study as NIOSH is considering.

Are there any questions, or would you like to wait?

MODERATOR GLASER: Questions would be fine.

DR. STUCHLY: Maria Stuchly. I would like to ask one question. How large is your final sample of the people who actually worked with RF sealers? How many persons are you -- apart from those you have gathering the data, but your sample of actual --

MS. BYRNE: Of actual RF. Over 100. That is all I can say. Which is a large size.

DR. STUCHLY: Personally, I was really surprised by your appeal to us to serve as the other side of the unexposed group. I am sure you are fully aware of the conditions the control group has to satisfy, and I don't think any woman in this room would satisfy those conditions. Age is not enough.

MS. BYRNE: What I was hoping is that perhaps someone from an industry or union may go back to the management and see if they have a plant where there would be women that might serve as a control group. We have been searching for a control group, and have found populations that either are not suitable or are not willing. We need a group that is both suitable and willing to perform as a control group. We have had suitable groups

that -- one in particular that decided not to participate. They did not want to interrupt the normal operations of the plant.

MR. CURTIS: I would like to ask, as far as the BMRC or the other standardized questionnaires that you are using, you can test your population against some norms for those particular -- can you give us anything on those, the results of that comparison as opposed to your new control group, the reason being, of course, that all these people here and of course OSHA, too, it makes a lot of difference on whether we are going home tomorrow with checkbook in hand or whether or not we say, well, let's wait for more scientific data, if there are any hints at all of which direction to go.

MS. BYRNE: Unfortunately, I can't give you any actual results. The nature of a contract is that until the study is completed, we first report to union and management simultaneously and then we are free to publish in the literature.

Are there any other questions?

Yes?

MS. SEGAL: Ellen Segal, from the office of Congressman Elizabeth Holtzman. Are there any other plans to conduct any other studies except for this one plant?

MS. BYRNE: Within the Occupational Health Studies Group?

MS. SEGAL: Yes.

MS. BYRNE: There is only one plant that is covered in

our contract at this time that uses RF. There is a second plant that recently started using RF, but only in the last year or so, and the numbers of female employees in that plant are very small, and they have not had long-term exposures up to this time. We do not have within our plants another suitable population.

MS. SEGAL: Okay. Thank you.

MODERATOR GLASER: Thank you.

On Wednesday, September 20th, 1978, NIOSH published in the Federal Register, Volume 43, Issue Number 183, I believe, Page 42306, a notice of research projects to be initiated. One of those projects was listed as reproductive history study of workers exposed to radio frequency energy. Ms. Cynthia Robinson is here, and will describe some of her involvement in that study.

STATEMENT OF MS. CYNTHIA ROBINSON

MS. ROBINSON: Thank you, Dr. Glaser.

Like Diane, I have no data, either. Our study is still in its preliminary stages. Some of you may have already been contacted by NIOSH regarding it. Today I would like to discuss our reasons for conducting the study, some of the difficulties we have encountered in trying to identify a study population, and briefly describe how it will be conducted, and I would like to say right off that Betsy Eagen, an epidemiologist with NIOSH, has been mainly involved with this study from the beginning, and I have only recently begun to work with her and the other members of

the NIOSH team, Clint Cox and Bob Herrick, Phil Murray, Dave Conover.

Various estimates have been made of the number of workers potential workers potentially exposed to RF in the work place. NIOSH estimates that there are about 40,000 exposed workers. This figure presents a population, a large population which may be at risk of potential occupational health effects.

Previously, it was thought that there were no biological effects at frequencies below 300 megahertz and lower. The potential biological health effects of RF exposure are not yet clearly defined, although RF exposure has been implicated in a variety of biologic changes which have been discussed yesterday.

Of particular interest are reports which suggest an association between RF exposure and reproductive damage. These reports, primarily from Eastern Europe and the Soviet Union, list a variety of reproductive and developmental effects resulting from occupational microwave and RF exposure of workers and experimental exposure of laboratory animals to electromagnetic energy at frequencies in the RF and microwave ranges.

Reported effects from exposure of women to fields of relatively high intensity RF and microwave energy have included changes in menstrual pattern, increased incidence of miscarriage, and decreased lactation in nursing mothers. Retarded development of the feotus and increased congenital anomalies have been noted among exposed offspring.

Laboratory studies have shown that irradiation of pregnant rats with energy at the frequency of 27.12 megahertz at unspecified exposure levels resulted in numerous fetal malformations. The abnormalities seen included those of the central nervous system, eye deformity, cleft pallate, and deformation of the tail.

There is a report of changes in spermatogenesis, or the production of male germ cells among workmen exposed to non-ionizing electromagnetic energy at high frequences in the microwave region but no similar reports have been found for RF frequencies.

Reproductive effects in male experimental animals including testicular damage, debilitated or stillborn offspring, and changes in spermatogenesis have been reported for microwave frequencies. However, no reports of experiments have been found for RF sealers and heaters.

Other allegations have been made associating microwave RF exposure with pancreatic cancer, and leukemia. Unfortunately, the size of the populations at risk in most of these studies have been too small to permit scientific evaluation of the data and make conclusions.

However, all these reports, studies, and observations, when taken together, suggest that the potential health effects in a suitable population of exposed workers should be investigated to see if adverse health problems exist, and NIOSH has

undertaken to do this.

Our preliminary inquiries indicated that the industries using RF heat sealers seem to have a more stable work force, which was important to us, because a stable work force is easier to identify and follow over time, as will be necessary for the NIOSH study.

Subsequent information indicated that one of the most common uses of RF heat sealers was for the sealing of plastic, and the first phase in our study has been to explore the feasibility of locating a suitable population of heat sealer workers. In doing this, we are doing this in conjunction with systematic industrial hygiene evaluation of their work environment.

To do this first phase, we have made several walk-through surveys in plants where RF heat sealing is used. Inclusion in this early phase of the study, however, does not necessarily mean that the plant will be selected for inclusion in the in-depth study. Two of our major criteria for selecting plants to be visited included the number of heat sealing machines located at the company and the number of employees, and of course, companies with a large number of heat sealers usually have a large number of operators.

We figure that a minimum of 300 to 500 exposed men or women employed in RF heat sealing jobs will be needed in order to statistically evaluate whether or not any adverse reproductive

effects exist.

Evaluations of chronic long-term effects would require studying even a greater number of exposed workers. We are also interested in conducting a medical study.

During our walk-through surveys, we found that the heat sealing departments were relatively small with less than 50 or 75 exposed employees. In order to get a large enough number of individuals to study, we will probably have to combine three or four plants.

Also, I think it is really important to note that effects have been associated with both males and females exposed to microwave or RF radiation. Most of the plants we visited so far have employed predominantly females in the heat sealing operation, and so we are really looking for any plants that might have employed men in those areas, because we would like to consider health effects in both men and women. Please contact me or Clint at NIOSH if you can help us with this.

So, the status of the NIOSH study is that we are still visiting plants. We hope to have a study population identified in the next few months. After a study population has been identified, we estimate that it will take about two years to collect the data and analyze it and write a report.

Thank you.

MODERATOR GLASER: Thank you, Cindy.

Involved with Ms. Robinson in this study has been Mr.

Clinton Cox, industrial hygienist at NIOSH, who will describe somewhat the sorts of studies that he has been involved with in connection with the last report you just heard. Clint?

STATEMENT OF MR. CLINTON COX, NIOSH

MR. COX: First let me say that I don't have a prepared talk. Dr. Glaser just asked me to say a few words about my involvement with the study that Cindy was referring to. As an industrial hygiene engineer, my responsibility on the study is to characterize all exposures to the workers, the operators of RF heat sealers, the reason being that you can have content and exposures, so you would want a population that essentially would have zero exposures to all the other agents but only exposures to RF radiation. It is much easier to handle in the analysis.

Basically, we have been to 16 facilities so far looking for a cohort. Of those 16 facilites, we have not found any potential cohort that has had any exposures that in my opinion could be compounded. We have found other exposures, such as, a lot of the facilities have string printing operations where they are exposed to paints, inks. We have found where they have spraying operations, paint spraying to the paints and the carriers which are solvents, to the pigments of those.

We have found urethane foam operations, MDI. We have even seen some lead pouring operations where they are making the letters to print with, but none of these have been in close

enough proximity that I feel they would be at high enough levels that would be confounded. I believe that in all cases we will find that they are very, very low or below detectable limits. So, this basis should not be a problem. When we do the full in-depth studies, we will measure for all of these exposures, so they will be documented.

In the preliminary visits, we have been making measurements of the RF exposure to operators. This has been a sampling. We in most cases have been 10 to 30 to 40 units. We will normally take about a 25-percent of those and random select them and do measurements on them. The operator has men in position. We have been taking measurements as the eyes, neck, waist, gonads, knees, and ankles. We have been -- cycle corrected for the exposure time on and off, as previously defined. Most of the application has been on plastics, but they are making such things as bookbinders, checkbook covers, briefcase covers, handbags, cosmetic bags, waterbeds, but in mo cases it has all been light plastics.

Of the 16 facilities we visited, three of them were in the automobile industry. Those three, I felt, were atypical to what we had seen in the other 13. The operations were such that they were to be well sheltered, because once they start the operation, it is the same one, and it can shelter it well, and the same die is used over and over again for months at a time.

The exposures were very, very low, essentially close to

zero.

So, I have done some analysis -- I am sorry to say I don't have it all with me -- on the 13 facilities that we visited -- of the 13, not including the additional three which would make it 16. Also in this data I have eliminated the compo machines. We have seen some of those. They are usually not located in the area of the other RF dieletric heat sealers. They are essentially zero at the operator position. The reason it was eliminated is that there are very few compos in relationship to the other units, so if I included the three or four that we have looked at it would skew the data for that direction of zero values.

We say that a lot of the dielectric heat facilities we have looked at, we have got zero values, depending on what type it is, and what company, and how it is being used, especially the ones with large rotating table tops. They tend to be lower, but of the 13 I did analysis on, I have just geometric means, which I ran on that data, based on the highest exposure of any body part that we took measurements on, and for the H field the geometric mean was .094 ounce per meter, which is very low. It is below the .5.

For the electric field, the geometric mean was 200 volts per meter, which is fairly high. It is ten millowatts per square centimeter essentially in the fire field equipment. We had maximums as high as 1,222, I believe, greater than that, because our meter was pegged out. That is DD cycle corrected, on volts

per meter, and as high as 6.5 or so for ounce per meter on the magnetic field. We had zero values as low points on both electric and magnetic fields, so the -- to give you a little bit of idea of the distribution, for the electric field, 80 percent of the operators were above 61 volts per meter when being exposed, and 57 percent of the operators were being exposed to levels above .164 ounces per meter.

I am in the process of performing different analysis on the data, and it should actually be completed by the time I get back, because I have got one of our statisticians working on it, and when that is out, I would be able to do more comparisons on brand names, size of units, power output, different types, whether it is stationary, table top, or rotating table tops, this type of comparison, to see if there is anything we can predict based on other characteristics.

When we do the final in-depth we will be looking at all units in those facilities that are participating in the study. Presently I am -- since we have basically been doing all the preliminary sampling that has been done of the person in the position -- Bud Acker, hearing some of the presentations here, will probably try to do at least all units of a person in position, an operator in position and if we can, all units of the person out of position.

That might be hard to do when you have got 30 machines, 40 machines in one facility, to ask the people to disrupt their

work schedules to do all of them. Possibly we may have to compromise and do a certain percent for comparison, but definitely that will be looked at in the final study, but we will be looking at all units then, at that time.

Thank you.

MODERATOR GLASER: Thank you.

If there are any comments or questions, there has been one formal request to make a statement, and I would like to get to that, but -- questions? Yes, sir.

MR. HUANG: Hank Huang of DuPont. I notice that there are people from Congresswoman Elizabeth Holtzman's offie here, so my question is this, and I also know Mr. Golden covered a little bit on this yesterday, but my question is, I would like to get into the record, is there or is there not OSHA standard now on non-ionizing radiation, and is there really a need for a temporary emergency standard at this point? I wonder if I can get an answer on these two questions.

MODERATOR GLASER: Is there someone from OSHA who would care to respond to that?

MR. LEE: I am David Lee. I am with the Office of Physical Agents in OSHA.

The answer is sort of two-sided. Is there a standard on RF? The answer, I would have to say, is yes. The standard as it is written now, there are some questions about it. However, there is a general duty clause. I have no serious problems in

looking at that and saying that there is a standard from that point of view.

The other question concerning emergency temporary standard, we are looking at the development of a standard. I can't say that there is going to be an emergency temporary standard at this time.

MODERATOR GLASER: Thank you, Dave.

I will mention that later this afternoon there will be some comments in the 2:30 to 3:10 segment, and perhaps we will get back to your question, Dr. Huang.

Howard, yes.

MR. BASSEN: Howard Bassen of BRH. You mentioned in your talk the compo machine where there were virtually no fields measured. Perhaps you could discuss that during the shielding discussion this afternoon, but it is just a point that wasn't too obvious, but I think it is very important, and if you could expand on that during the shielding session, I would like to hear about these compo machines.

MODERATOR GLASER: Thank you.

Mr. James Dearing has requested at this time an opportunity to make a statement.

STATEMENT BY MR. JAMES DEARING

MR. DEARING: The answers that were not given to you by the previous three speakers I think we will give you answers to at this time in large part.

My name is James E. Dearing. I am an attorney in St. Louis, and I am here representing the Hazel Company of Washington, Missouri. Now, I would take one moment. We were asked to make comments and criticisms on this workshop. Mr. Bassen made the statement in his initial presentation that he had never been up close to a machine, or never operated a machine, one of these nasty RF sealing machines, and I asked him at the first break if he didn't think it would be a good idea to operate one for the experience of it, and his answer was that he would never voluntarily subject himself to such hazards.

Now, if that is typical of the openmindedness of the agencies that are involved here, then we do not have a workshop there, we have a showcase preliminary to issuance of regulations, and whether that happens or not, I guess only time will tell.

If you want to see what it looks like to operate a sealing machine, the -- I guess you would call him a rotund gentleman on the left there, as was described earlier, Steve DiDiacamo, who is the plant manager of the Hazel Company. If you want, you can turn out the lights and see if he glows in the dark-- he has operated the sealing machine and been an immediate supervisor in the sealing room for 23 years.

His health is good. His wife can attest to his lack of sterility, and he seems to be otherwise unimpaired.

The Hazel Company has been in the sealing business since

1956, approximately. We have data, definitive data going back to 1968, and since 1968 to date, we can show 651 employment years of RF sealing machine. Now, that is 651 years of five days a week normal eight-hour shifts, 651 years, and there has not been one single RF-connected injury or adverse health effect.

Now, that is something that is documentable and provable. I want to ask Dr. Bonney -- Dr. Bonney is a medical doctor from the Washington area. He has practiced for many years. He got active in the occupational and industrial medicine fields back in 1961, when he began to be associated with Hazel. He is now the acting director of the division of Occupational and Environmental Health of the School of Medicine of St. Louis University, and he is also chairman of the Governor's Task Force on Emergency Medical Services in the State of Missouri.

I would also say one other thing about his credentials, and when he talks to you about the medical backgrounds of the employees of the Hazel Company. Washington, Missouri, is a fairly small town. Becuase of the size of the town, just about everybody knows just about everybody else, and what everybody else is doing, so the patients that Dr. Bonney has not directly treated, if there were many problems for other doctors' patients, he would know about them and be aware of it, particularly because of his involvement with the Hazel Company.

Doctor, I think you are eminently qualified in this field. Do you want to give us your findings?

STATEMENT OF DR. SAM BONNEY

DR. BONNEY: If I can correct one statement of yours--Dr. Sam Bonney, B-o-n-n-e-y.

There have been injuries with RF sealers, Jim. These have been, as you would expect, superficial ones, superficial burns of the thermal, and a few initially of more of the arcing type. All of these have been in small surface areas, and all of these, there has been complete healing without any disability, but there have been injuries of that nature, as I think anybody who uses these machines has had similar episodes.

The population in Washington is an interesting one, because as he said, it is primarily a fixed population. The people don't migrate around from job to job. The people who have employment stay in the employment until they are ready to retire.

The work situation at the Hazel plant is such that once they establish themselves in a particular area, they tend to stay in that area, and they don't move around within the plant, and for that reason we are able to identify with a population of approximately 25 people who have had, as he mentioned, 25 people that have had long exposures to RF sealers.

In this group, we did a retrospective study by examining the patient records and using insurance forms and supplementing this with hospital discharge data. This is also easy to do because they all use one major health facility within

the community, so it is easy to follow and look into the discharge data of people who are hospitalized. We use primarily personal illnesses in which there was a time loss. I talked with Dr.Fletcher of our Department of Radiation and Oncology. There isn't a great deal of really good data on human effects yet, and some of the studies that are going on at the present time mentioned by Mrs.Eagen and the girl from the University of North Carolina may develop some things in the future, but we looked at the potentials for eye diseases, for major argon(?) systems illnesses and hemopoetic problems, and central nervous system problems, and found none of these in this data that we surveyed.

There was an interesting group of a population of about 33 females who were in the childbearing ages, and from that population there were 28 full-term normal deliveries, and granted, this is a small group, and you can't draw vast conclusions, but at least in this group there were 28 full-term normal deliveries. There was one girl in this group who had worked for nine years in the RF sealing department, and had three full-term normal deliveries.

The other thing that is interesting about this population and its relative stability is that it is possible to get some idea, because of the relative degree of prominence that I have in the community to find out things about the offsprings of the people from this facility who are now in school and compare these with their particular piers in the school system, and

they all seem to be comparable also. This is an interesting study. It is one that we are going to go into with a great deal more depth, and it will be the subject of a paper, limited as it is, and hopefully it could be used in conjunction with other studies similar, and we will continue this as a constant monitoring program in the future.

MR. DEARING: The principal point that we are trying to make here is that we do not have a -- Mr. Billy made of play dough to play on a computer with, and we don't survey testicles of beetles, but we have live human beings, both male and female, who have survived many years in excellent health, and if there is a need for a regulation on these people who work on these machines, it certainly doesn't merit or justify any sort of emergency definition or requirement, and we have very serious question whether it requires any at all, because there are no demonstrated occupational hazards from RF sealing machines other than would be connected with any other kind of machines.

There is no radiological proof at all in humans, and I think the 651 employment years is a pretty good background from which to draw that conclusion.

Steve or Dr. Bonney will be glad to answer questions. They are far more capable than I.

DR. STUCHLY: I have a suggestion to make, not really a question. I was very glad to hear about the medical side of the story. I think it would be invaluable to have the field tests of

the stray radiation intensities in this particular plant.

MR. DI CIACAMO: We have already had that. I have a copy of that, if you would like to look at it.

MR. COX: If I may make a comment, Clint Cox, NIOSH. We did do some sampling which is included in the data that I presented at the Hazel Company, and it was a sampling of the units. We did not again measure all of them. And I am sorry to say I don't have it with me at the time. I could present the data, but it is available and it is in a report that has been published.

MR. HUANG: Hank Huang, DuPont.

Just a follow-up question. What was the exposure level? Was it below or above OSHA's standard?

MR. DI GIACAMO: Steve DiGiacamo. That is D-i-G-i-a-c-a-m-o.

Two of the machines were found to be over OSHA standards. The rest of them were considerably under, and that probably had to do with the die or the electrode that was probably in the machine at that time.

MR. CURTIS: Bob Curtis, OSHA. I would like to ask just a couple of questions.

Would ovarian cysts be picked up in your medical review?

end 2

MR. DIGIACOMO: I said that the data that I used was for a personal time loss illness. The time loss illness required hospitalization or required a sick leave, then it would have been listed as such on an insurance report.

MR. CURTIS: So in your opinion would ovarian cyst be included or not be?

MR. DIGIACOMO: If it were detected, yes.

MR. CURTIS: Okay. Of course there is that problem. We do the complaints from workers. Three out of the six women that work here have had ovarian cysts. Is there a problem here? Is this caused by the fact that we all work with RF heat sealers. That kind of question we cannot answer without some kind of an epidemiology study, and I'm very encouraged that industry has taken this step. I really support that kind of thing because I think it should be done by industry as well as by government agencies.

I think that we would have to admit that there would be a number of health effects that would not be picked up by that particular study you're talking about, particularly if you're only talking about 35 people, and especially if only two out of the 35 machines, or however many machines, two out of 35 machines are above the standard.

What we are saying is then that if you are exposed well below the standard you will not have any health effects. That does not address the situation of okay, what if you

have a machine. Ideally you would do your study with 35 machines above the standard, and then if we see effects, or we see no effects that tells us quite a bit more.

MR. DIGIACOMO: I would like to ask Mr. Curtis a question, please. Dr. Conover mentioned the new regulations which would be coming out shortly of 60 volts per meter and 1.5.

MR. CURTIS: No, I think I can save this for Dave. That is in a draft, not a criteria document. That would just be handed to OSHA as a recommendation for a standard. OSHA I'm afraid has been guilty of not promulgating the standard immediately after we have received those criteria documents.

MR. DIGIACOMO: How was that figure arrived at? How were those standards arrived at, even if it's just proposed?

MR. CURTIS: I was going to say I might refer that to the criteria document manager and get myself off the hook. At this point I would say the current standard that OSHA is enforcing is the ten milliwatt and equivalent standard, not the new 60 --

MR. DIGIACOMO: The reason I'm even asking the question is if those standards are proposed, then our machines will not be meeting OSHA's standards and that would seriously affect our business.

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MR. CURTIS: Yes. I think the data that Dave pointed out and Maria did too, that in fact most of the machines would be adversely affected if you take that viewpoint, by a standard as low as 60 volts per meter. Most of them would not qualify, particularly if you include partial body exposure. If you include anywhere, if the person's son's hand is above the standard.

MR. DEARING: Well, may I throw in a personal comment on that? It just seems to me that the rule, the reason would be that you would not close down plants indiscriminately because of the chance of a possibility of maybe that something might happen if something happened way down the road. You're talking about a lot of people's actual lives and their day to day present existence against the chance of what might theoretically happen when you extrapolate a beatle experiment against their future being.

MR. CURITS: Well, actually, I'm afraid I've heard that particular position on a number of standards, because we are involved with besides radiation asbestoes, and sure enough, I've heard the plant manager say "I've worked here for 35 years and I've never had any problem with asbestoes," and two years later watched him die of mesothelioma.

I think the only way you can address that kind of

question is with the epidemiology studies and the animal studies. The animal studies have been very good predictors for most agents, been very good predictors of potential problems which we then, not until we go out and count dead bodies or count malformed children do we actually verify.

As a regulatory agency we are obligated, when I go into a plant, to tell that worker and that manager whether or not I think that's a safe operation, and I have to do that on the basis of all the data that's available to us. I can't wait and count dead bodies before I can start citing people.

MR. DEARING: I'm just suggesting that it would be better to do it on the basis of facts rather than speculation.

MR. CURTIS: But again those facts include medical studies and animal studies and in some cases scanning and modeling and that kind of thing.

MR. HUANG: Hank Huang, of DuPont. I know Cynthia wants to ask a question, but if I may cut in to ask a question to the coordinator of today's workshop, could we allocate some time early this afternoon to provide industry a chance to respond to NIOSH criteria document? We would very much like to do so.

MODERATOR GLASER: I think that's indeed possible. Of course the NIOSH draft of the criteria document on

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radiofrequency of microwave radiation, some copies of an earlier draft were made available for comment and so on. Since that time, the documents have undergone two additional versions. If you would like I could say a few words about it, taking off my moderator hat and putting on my NIOSH criteria document manager hat. I think we could do that this afternoon, yes, sir.

MS. ROBINSON: Cindy Robinson, NIOSH. First, I'd really like to commend Hazel for taking the initiative to do some surveillance on the workers and for sharing that information with us here today, but I think that we should put that information in its proper perspective, because I think that the small sample size would preclude making any conclusions that could be extended to the general population.

Secondly, I wanted to ask if your survey of the 33 women of childbearing age got any information on miscarriages or spontaneous abortions or if any data was obtained at all.

MR. BON This just demonstrates the smallness of the group, but in this group we did not have any evidence of any miscarriages. Now that's contrary to what you would expect for the general population, so that you can't say "Well, gee, maybe RF sealers are more conducive to pregnancy."

There are some women in that department that think that might be the case, particularly the one who has had three.

MS. ROBINSON: Okay. Were you looking only at hospital records or missed work records or did you actually ask the woman or the husband or -- ?

DR. BONNEY: Well, we haven't started going through the facility and probably would not do that unless we did the survey on the general whole plant. We wouldn't want to create mass hysteria in one department.

There is another source available in this facility and that's a worker who has to leave work during the day for some reason, a personal illness, or if they seek something from the first aid room in reference to a personal problem such as a headache or something like that has to go through a procedure whereby this is registered in the book and what they received is recorded, as you would expect.

Reviewing this doesn't show anybody in this department for instance significantly occurring two or three times during a shift repeatedly for aspirins for a headache or something like that. This also is available and this was again of minimal help, but it was beneficial in just a general survey.

MS. ROBINSON: Well, I hesitate to say this, but

maybe you'd like to join the NIOSH study.

MR. DIGIACOMO: Excuse me. I'd like to ask you a question, please, Steve Digiacomo. We have heard a number of times on the reports from East European and Russian countries on the health hazards of RF and that this is what from my understanding perpetrated the United States going into this.

Is there any copies that are available of these reports where we could see some of the conditions that these countries were working under? Are these reports available?

MS. ROBINSON: Yes, sure, and I will be glad to send you copies of the ones that I have referenced in my talk.

MR. DIGIACOMO: Fine. Thank you.

MODERATOR GLASER: I would make one comment, not really directed with what we have just been hearing, but information has come to my attention. The first time it did while I was in a plant, an RF sealer user, that one of the representatives of the workers said to me that he had reports from a number of the operators of the sealers that they were always thirsty.

He said that in some cases it was particularly on hot days that they were more thirsty than otherwise, but that it seemed as though the operators of this equipment

reported that they were thirsty quite a bit.

If a person is being overheated, sweating is one of the ways that the body defends itself by eliminating heat and that could account for being thirsty. But apparently this representative of the workers was successful in bringing this to the attention of the management and they decided that there would be an additional break for the workers so that they could get to a water fountain presumably more easily and also they were installing a water fountain just outside the screened in room.

Now of course I realize that since the operators all worked inside this screened room which was quite an extensive structure, perhaps 80 feet or 100 feet in length, and there were about 12 or 15 workers inside there, that it could be that ventilation might not have been so good inside that screened in enclosure.

But I would ask Dr. Bonney if that is a factor. Have you had any reports of worker thirst untoward or -- ?

DR. BONNEY: To answer your question, not that I have noticed, but you have to understand, these machines do generate heat. I mean not thermal heat, but just heat, and so it's understandable that a particular area would be warmer than a so-called rezoning (?) department.

Our plant is air-conditioned, fully, so we don't have that particular problem.

geometric mean of .04.

For the knees-ankle, zero for the lowest, .53 for the highest, with an arithmetic mean of .23 and a geometric mean of .09.

Now I have not yet broken the companies down to get statistical data on the maximum values. These are broken down for the different parts of the body, I haven't run that data yet, but it will be available for the future when we run the complete program through. It is duty cycle corrected.

MR. DIGIACOMO: Steve Digiacomo. The equipment that you used, I wasn't familiar with it at the time. Was it the same type of equipment that they found to take the accurate readings?

MR. COX: It's the Narda 24450 model with the E field probe, and H field probe, 8644 and 8635, which is the latest equipment from Narda to measure RF in that frequency range that we're looking at.

MR. DEARING: Dr. Bonney and Mr. Digiacomo and I will be there through the rest of the day and will be available if there are any further questions.

MODERATOR GLASER: Thank you for that. I think before we break for lunch, I see someone walking to the mike. Let me ask if there's --

MR. SCHNEIDER: I'm Roger Schneider from BRH. I

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would just like to extend the comment that Ms. Robinson made on the effect of sample size on results that we have just heard presented here. If these workers in this plant had been ionizing radiation workers and had been exposed to doses of let's say if they averaged a 20 year career in this plant and given a dose of 50 rads per year of ionizing radiation, which is far above any limits that would accepted in any country in the world or any plant in the world, you would expect to see less than one case of cancer in this sample, so that is the impact of small sample size.

MODERATOR GLASER: That's a good point. Can I make one suggestion? I hate to cut off discussion, particularly on this issue, which I think is vital. However I'm told that there is another vital issue at this moment, that of lunch and the fact that the cafeteria has a tendency to sometimes run out of some of the entrees beyond 1:00 o'clock. They're still open but you may have a choice of only one item.

In that case, why don't we take a somewhat abbreviated lunch and to try to get us back on the schedule I suggest that we reconvene so as to start promptly at 2:00 o'clock, it being just about four minutes after one now.

(Whereupon, at 1:04, the hearing in the above-entitled matter was recessed, to reconvene at 2:00 p.m. this same day.)

AFTERNOON SESSION

(2:00 p.m.)

MODERATOR GLASER: I would like to say that a couple of people have asked what we meant by the notation on the program for this afternoon starting at 3:55 as "optional panel discussion involving representatives of organised labor, state and federal agencies, sealer manufacturers, consumer and environmental groups, and other interested parties." What we meant by the term optional was that if there was interest in doing that and if we had people who were interested in participating in that, we would do it.

We didn't want to put it on and say "We will have it, because we didn't know if we would be able to get representatives of those groups together. I have been told that there are some people who would be willing to participate. If you would like to participate, if you would be willing to participate, Mays Swicord has graciously offered or consented, I don't remember exactly, but anyhow, Mays said that he would moderate such a panel discussion.

I think it would probably be a good way to exchange some information and maybe get some questions answered and asked and so on. However, I think we would like to have participation from state and federal agencies, we'd

like to have environment and consumer groups represented, we'd like to have the labor sector represented. There was an offer from the industrial group to participate. So if you are interested and willing and so on, please make your willingness known to either Frank Tipton, myself, or Mays Swicord and probably the sooner the better, because with us running a little bit late we could allow our program to fill up that space. However, we can reserve that time slot for that purpose.

Frank, you said you -- ?

MR. TIPTON: A brief announcement here. Give you a lot of other phone numbers and for publications. The OSHA publications office is located in this building in room S1212 and their phone number is 523-6877.

The non-ionizing radiation standard is part of the general industry standard; it's not available separately. We can provide from the publications office one to a customer. If you want more than that you have to go to the Government Printing Office. The cost is $6.50 and if you want to order it that wan again their order desk number is 783-3238.

And I can save you one phone call. The stock number for the OSHA general industry standards is 029-015-00054-6.

MODERATOR GLASER: Thank you, Frank. As we were breaking for lunch there seemed to be a few questions or

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comments. I think we could take time to get to those points if anybody had comments or points. Not seeing anybody rising to make those points, I would like to make two very brief points that were mentioned.

If I could have that slide on, please. While we're getting those on, I would like to just make a comment on another point too. We heard Bob Curtis, we heard Roger Snyder, and we heard Cindy Robinson all make a point about the need for appropriate sample size in doing any study involving humans, and that's a very important point because the normal incidence of certain conditions, diseases, and so on in the general population, the unexposed control population if you will, is some finite number.

If you don't have sufficient numbers to make statistics meaningful, then you come up with a condition, as we heard the physician whose name escapes me at this moment comment that you can come to the conclusion that the conclusion might be drawn that the situation actually leads to an increase in the health or an improvement in the health conditions.

The other thing is that some conditions and some illnesses such as cancer for example, and I'm not suggesting that exposure to radiofrequency energy can lead to the condition of cancer, but some conditions take a certain period of time to develop, for example, well,

cancer is a good example. Sometimes it takes 20, 30, 40 years for cancer to develop.

So without studying the individuals over that long a period, one would never know that a condition would lead to that illness. Thank you.

This slide shows the point that I made about materials handling. What you see in the center of the screen are a couple of RF sealers. The gal in the red and white checked shirt just off to the center is operating one of the sealers and up on the left side just above the middle of the screen, there is a gal with her back toward us operating another sealer. Then the gal just to the right edge of the screen is operating a sealer.

There were three or four sealers all together, and they were along a material conveyor belt where bins of material, raw material to be sealed would be delivered to them at the appropriate time and as they finished that bin of material they put the bin on the conveyor belt and moved it out of the way. So that was one way of handling the raw and finished material and there the operators don't have to get up and move around.

The next slide if I could have it, please. I'm sorry that this is not better quality, and that's why I didn't show it yesterday when I was giving you some examples. This is an edge gluer, and in a furniture plant that did

some veneering. What you see is material sort of moves through this. This was a machine that it was alleged two operators had managed to back up into and received burns on that large muscle and it's also the machine that was capable of lighting the eight foot flourescent tube at some distance.

Okay. Thank you on that. Continuing on with our -- Yes, sir?

MR. DEARING: Jim Dearing, sir, from Hazle, again. Not to belabor the point at all, but I just wanted to pick up on one thing you said. I don't think there's anybody here that would argue with the concept of an on-going investigation to find out if there are deleterious effects from the use of RF sealing equipment.

But I think what our concern is and I think hopefully we have demonstrated to everybody here that our company at least has an interest in the medical well-being of our people. I think that the concern of us and the people representing industry here is that there not be a sudden regulation which comes out and in an overkill manner and says "We don't know if anything is going to happen, and maybe this is the safest thing in the world, but we're not going to take any chances of anything going wrong, and we're going to put you out of business so that nobody ever gets sick."

Now again none of us would quarrel with an investigation and if it does turn out to be that there are improper elements that affect the health, I think everybody would be in favor of doing it. But I think our request to the agencies is that let's do it moderately and let's find out where we're going before we do something. Let's not ruin an industry on a theoretical possibility.

MODERATOR GLASER: Thank you. I have one additional piece of information that I received and I'd like to just describe it very briefly to you before Paul Ruggera comes up. I think it's important to at least acknowledge and then clear the air.

I received a number of phone calls from people who said "We have heard about your workshop; we'd like to provide you with information as you have called for. We have knowledge of injuries." Okay. I spoke to some of these people. Some of them I didn't get to talk to. But one person in particular, Mr. Bill Eden, with the Department of Health and Rehabilitation Services in Tallahassee, Florida, wanted to be sure that I was aware of one situation.

Allegedly two operators were involved in a accident in a plant and to summarize and not to go into all the details, one operator sustained a severe burn on his arm while he was repairing an RF sealing machine. Now from what I could establish it was a situation in which the power to

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the machine was turned on in error while the person was repairing the machine. I can see no other explanation but that this was an electrical energy burn having nothing to do with the RF component.

The other accident was in which a foreman apparently overrode an interlock switch in a sealer and the person working on the machine was electrocuted, and again that was the same situation.

Now I mention these because I think it should be made clear and understood by the community and others that these are pieces of electrical equipment which do have the capability just as other electrical devices of causing burns, injuries, electrocution, but that it's the same sort of thing if you happen to be repairing a home power tool or something of that sort.

If I'm mistaken in that perhaps we could clear that. I see people nodding, so I guess I understood that correctly.

Yes, sir?

MR. DIGIACOMO: Steve Digiacomo from Hazel. Yes, you're right, it is an electrical function of the machine. I'll just kind of give you an illustration of an accident that I had concerning the machine.

1962, if I recall it correctly, I was changing a die in the machine and had my arm caught under the machine

and I received burns from RF and also from the heat of the die. It hurt at the time but I have overcome it. I have had a number of burns on my hands. They take a little while, RF burns, as you mentioned earlier, they are penetrating burns, but they do heal. There's no effects from it that I can see. Dr. Bonneys treated me at that time for those. So it's just a point that I'd like to bring up.

You can get hurt on these machines, but you also can get hurt on a table saw. It's the same difference. Thank you.

MODERATOR GLASER: Thank you. Mr. Paul Ruggera, who you have already heard from a couple of times on this program is back with us to describe some of the techniques for control of stray emissions from RF sealers and some comments on RF shielding effectiveness and the possibility of retrofitting existing sealers.

STATEMENT BY PAUL RUGGERA, OF BRH

MR. RUGGERA: I'd like to think that I was as qualified to tell you people abou shielding as perhaps I might have been earlier with the other speeches about instrumentation. I'm no fool. I know that people out there know ten times more than I know about shielding and ways to implement it.

But somebody had to say something about what we have seen and I guess my eyes are as good as anyone else's,

so let me show you what I have seen and my interpretations of it and take it at that.

The first slide. Well, just a general thing about shielding. I didn't know whether this was going to show up or not. It's the only time I have encountered this in a plant that I was visiting. There is a banner hanging up in the middle of this warehouse place where they're making this oil boom again.

It essentially says for the operators of the sealers to stay at least three feet distance, because burns will result. Now I assume that this means touching it, you get burned.

I didn't say anything to the operators, and in fact I was quite -- I was wondering how come they put this sign up and who put it up. I never was able to find out. But during the day I asked the operator, or he saw me measuring around and he said "What are you measuring out here for?" I was of course measuring around the operator.

He said "You know, that sign up there is so you don't go behind that machine three feet away." He said "Go take your measurements back there." So just to satisfy him I did go back there to take the measurements and of course I found no RF and the electricity looked pretty good to me. It was a fairly good sized cable.

I guess what I'm trying to say is that certainly

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the worker doesn't appear to understand the RF energy, the idea that yes, he can burned, but I think he'd use it as a hot type burn thing. His comprehension is very low.

On the other hand I don't think putting a sign up on the machine saying "three feet away" is very practical. I don't think they will follow that either.

Next slide, please. You will see that these people do have the things on pedestals. This is the same machine. They could have moved those three feet away. They could have stepped back each time. But it's just a matter of well, I think it's more convenient to stand there and push the button. You don't have to walk so far. This could be a lot of walking during the day.

So yes, a remote control type thing where a person moves in and out, at least where he's standing up, is a possibility. As far as a shielding possibility, I think it offers no great solution.

The very first plant that I visited, which was about three-four years ago now, I saw this machine. I asked the person, I said, why is this machine sitting out in the open and all the other machines are in the screen room?

And he says "Well," he says, "that's because this is a really good machine. It doesn't leak radiation." Of course. He also said that when the machine was first installed, that people were getting warm about five to seven

feet away from it.

He said he then called in, I don't know whether it was actually the company who built the machine or a consultant or who, and they made a modification. Now the modification as he described it was essentially that top plate coming over the top of the die. Apparently that was enough to at least cause them not to feel heat at a five foot distance. He said it was very "cool," I believe you people use in the industry, or "hot" is the other term. But he cooled this one down.

So, if I could have the next slide. I did revisit this company again. I just wanted to reconfirm my suspiscions at the time that indeed this is a ten kilowatt machine. They had another ten kilowatt machine in the place that didn't have this plate, and sure enough the emissions from this unit were lower. There's no question, the electric field was lower.

This in my earlier presentation, was machine number 8, the stabilized unit. Even on the spectra, I had to get three feet away to get about the same value, whereas with the other machines I could measure at six feet and get that value of volts per meter. This is for the spectra data which is of course very low field strength data.

So it appeared that just the fact that grounding that and putting it sort of like a half type shield around

it did something.

If I could have the next picture. This is the machine that I mentioned this morning. I referred to it as unit number 3, I believe, the one that the guy had retuned, and he ended up with hot objects in the room, or he actually had hot objects in the room, and he retuned it to get rid of the heating of other metal, other pieces of metal in the room.

Obviously this machine has no shielding at all on it as far as the upper plates.

This is one that I showed you yesterday, the RF type shielding, the bonding. Again like I said I think that this is one way of shielding. It's not really of our major concern at this time.

Could go on to the next one. We then asked Solidyne what they had on the market and this is their latest version of a shielded machine. It has been mentioned earlier today that several of us, Dr. Glaser, Mays Swicord, myself, and Bob Curtis did finally arrange to visit Solidyne and look at this machine approximately two weeks ago.

This was the first opportunity, and we're thankful that Solidyne let us do it, that we actually had to see a machine and then essentially take it apart piece by piece and see what started to happen. It's very difficult

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in the field to dismantle one of these shielded units.

And some of the data that we got of course like the Nerf ball experiment and things like this wouldn't have been possible either, I don't think, in a regular manufacturing facility.

So we did a general survey around the machine and we did find a hot spot on the left side. Let's say the highest leakage point from the machine, I won't even refer to it as a hot spot, turns out to be where the hot lead to the middle plate, the active electrode, sort of ends up in the gap between where the ground comes over to the --

With this down, this area of course becomes in here. There's usually the active electrode in here. It forms like a little loop in there. Okay. Let's zero in on that with the next slide.

You can't see it too well here, but looking at it from underneath, again the hot lead, which has like a channel around the electrode coming up, but there is the active electrode and the shield's on the side.

So we took a measurement there. We said "Why not?" You recognize my laboratory instrument from yesterday, the one built by Southwest research. You can see we're very close, probably two inches, ten centimeters or so. And we did get a reading.

Now I wanted you to leave that one on for a

14 second. What we then said was "Well, how can we lower this reading?" Here we have got a nice confined little area that's leaking. What can we do to see if we can lower it? "

Well, we essentially took another piece of metal and literally paper clipped it with one of these spring type paper clips, one here, two here, just that simple thing of closing a hole, since we were fairly sure it was coming from the electrode.

What did that accomplish? Well, here's what we saw. Essentially the electric field as .32 milliwatts equivalent and 17.7 magnetic field. With the metal clip to the opening we essentially dropped it down by a factor of roughly ten.

As far as the operator region around this machine is concerned, the highest value we got, again at about a ten centimeter distance, was a point that will be shown on the next slide. It's on the righthand portion of the machine, just about in that region there, about where the gap is, somewhere in there.

That value was .01 milliwatts, E .27 milliwatts per square centimeter H. I will be repeating these figures later. You don't have to remember them, because I do have on a table.

But the next thing we did was we removed all the shielding from the machine, or at least let me present it

that that's the next thing that we did, because it will be a better comparison for you.

So if we could have the next slide. You have seen a picture of this before. Bob Curtis showed it roughly. His stick man is in there. We're now at 30 centimeters away. The little white dot you see sort of going up on his stick man are pieces of tape that we used just to pick out certain portions that we would take measurements at, in other words simulating going up and down a person standing then.

We could then compare this very nicely with the shielded data, which was taken at a different distance, but let's look. Okay. With the shielding in place we got the two values I mentioned earlier, the .01, the .27.

At the same position, but now 30 centimeters away we were still getting 130 milliwatts and 14 for the magnetic field. This is quite a difference. As you can see we scanned up and down at the ten centimeter distance and essentially got nothing with the shielding in place.

On both the shields, take them off, the plate's still on the machine now. We move back for ease of measurement and we also had you know completely enough numbers. Really at 30 centimeters we wouldn't have been able to read anything with our instrument, with the shielding there.

I think this is quite effective and I think this

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demonstrates rather dramatically that some things appear to be able to be done.

Now there is one thing and I think as an engineer and as a person who respects the quality of work that has to go into something like this I'm almost obliged to mention and that's the fact that I don't think you can do this without some insight as to what you're trying to do, whether or not you have to go to the extent of buying instrumentation to find out how good your shielding is or whether or not you just base it on experience I think is something that will have to based on experience.

But I don't think just because a person looks at what Solidyne had done, for example, he can go out and reproduce this and get the same electrical effective results. So what I'm saying is I think it's a job for competent people to do and they can do it and I'm convinced of that.

I don't think it's a job for Joe fly-by-night and company out in the boonies out of his garage to go around shielding machines. I think that may be a mistake.

Why do I say that? Well, we conducted a couple of other experiments, just one of which I'm going to tell you about here. We thought "Well, sure, this is a nice thing if you have got a piece of plastic that always fits inside of the machine, inside of that shield. What happens if you actually break this shield and let the plastic hang

out?" Let's say you had a big size piece of plastic.

So here's what we did. Next slide. We laid plastic underneath all the shields. As you can see it's sort of whiteish looking there. I think it was 20 thousandths plastic.

We then took a measurement. This is all going to be referred to that highest operator location point, the .01 that I mentioned before. We did that to simulate a great big sheet of plastic in. The other thing we did was we pulled off the front thing, let the shield exist like it should be in the front, sort of simulating a long piece of plastic hanging out of both sides.

The idea here is how much could we disrupt this shielding and still see some shielding effectiveness. Here's the results. Okay. At the top you see the conditions, shielding in contact with both sides, measurement distance ten centimeters, the .01 and the .27, same figures you saw before, same location.

Plastic strips breaking the contact on both sides of the machine, .01, .40. Electric field still looks about the same, magnetic field increased somewhat. Plastic strips breaking contact on both sides and in front. The magnetic field all of a sudden starts going up quite dramatically.

Electric field increased -- well, from .01 it's quite dramatic, to 2.6, I guess. It doesn't look as impressive.

lb18

But unshielded, now we had to move back to the 30 centimeter distance, three times as far to even get the numbers relative on the same graph, I guess you would say. We're now talking of 130 volts electric field and 14 milliwatts.

Now note very carefully, that is at a 30 centimeter distance. Had we tried that at ten it would have been much higher.

All I'm saying is that even breaking the contact on both sides or in front the shield still appeared to be of some use.

Well, that's what we did, like I say, with Solidyne's blessing and we do appreciate their cooperation in allowing us to do these sorts of things. As Bob mentioned we did get some data that we were not able to get before and like I say I'm sure things can be done and I just hope that if the need come up we do get nice responses from other manufacturers.

MR. YODER: I am John Yoder. For those of us who are beginners, could you tell us the details of the shielding, of the components of the shielding?

MR. RUGGERA: I would ask Mr. Angelo Vassallo if he would to mention what the material is that you're using. This is Mr. Bassallo from Solidyne. He spoke briefly yesterday afternoon.

MR. VASSALLO: Angelo Vassallo, Solidyne. Basically

lb19

the shielding is composed of aluminum material, phospho-borons (?) as you have seen in the slides, and of course it has to be properly caught, bended, and shaped to the proper configuration to match the existing machinery.

I guess I cannot go into all kinds of details of design over the microphone. And strangely enough each piece of equipment requires different shielding and the time source of the tuning is important. You might have to add capacitors, add capacitance inductance in order to obtain a better tuning and reduce the radiation.

I don't know if this will be enough?

MR. RUGGERA: Is that what you were after?

MR. YODER: Not (INAUDIBLE).

MODERATOR GLASER: On the last slide we showed there was that vacuum capacitor was visible. Would you want to comment on that?

MR. VASSALLO: Well, for that particular machine and for the dies we were using we found that that particular vacuum capacitor was helping in reducing radiation and we used it.

MR. RUGGERA: One thing I might say about this is that it turns out that if you can -- these electric fields and and magnetic fields that we talked about -- if you can build a box around them most of the time you can get away with it. The point is how tight do you want to make that box.

As Angelo said, there are other considerations, and that's why the spaces in between, the gaps, you know, it wasn't a solid shield around there. You need a cooling mechanism, you need this mechanism. He adds actual additional capacitance to the circuit to make it even balance out.

I don't know if you recall earlier yesterday Mr. Swicord showed a couple of fields, some coming this way and some coming this way, so that they would cancel. That's exactly what these capacitors are doing is essentially building a field equal but opposite in direction to the one that's really going on.

MR. YODER: The capacitors are the phosphoborons that you talk about, or -- ?

MR. RUGGERA: No, they're elements within the machine that they actually plugged in. I didn't point them out. The phosphoborons thing has its own capacitance, its own inductance, that's why I say it's a lumped element circuit I guess we would call it in some elements. Being a stranger, I don't know how to describe it. It's an art, I think, rather than a science that I throw an equation up and say how it works.

MR. ARUTT: Ken Arutt, Cosmos Electronics and Kabar Manufacturers. If it's of any value, our company has done exactly what I just saw up here on several of our

units recently and I would say within the last month and it did reduce the radiation considerably and we were running some tests in line with some of the information we've been receiving from the various organizations here and we found exactly the same thing, so if that's of any encouragement to anybody, I thought you should know that.

MR. RUGGERA: Thank you for bringing that up.

MR. HERMAN: Bill Herman, BRH. I have another question for Mr. Vassallo. I'm not sure that I understood what he was saying about different requirements for shielding on different machines. Are you saying that you find a need to have different types of shieldings for different units of the same model, or are you just talking about changes in the capacitor, or what?

MR. VASSALLO: Angelo Vassallo, Solidyne. Yes, there are times that units of the same models, the shielding might slightly vary. It depends if that particular unit is used to full capacity. Even though it's the same model, the bed plate, the work area could be bigger.

We have one model that could have a bed plate 36 inches wide and another model that would have a bed plate 48 inches wide.

MR. HERMAN: Is that the die?

MR. VASSALLO: No, that is not the die, that is the work area, but of course with a larger plate, it will

accomodate a larger die of different configurations and that will require a different size shielding, and perhaps adjusted in somewhat different ways. I will be very happy to show you how we do it and what we do if you come to our plant.

MR. RUGGERA: The picture that Zory has just put on the slide is another shielded version we had seen before. In fact, this is the very one that Dr. Conover was talking about that he could measure no radiation from. It's a compo unit, a compo machine.

Essentially the same idea, a little bit smaller phosphoborons contacts, but the same principle is that you close up this gap, you put these electrodes in a box.

The next slide I believe that he has up there, we were referring to these capacitors. These are the capacitors I was referring to earlier. They're located right in here. You see these two glass looking things? If you don't have them there of course you have no current flow up. You have current flow down because you're going through dielectric material, these fringe fields.

If you put a capacitor in there you can sort of balance these two, and since they're going in opposite directions you end up with a net shielding effect of the person standing in front of it. This is another thing that apparently works at least for this machine.

lb23

Is there anything else?

MODERATOR GLASER: We're rapidly approaching page 3 on our program. Actually we're on page 3 of our agenda, but we're rapidly approaching the departure time of a couple of people who have to make planes and other reasons, and one of those people is Bob Curtis from the OSHA Health Response Team in Salt Lake City, who will share with us some comments on perhaps what he and others in OSHA are thinking about. Bob?

MR. CURTIS: My first comment I would like to make is that I really do see this kind of a meeting as extremely useful for the development of standards and the dissemination of information out and the contacts in terms of identifying people that can be useful to both government agencies and the people in the field, the manufacturers and users.

Can we have the first slide, here? Basically the thing I'd like to mention is what OSHA intends on doing on this point, what we are currently doing, and we need to make sure we separate ourselves from the NIOSH criteria document as a proposed standard and what's happening today, as far as OSHA's concerned, because there's a major difference between the current standard and what has been alleged to be proposed. I guess I should say it that way, for Zory's benefit.

1524

First of all, we are developing tests, survey procedures. Again BRH is taking a lead agency role in this under the Interregulatory Liaison Group and under that group we do expect to have the survey procedures finalized by the end of the year and tested even more than they are at this point.

In those survey procedure testing, that will include dosimetry work that's done under OSHA, basically taking a mannikin filled with muscle material and measuring with implantable E-field probes the fact that there is induced current and there is absorbed power by these near field conditions. There really is some concern. So we will do that with both phantom studies and most likely cadavers.

We are also, beyond the survey procedures, we will be training OSHA teams. Right now the equipment is very limited. We have two sets for all of OSHA at this point. We are ordering six sets more. I am to train six field teams to conduct OSHA inspections in the next month.

So OSHA has committed themselves to at least one person within each OSHA region.

We will also be training consulting services. For instance we have done so already for the state of Utah, Colorado. I will be doing that next week in Oregon -- I'm

sorry, that's a couple weeks. Ken Mott, I need to meet with him on that. Basically there will be consulting services available in certain states and hopefully through OSHA contractors.

Meanwhile, however, we have mentioned a lot of questions of both instrumentation, experimentation, the biological effects, and one might say "Well, good, we'll just wait until all these things are done. We don't have to worry about OSHA for a couple of years while they're doing these studies."

Well, the fact is we will be conducting compliance inspections. We have been, both complaint initiated and OSHA initiated. Complaint initiated, I hate to use the word complaint. They are an official form that is called a complaint form. Many of the so-called complaints we get are from workers saying "You know, I'm just working with this thing. I'm pregnant. Can you come and see whether it's hazardous." It's really an inquiry as opposed to you know, "The mean old man is trying to make me work in a field that's hazardous to my health."

So we are responding and we have responded to every complaint that we have had to date and we will continue to do that in the future.

We also will be doing -- it is proposed that we inventory the sources within each region, within each area,

inventory the RF heat sealers and other RF sources, and from those if we run out of other work to do, OSHA can initiate their own inspections, you know, assuming the number of complaints are not so excessive that we don't have manpower to do our own initiated studies.

We will also be testing as we do compliance work. We do like to help industry in terms of solving the problem. The testing of on-site controls includes the engineering controls, which Paul just mentioned to you, and that's why I was involved on that Solidyne trip.

Another one, if you might take the next slide, another alternative was personal protective equipment. Again, we had a manufacturer of protective clothing that felt he'd like to attack this problem because he sees it as a good market, and sure enough, maybe not so much for RF heat sealers, but for other RF sources, and so we arranged to have a test of his suit.

This particular suit is very light weight. Unfortunately -- we had it on a manikin and put an H field probe inside. The levels of disposition by the way are over ten milliwatts per centimeter squared, even though we are about five feet from the -- I guess only about three feet from the machine itself.

It didn't work, as it turned out. In fact, I was a little scared. We started getting sparks and we started --

lb27

It was a nomax (?) suit, which means it cannot catch on fire, but instead the metal vaporized, so we figured -- we were running about 400 degrees centigrade by the time -- at certain points in the suit.

It did not get down in the H field at all, by the way. It may have done something for the E field, except that at the time I'm there in the industry and I've got workers watching the smoke go up I felt obligated not to continue the experiment.

By by the way, this is a company that's a subisidiary of Emerson Electric that is extremely interested in this and if manufacturers or users are willing to work with them they're extremely interested in developing that and I'm sure other personal protective equipment companies may be so in the future too.

Back to the slide, just to get back on the outline here. The third control, administrative control, is one that we do not normally like in OSHA because they're hard to control, they're hard to administrate sometimes. You can have a sign and if the guy doesn't read the sign then that's the end of it.

Such things as duty cycles, however, alterations in duty cycles, will reduce, assuming we have a standard and we do it right now, a six minute average, you lower that duty cycle and you can increase your exposure to the

worker.

The distance, we saw the rotating table, and just by taking physically the operator and putting her or him at the other side of the table from the RF source indeed is a good control that seems to be effective.

So we will be active in testing the on-site controls and at this point it looks like we are actively considering, if I should say it that way, promulgating a new standard. We are on that road by the fact that NIOSH is writing a criteria document that is indeed a recommendation. It is not a standard.

It is true that once NIOSH makes a recommendation that has a lot of weight, but OSHA at that point can accept it completely or reject it completely and that will be up to our office of standards people and we'll have a number of hearings on that kind of thing. That was probably discussed yesterday.

In the interim, again, just to make it a strong point, and the man from DuPont, his name escapes me now, who wanted that in the record, do we have a standard right now. Yes, we do. I have a program directive which is in print right now, instructions to the field, again verifying the fact that what I have been doing the last couple of years anyway. That is that we are enforcing the current occupational safety and health standard 1910.97 and the far

lb29

field equivalents.

In other words, we are enforcing ten milliwatts per centimeter squared. We are enforcing .25 amps squared per meter squared, and we are enforcing the 40,000 volts squared per meter squared averaged over the six minutes. Basically that's the 200 volts per meter, half an amp per meter. It's the ANSI standard, the 1974 standard.

We are doing that, and someone can say "Aha, that's an interpretation of the existing standard." Well, we are also citing -- when you get a citation it will be 1910.97 and 581 in the alternate, basically covering ourselves if the Judge rules that 1910.97 is unacceptable because this is near field exposure instead of far field or this is -- you were measuring in volts squared per meter squared instead of milliwatts per centimeter squared, that kind of thing.

Fine, then that means the 581 (5A1 ?) applies to you, and the 581 is the general duty clause which says that there is no applicable standard and so we have to cite on the general duty clause.

So again, it is true -- to conclude someone might say "Well, how can we do this?" Just to let you have a little bit of taste of what we go through, when I go to a plant as an industrial hygiene engineer, and that's as a certified industrial hygienist, I have two people who

can sue me, and it's the worker and the plant manager. And I'm taking my measurements and of course they're both sitting there waiting for me to tell them what we found out.

If I do not give a citation I am telling that worker that it is safe to work there. If I give a citation I'm telling that manufacturer that it is not safe to work there, and in fact he needs to spend money to make it safe.

Now scientifically I'd like to say "Well, I'd like to wait until two years down the line until we have solved a lot of these other problems." Well, I think at this point I can't do that because I go to the plants. I have a worker complaint today. I know that I have people exposed today. I know I have people exposed today at 2,000 volts per meter, for example.

So I have to make that decision today when I'm in that plant, whether or not he or she can continue to work in that situation. So I have to use the best available data today. Today I do feel we have commercially available equipment that is satisfactory. It does give you a good indication of the fields that are there.

Certainly instead of write out ten milliwatt per centimeter squared there'll be a little play are in there, I wouldn't, you know, just for the accuracy of the equipment. And I do feel like there's commercially available equipment. I feel like there is technologically feasible and economically

feasible controls for the exposure. I feel like there's enough concern at ten milliwatts per centimeter squared, enough risk that now I can as a professional industrial hygienist who has to worry about getting sued by either of these two groups, that I would go to court and say yes I think it's worthwhile to force this company to meet this standard.

So again, that's where I'm coming from and that is that I'm caught in the middle. I have to make a decision today. I can't wait until the scientific studies are done. I am extremely encouraged by the medical workup that industry has taken by Hazel and of course all the bioeffects work that's being done. Thank you.

MR. KELSEY: Bob Kelsey, private consultant. Mr. Curtis, can you give me any time table? You said that your test procedures would be ready by the end of the year. You are planning to train inspection teams I would gather in the interim or following that?

MR. CURTIS: We are already on-going training people to conduct inspections. I am getting tired of travelling around the country. We are doing that now based on the procedures that I showed you earlier, and that was the stick man, you know, the screening and then the stick man, and we feel like that procedure has a solid enough foundation that I'll go with that even before the final

lb32

evaluation specific procedures by BRH.

So I'm kind of jumping the gun. Again it's because I have to make that evaluation today, not tomorrow.

MR. KELSEY: And how long will you continue to test on-site controls and how are you going to find out about these on-site controls being installed, voluntarily from the manufacturer?

MR. CURTIS: Yes. Luckily that's identified by -- Well, let me say it this way. When I go to a plant and I find a machine in excess, -- I'm sorry, let me go the other way. If I find a machine that works that is not in excess, then I take that piece of information just like we have seen here. We take slides of it and that kind of thing and we hope to disseminate that out to the next plant I go to when the guy says "What do I do about this machine that's way above?"

Then I can tell him "Well, here's some things that work in other plants. Contact your manufacturer and he'll be able to get you onto some expertise to have that work on your machine.

MR. KELSEY: All right. But how long are you going to perform those until you get a body of data that you can say "All right. Now we know what kind of standard we can put on because we know what works?"

MR. CURTIS: Okay. The standard -- this does not

lb33

involve the development of a new standard at all, because what I am talking about is enforcing the current standard, the ten milliwatts, so I'm not going to be waiting for any collection of a body of data. Any data we do collect, and we will collect in the year, we'll summarize it and that will be inputted into the development of a new standard and it will be evaluated with the health information and everything else.

MR. HOLADAY: Reed Holaday, from Holaday Industries. Bob, could you address yourself to I guess I would say error incorporated in making these measurements? I am a little more familiar with making the measurements in the emission exposure standard where we define a distance and all the worst case errors are called out.

But how do you make these near field measurements and what kind of numbers do you put on this ten milliwatts per square centimeter or the associated field strengths in order to know if if it's in compliance or out?

MR. CURTIS: Okay. Fortunately I don't have to address that directly either, because as it turns out the machines very often are extremely high and well over and so my measurement can be very broad. If I say okay, 20 percent, then everybody knows, ah, we can make our machines at 12 milliwatts per centimeter squared instead of -- you know, OSHA won't bother us until we get to 12.

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So what I'm saying is that instead, any particular machine that I feel that I could defend in court that it was definitely above ten, then I would cite it, but sure enough, I am going to have instrumentation, depending on which one I'm using that day, and BRH may -- you know, working with them we may find out we're going to change the instrumentation next week.

What I'm working with at that time, that will determine my confidence limits. Ninety-five percent confidence limits by the way is our standard procedure.

MR. HOLADAY: Excuse me, I didn't get a number out of that.

MR. CURTIS: What I'm saying is that you won't get a number because I just have to be able to defend in court that I really believe that the levels are above ten milliwatts per centimeter squared. And you know for instance if I get 100 milliwatts per centimeter squared, I think I have got a pretty tight case. If I get 20, not as good a case, and get closer to ten, it's harder. I won't give a number on that.

MR. HOLADAY: But I have heard in the past couple of days information regarding the fields changing with the operator present, with the operator not present by quite significant values, and I have seen tables of data on instruments that have been under evaluation where there

lb35

were some fairly large percentage figures. I just wonder how you can go by feel on this.

MR. CURTIS: For citation purposes, we take measurements without the operator, because those are consistent and so our biggest problem then is the instrumentation and at this point those are published figures, the instrumentation -- I am sorry, they are published by the manufacturers of the equipment and that is something that BRH will reconfirm for us.

MR. DIGIACOMO: Steve Digiacomo, Hazel. I asked a question earlier on the new proposed standard and we keep talking that there's going to be one. How do we know we need one? How do we know that we need a new standard? How have we arrived at that data? I'm a little puzzled on how we arrived that we need a new standard.

MR. CURTIS: My point on that by the way is that at this point the OSHA current standard does not -- I'm not addressing a new standard whatsoever. As far as people are concerned, OSHA at this time has a standard, we are enforcing that standard, and if we come up with data that show that we need a new standard, no matter which direction. We can't assume that it's even going to go down. Some people might assume that.

At this point the obligation, OSHA's concern, is the current standard and to keep abreast for anything new

beyond that.

MODERATOR GLASER: Thank you. One last question?

MR. HUANG: Hank Huang, of DuPont. Just wanted to make a comment. Since we already have exposure standard from OSHA, my question now is how could we justify another performance standard or emission standard from some other agency? What I am commenting on is the desirability of only one standard, either exposure or emission standard, so industry has a way to follow it.

And also I am commenting on it would be desirable if only one agency responsible for controlling the worker safety. In this case it appears to me should be OSHA rather than either if I may, rather than BRH or maybe EPA. Just a comment.

MR. CURTIS: Thank you. So noted. Yes; I will say to that, I think another example would be the microwave performance standard. I think that emission standard by BRH is extremely effective in reducing the problems that we might run into when someone commercially uses that microwave oven, in other words, the fact that they have got the interlocks and they have tested the performance characteristics of the microwave oven before it has left the manufacturer.

We will always need in addition to that a personel exposure standard just because someone's going to alter the

machines, particularly in these cases. The users can alter that machine after it leaves the manufacturer, and so as far as OSHA is concerned, we don't care how much they alter the machine as long as the person is still not exposed above the standard.

MODERATOR GLASER: Thank you, Bob. Before I introduce Art Wall, I would like to ask if Frank or Mays, you had any indication from participants with regard to the optional panel discussion. I have had two indications both from industry of willingness to participate, but you're saying no, you have not. Okay.

In that case, and unless I hear to the contrary, I will assume that we will not have the panel discussion and we will continue to move on through our agenda. If the people who were indicating willingness to participate on the panel would like to make any particular comments, I think we would be able to handle that.

Frank?

MR. TIPTON: Zory, I could note that David Lee and myself will be here for any discussion or comments that people would like to engage in.

MODERATOR GLASER: Okay. Thank you. Contrary to what the agenda says and Dave, forgive me for jumping just ahead of you, I received a call the other day from Mr. Art Wall, of the FCC, who indicated that he would be coming

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and participating so that W. McGibbons name is not correct the program.

However, Art indicated that Mr. McGibbon might be still coming and if so I guess Art will handle that.

If I may be permitted to bring to your attention the fact that on Monday, June 25, 1979, in the Federal Register Volume 44, number 1, 2, 3, on page 37008, the Federal Communications Commission published in the proposed rule section the following.

I will read the title. Enquiry Concerning Biological Effects of Radiofrequency Radiation When the Use of Radiofrequency Devices is Authorized; Potential Effects of a Reduction in the Allowable Level of Radiofrequency Radiation on FCC Authorized Communications Services and Equipment. And it summarizes a notice of inquiry.

Mr. Art Wall has long familiarity. Bob, you didn't forget my slides, I hope. All right. Thank you. Mr. Art Wall has long familiarity with the rules and regulations of the FCC and he has agreed to discuss and describe some of the implications of the notice of inquiry. Mr. Wall.

STATEMENT OF ART WALL, OF FCC

MR. WALL: Thank you, Dr. Glaser. I found out that I was going to make this presentation the day before yesterday. Well, that's not too much of a problem. I was

going to highlight the notice of inquiry that Dr. Glaser just referred to.

However, after listening to the discussions of the past two days and references to the FCC rules, I thought it might be helpful to briefly describe the rules for industrial, scientific, and medical equipment of which dielectric heaters if a part to put them in a proper perspective.

The Federal Communications primary interest in industrial, scientific, and medical equipment is the interference potential of such equipment to radiocommunications. Obviously we would have a public interest in such equipment causing harm to the worker, and that was the purpose of the inquiry, to get information about that problem.

Thus for scientific and medical equipment includes microwave ovens, it includes epilators, it indludes dielectric heaters, induction heaters, almost all the equipment that we have described here, in addition to some others, arc stabilized waters (?) is also included in ISM equipment.

Basically it's any equipment that generates radiofrequency energy and uses that energy for other than communication purposes.

We define RF energy a little bit different than some of the definitions I have heard yesterday. We define

RF energy as being above ten kilahertz. This is the same definition that's in the IEEE Dictionary Second Edition. The same problem with generic terms like microwave energy, looked in the IEEE Dictionary, and they define it as above 1,000. Again, that's a loose definition.

I have a few slides to show of some ISM equipment. Before I get to that I want to show one of the apparently benefits for using RF energy, and I think this piece of wood is an excellent example of that. When you do thermal heating you heat the outside of the block and then after the outside is charred it starts heating inside and which, like a piece of meat.

This block of wood was put in to plates of a dielectric heater, heated, and then taken out and cut, and you can see that the wood was cooked on the inside, more so than the outside. This slide was compliments of Mr. Wilson.

The second slide here is a wood gluing machine. This is the generator section of it. It's I believe 1.2 megawatts. It's 6 megahertz.

All right. Next slide. This machine here is a dielectric heater, common variety. There are quite a few of these machines around. They typically run between 1- and 20 kilowatts. This is a pants press, used in the textile industry.

Okay. As far as the present rules. The present

rules are in part 18 of the FCC Rules, Title 47 CFR. They were adopted in 1948. They allow unlimited radiation on seven frequency bands that are allocated internationally. The seven bands were shown yesterday, 15, 27, 40 megahertz, 915, 2450, 5800. I think 22.125 gigahertz.

The rules allow unlimited radiation on those seven frequency bands. There's no upper bound with the exception of any limit established by HEW or OSHA. I guess it would be OSHA. But as far as the Commission is concerned, there is no upper bounds on emissions inside that frequency band, any one of those seven bands.

However, outside the bands we presently have two limits. Next slide. The two limits for the industrial equipment is ten megavolts per meter at a mile for industrial heaters and 25 microvolts per meter at 1,000 feet for miscellaneous ISM equipment such as medical diathermy, microwave ovens, some other types of equipment.

These limits are fairly liberal. In practice they allow operation of ISM equipment almost on any frequency. If you take that limit, ten microvolts per meter as a model for a device operating below 30 microhertz, an extremely liberal limit. And consequently there's no reason for a lot of this equipment to operate in the ISM bands.

A lot of people both within the Commission and

outside the Commission believe that most ISM equipment operate in the ISM bands. This is not true.

The Commission has a notice of proposed rule making that we released last September to tighten the limits for the other band radiation to conform with the recommendations of the CISPR, and the National Special Committee for Radio Interference. The recommendations adopted by CISPR, which is under the IEC, International Electrotechnical Commission, recommendations a number of countries have adopted, European countries, Japan is in the process of adopting the CISPR recommendations and we're seriously looking at the CISPR recommendations.

I might mention at this time that the World Administrative Radio Conference convenes the latter part of this month. This is a conference that takes place every 20 years. It sets out the frequency allocations and radio requirements internationally for the next 20 years.

There are some proposals at this conference to introduce new ISM bands. The two that I have hard mentioned are three megahertz and six megahertz for wood-gluing machines. I think there's another band, 915 megahertz, to make that world wide. Right now the allocation is only for North and South American, region 1 of the world.

That's basically all I wanted to say about the present rules. Now as faras the notice of inquiry is

concerned, that's general docket 79144. That was released in June of this year, as Dr. Glaser has said. Comment date is December 15 of this year. Reply comments are March 15 of next year.

The inquiry is basically to gather information. The Commission authorizes most of the radio matters, with the exception of those operated by the U.S. Government and if the equipment that we authorize is going to cause harm, then we have an obligation to at least consider what the harm is going to be.

In addition, if other agencies adopt some regulations we may be forced in a position of enforcing some of those regulations. So we're trying to get as much information as we can.

I have extra copies of the inquiry with me here on the table for anybody who would like to have a copy. I also have a few copies of the notice of proposed rule making to tighten the outer band limits for ISM equipment.

I think that concludes my presentation and I will be glad to answer to any questions.

MR. WILSON: T.L. Wilson. Is there any possibility, and this is a question maybe not only for Art but for others, is there any possibility of getting a uniformity in the method of describing the limits? Microvolts per meter at a mile I suppose somebody smarter than I am might be able to

translate that into milliwatts per square centimeter at three feet, but I wonder if there is a formula or a method of doing that or is there any way of getting a uniformity of statement so that at least the U.S. has a uniform thing that we can all work with.

MR. WALL: Well, that was one of the problems with the present rules was the extrapolation of that limit, ten microvolts per meter at a mile to a more convenient measuring distance, and it has given us problems with the measurement results for some time.

What we proposed in the notice of proposed rule-making, docket 20718, was to make measurements at 30 meters from the equipment or from the building in which the equipment was operated. Let me mention a lot of this equipment in order to comply with these limits are operated in shielded rooms, so measurements would be required from the shielded room or from the building it's operated in.

But to get back to your statement there, CISPR has recommended that measurements be made at 100 meters or 30 meters and we're trying to conform with what the rest of the countries are requiring in this area.

MR. WILSON: You're still talking about microvolts per meter rather than milliwatts per square centimeter.

MR. WALL: Well, it's probably not too much difficulty of converting that microvolts per meter in the far

field to milliwatts per square centimeter.

MR. WILSON: You use the inverse square relationship then to change the distance?

MR. WALL: If you're talking -- are you converting just from microvolts per meter at some distance to power density? Are you converting the distance now? It's two different things.

MR. WILSON: Let me go from the back of my mind. It would be very nice to know if some equipment that a manufacturer or a user has does comply with FCC rules and regulations. Then that automatically says they do comply with OSHA regulations also, provided it's not a screened room. I'm not talking about that. But I'm talking about equipment out in the open where the radiation is not on an ISM band, then it seems to me that ten microvolts per meter to a mile is probably going to extrapolate to considerably less than ten milliwatts or even some other figure per square centimeter.

I was wondering if there was an extrapolation figure or some possibility of getting everything in one term so we could understand it.

MR. WALL: Well, one of the problems is we're concerned about two different things. The Commission is concerned about the protection of radiocommunications, so we can make measurements in the far field. OSHA's concern is about protection of the individual probably in the near

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field and it's very difficult to convert from microvolts per meter to a power density in the near field. This is one of the problems. Maybe it can be overcome. I don't know. But indications right now seem to indicate it might be some time coming.

MR. HUANG: Hank Huang, of DuPont. I gather if we converted back by inverse square law will be a lot lower than whatever OSHA limit is talking about, but I also if I may assume, our main subject today is worker safety rather than radiofrequency interference, so I would like to comment on the other two dockets you mentioned.

But today I would like to concentrate on the last docket you mentioned about whether FCC should be involved in some activity related to the bioeffects of non-ionizing radiation. I still would like to stress the desirability of industry only have to deal with one agency on one subject.

If it is worker safety, it will be very desirable for industry to only have to deal with OSHA as far as the bioeffects, or safety of the worker is concerned. My own opinion of FCC is probably -- just a personal comment, Art, is more concern with avoiding interference to each other for the use of frequency spectrum by different services.

MR. WALL: Well, just a brief comment on that, Hank. That inquiry was intended to deal with a whole gamut of radiofrequency emitters, licensed transmitters, AM, FM

broadcast bands, as well as industrial, scientific, and medical equipment which are emitters also. The problem that we have is that we authorize many of these emitters, so what is our responsibility? If there is a public health hazard, then and another agency has established a hazard, then what is our responsibility?

One obvious conclusion is that maybe we shouldn't be authorizing that or maybe under certain conditions it should be authorized. This has been done I think with several broadcast transmitters, where they put up warning signs and require the broadcasters to file certain statements that they have looked at this potential hazard around antennas.

MR. HUANG: If I may add a litle bit more comment. From our viewpoint it appears to us broadcasting of radio-communication industries is also covered by OSHA anyway, for their worker safety, if I am right, and it also appears to me if it is related to public safety, such as consumer products, then BRH do come into play.

That certainly is a good way of controlling the safety. The main point I am coming back to restating is that it will be highly desirable for each group of people for one item or one subject they only have to deal with one agency, do not have to deal with several different agencies, several different reports, and so on.

MR. FRANK: Robert Frank. I'd like to comment on

the document from the FCC which is pertinent to the problem. As I mentioned yesterday, a great deal of my business depends upon disseminating information of all those bulletins I read yesterday to my various clients, who have no other way of being aware of these new regulations or the results of tests.

I have here one which I think I sent some 28 copies out to my clients by one of the FCC engineers by the name of Jay Damelin,report # 7104. It's a report of the FCC, office of the chief engineer, research division, and it's headed VHF-UHF Radiation Hazards and Safety Guidelines.

MR. WALL: When was that published, sir?

MR. FRANK: It was published in Washington, D.C. on July 19, 1971. And it has various formulas to determine the ways of calculating this and they have a rather unusual set of curves on the end, and I don't think you see them from here, but they plot distance versus hazard. It's available, I hope, if it's still in effect, from the FCC. Are you familiar with this, Mr. Wall?

MR. WALL: I haven't seen that.

MR. WALL: I haven't, no, sir.

MR. FRANK: Do you know Mr. Donalan?

MR. WALL: No, I don't.

MR. FRANK: Well, I thought I would go on and put it into the record.

MR. WALL: Is it a specific comment that you had about the report, or a question?

MR. FRANK: What was that?

MR. WALL: Was that a specific comment or question about the report that you --

MR. FRANK: No, I am not, I am just entering it into the record for anybody in the field that is interested in receiving it, since this is a hazard problem and this is directed directly at the hazard problem.

MR. WALL: I think there is quite of bit of up-to-date information referenced in the notice of inquiry that I put down here earlier. I guess it is in the end of the table now.

MR. FRANK: Well, I thought I would put it in the record for anybody that wants to try to get a copy.

MR. WALL: Sure.

MODERATOR GLASER: Thank you, Art. I owe Mr. Wall an apology. I neglected to introduce him properly as being part of the RF devices and experimental branch in the office of the chief engineer at the FCC.

THE REPORTER: May I have the spelling of his last

name?

MODERATOR GLASER: W-a-l-l.

THE REPORTER: Thank you.

MR. WALL: I have to make one correction that. That is Office of Science and Technology. We changed the names at May of this year.

MODERATOR GLASER: Thank you. We are at a difficult juncture right now. We are still in our section from three to three-forty-five. However, we are a little bit behind schedule, which I think we can handle, except for the fact that I have bee told, on excellent authority, that the coffee or the snack bar closes at four o'clock. If we need to take a break, need that coffee lounge for whatever, then perhaps we should take a few minutes now. I would hate to run beyond that point.

In view of the fact that we did have lunch from one till two, perhaps people could hang on -- I am seeing some nodding -- past the break and continue on. All right.

THE REPORTER: I would like to take a brief break.

MODERATOR GLASER: Okay. While you are doing that maybe what I will say -- and this doesn't have to be on the record or the tape -- but I have been asked will the comments and questions and so on be part of the record. And indeed it will be part of the record and will be part of the transcript.

Okay, why don't we take five minutes, I guess. And that is probably not a good time. Oh, and I am told also that

Frank Tipton will have the attendance sheets for us when we get back, also.

(A brief recess was taken.)

MODERATOR GLASER: I hate to be the one to drag everyone back, but I guess that is one of the roles that I need to assume at this point. It is ten minutes of four. I know that there are people who do have car pools and things of that sort that they need to grab onto. We did announce that we would be ending at five. So in the 70 minutes remaining I would like to return to things.

Our next speaker is Dr. David West, who is a environmental engineer with the technical evaluation and review branch of the office of extramural coordination and special projects at NIOSH. And Dave will describe and discuss with us some of the activities that were described in the August 9, 1979, issue of the Occupational Safety and Health Reporter, Volume 9, Number 10, on the front page and on page 237 and 238 of that issue, entitled "OSHA and NIOSH Plan to Issue a Joint Current Intelligence Bulletin on Worker Exposure to Non-Ionizing Radiation from Radio Frequency Heat Sealers, a Type of Industrial Heating Device."

Without taking any more time, I will introduce Dr. David West.

STATEMENT BY DR. DAVID WEST, OF NIOSH

DR. WEST: Thank you, Zory.

I think, for the benefit of the diverse audience,

before I speak directly to the current intelligence bulletin, I would like to put the mission of NIOSH in perspective with everything that you have heard here these last two days and then put the issuance of a current intelligence bulletin in perspective of what is going on.

The Occupational Safety and Health Act of 1970 created three governmental agencies: OSHA, Occupational Safety and Health Administration, with the Department of Labor, which sets and enforces health and safety standards in the nation's work places; this Act also created NIOSH, the National Institute for Occupational Safety and Health, in the Department of Health, Education and Welfare, which is, essentially, a research agency that might be called the scientific conscience of the federal occupational health and safety program; the Act also created the Occupational Safety and Health Review Commission which settle disputes arising from enforcement of the Act.

But NIOSH is headquartered in Rockville, Maryland, just outside Washington, D.C. And its research facilities are located in Cincinnati, Ohio, and Morgantown, West Virginia.

It is NIOSH's job to gather information about injuries and illnesses, to perform original research, to analyze and organize this information and make it available to those who need to know, to recommend new standards to OSHA and provide technical assistance to workers or employers concerned with health hazards at their job sites, and, lastly, to help train safety and health

professionals.

The nature of an alleged hazard, the urgency for a recommendation, the availability of reliable information, and the level of recognition of the hazard dictate the procedure to be used by NIOSH in developing a recommendation as well as the type of report that it issues to the community.

As required by the Act, NIOSH notifies OSHA of what the institute considers to be the requirements for safe exposure to a recognized hazardous substance or condition, by means of a written report called a criteria document. And I am sure all of you are familiar with some of the criteria documents that NIOSH has produced.

These documents present detailed analyses of the problem and the extant literature, NIOSH determinations and conclusions and recommendations for a standard, including recommended permissible exposure limits and, just as importantly, control measures.

It is these documents that are considered by OSHA, among other things, in promulgating its standards.

When new evidence of a particular special nature is available for alleged hazard in the work place, a special occupational hazard review may be initiated; based on an evaluation of the health effects and review of data on existing exposures and control measures, a special hazard review document may be issued. These documents may include recommendations for occupational

standards or temporary emergency standards.

So we have two documents by which NIOSH can make formal recommendations for standards that would apply in the work place. When significant new information is discovered for a chemical or a physical hazard, even if a criteria document or a federal standard already exists, NIOSH can issue a current intelligence bulletin on the substance or the hazard. These documents are not as detailed as criteria documents or the special hazard reviews, but they are issued on a more timely basis to alert OSHA, industry, labor, academia, and the occupational safety and health professionals to specific hazards that are either unrecognized or are greater than generally recognized.

The institute maintains a current intelligence system to promptly review, evaluate, and supplement new information on occupational hazards. The current intelligence bulletin, that I am going to address myself to in just a moment, is a rapid alert system and it is the primary product of this current intelligence system.

A bulletin is written based on the evaluation of new information on a particular hazard and in light of other known epidemiology, production, and use data. As part of this evaluation, an estimate of the number of persons occupationally exposed is developed, the occupations and industries involved are identified, and the characteristics of the hazard and its potential impact on occupational safety and health are summarized. In

addition, general industrial hygiene practices are recommended, to minimize worker exposure.

Each of these bulletins are official institute publications and are disseminated to approximately 15- to 20,000 potentially affected members in the industrial hygiene community, key federal agencies, national associations and unions that would be affected by that hazard, and others as appropriate.

The bulletins are not intended to assist in the formulation of regulatory standards. And this is a very important point.

This particular bulletin, which is entitled "Radio Frequency Sealers and Heaters, Potential Health Hazards and Control," will be issued jointly by NIOSH and OSHA. And there is a precedent for this; it has been done before. And it was prepared with major contributions from NIOSH divisions of criteria documentation and standards development, most notably Dr. Glaser, and the division of biomedical and behavioral sciences, primarily Dr. Conover and William Murray, and also from staff members of OSHA, including Bob Curtis, Victor Alexander, and Steve Malenger.

More specifically, the current intelligence bulletin, while the potential hazards of exposure to RF energy are not fully known and meaningful new bio-effects information has not just become available, there is a growing awareness that operators of dielectric heating devices are frequently exposed to

energy fields which exceed existing federal standards. Additionally, most workers who operate RF dielectric heating devices and their employers are not aware of the extent of worker exposures or, frequently, of the concern that exists for the potential health hazards. For these reasons, NIOSH and OSHA have decided to issue a CIB, or a current intelligence bulletin, on RF dielectric heating machines, despite the fact that NIOSH is preparing a criteria document on RF and microwave energy.

The purpose of the bulletin coming out now, in advance of the criteria document, is to alert employers and consulting industrial hygienists and engineers and the employees of the potential for worker exposure; secondly, to inform them that there are serious concerns about potential health effects; thirdly, to preview the control recommendations that NIOSH is currently considering for inclusion in the criteria document; fourthly, to inform the community of NIOSH's interest in this problem and its interest in acquiring further information on bio-effects and field measurements; and fifthly, to inform the community of OSHA's intent to inform the current federal standard, as described earlier to you by Bob Curtis.

So that is what a current intelligence bulletin is for. The bulletin has been prepared. It is in the last stages of preparation and will probably be issued, as I say, jointly by NIOSH and OSHA, within the next week or two weeks. And as I indicated previously, it will be sent, it is sent to a standard

mailing list that comprises several thousand individuals in the occupational health field; it is also being sent to targeted audiences which we hope, and which we believe, will include almost all manufacturing associations that are associations of manufacturers believed to use RF sealing devices and all of those unions that are believed to have employees or members working in these industries and other trade associations and industrial hygienists.

Are there any questions?

MR. KELSEY: Robert Kelsey. Will that, will it be automatically sent to the attendees here?

DR. WEST: We can make arrangements for that, yes. If we get the list of the attendees, we can just plug that right into our automated mailing system.

And I would suspect that most of you are already on that list.

(Pause)

THE REPORTER: Excuse me. Is that important enough to be on the record?

MODERATOR GLASER: Yes, I think that is. The question was will the list of attendees from this two-day workshop be receiving, or will that list be made available for NIOSH to send copies of the current intelligence bulletin on RF sealers. And I said I thought that that was, indeed, a valuable reason for having the list.

MR. HUANG: Hank Huang, of DuPont Company. Since I gather you are from NIOSH, so, if I may, I will bring up the question of action level in your NIOSH criteria document. My question is: If there is a safety standard already decided to be safe, why do we need another level of so-called quasi standard called action level, which will require industry to trigger certain documentation requirements.

That, in fact, will, essentially, set the new exposure standard to the action level, rather than the primary safety standard set up in the document.

Could you comment on that?

DR. WEST: Yes. The action level is not unique to RF or microwave energy. The action level is a concept that has been employed by NIOSH, I may be wrong but I would say, virtually in every criteria document, at least those that are not written concerning known carcinogens.

Philosophically, the action level derives from statistical considerations in which it is known that although a work environment may have concentrations, say, of a chemical substance at levels lower than the time-weighted average permissible, that because of just taking a sample, indeed, there are times in which the limit that is thought to be safe can actually be exceeded. So the action level is a mechanism by which you acknowledge the fact that although the time-weighted average may be not exceeded, that indeed employer-employees may be exposed to levels

approaching or exceeding momentarily the value.

And the purpose of the action level is to provide a zone in which certain record-keeping and employee-surveillance activities can be implemented, so that you can take a closer look at those employees that you know a priori are being exposed at or greater than the permissible TWA.

Zory?

MODERATOR GLASER: Well, I might jump in at this point and thank you, Dave, and say that there has been considerable interest and a number of people have asked about the NIOSH draft criteria document on RF and radio frequency. And Mays just said that he wouldn't mind holding off on his presentation to give me a chance to say a few words and show a few slides. And I hadn't planned to do this, and I again will need to take off that hat and put this hat on, but now in the capacity as on detail, part tied to NIOSH, at the request of NIOSH and my own initiative and the willingness of the director of the Bureau of Radiological Health, I have been continuing to work on the NIOSH criteria document as the assistant project officer and the criteria manager.

And wearing that hat now, I will tell you what we have been doing on the criteria document over the last two years or so. And I put a few slides in the box, and if we could have the lights dimmed a bit, please. Nope, that is not it. Must have put it in at the wrong place.

Well, I can only blame myself, because I put the tray in.

The problem is that I have got -- oh, that is a good one to show you -- I have got a whole bunch of different slides in this tray and using them at different points. But if Paul Ruggera will forgive me, I remember that he showed a picture of the Instrument for Industry three-axis probe, but it wasn't clear where those three axes were; you could only see two-thirds of the three axes. And on this shot you can see all three axes, X, Y and Z, and you can also see the other antenna leads that can be screwed in.

Have a good trip back, guys.

Okay, the next slide, please. Okay. A question was asked about on what basis, what data, what bio-effects data, is the recommendations on the criteria document based. This, let me preface this again by saying this is a draft of the criteria document; it is the current draft. Back in April or May we had the external review draft that was sent out to 50 or 60 or so individuals and organizations and so on for comment. We have received comment. We have responded to that comment. And we have prepared two drafts subsequent to that. And in about two weeks or so, or three weeks, I don't remember the date exactly, we are due to receive the next draft back from a contractor that is helping us with the day-to-day work and so on on the document.

So that the document is a draft. And it will be,

presumably at this point, presented to the director of NIOSH for his consideration and review and so on and his determination as to what should be done next with it.

Usually what is done next is that it is forwarded to OSHA as a recommendation and then OSHA decides how to treat the information that is in there.

The draft is to include radiation within the frequency of 300 kilohertz up to 300 gigahertz. And the standard recommended is designed to protect the health and provide for the safety of employees for up to a ten-hour work shift in a 40-hour work week over a working lifetime.

Compliance with all sections of the draft, it is felt, will prefent adverse effects of exposure to RF energy to the health of employees and provide for their safety. Monitoring techniques described in the draft are generally available. And NIOSH expects that the RF monitoring instrumentation will become commercially available in the near future and will enable compliance with all aspects of the draft. And there are chapters in the draft which talk about instrumentation and monitoring techniques and so on.

Although NIOSH considers the recommended work place environmental limits to be safe levels based on present information, employers should regard them as the upper boundaries of exposure and make every effort to maintain exposures to as low as technically feasible.

The criteria and recommended standards will be revised and reviewed -- in the reverse order, reviewed and revised -- as new studies and data become available.

Okay. The bio-effects in the world data base was reviewed. We had at our disposal the bibliography of radio frequency and microwave radiation bio-effects that I have been involved with in compiling over the last ten years or so, and which has in it about 5000 or 6000 citations to the world literature.

The information contained in that data base was reviewed. And the effects have generally been classified in about 15 categories, the first five of which are listed on this first slide. And I have been told that, contrary to some of my slides, this one is readable, so I will assume that you can all read it and will suggest, in the essence of time, that we might go on to the next slide in this series.

And I will say on this one, well, perhaps I should have said on the last one about studies in the area of blood/brain barrier and that that is an area in which there seems to be some studies showing that at some very low effects there seems to be changes. Now, these changes can also be produced by other forms of stress on the body. And some of those other forms of stress are thermal stress, heat. Too much heat can produce some of these changes.

Now, the first one on this slide, item number six, that

of cataracts, is something that is recognized, and there seems to be very little dispute on the fact that microwave or radio frequency energy is capable of causing cataracts at high levels of exposure. It is just not entirely clear what the threshold for the lower dose is and what the time over which the energy to be given should be administered.

Yes, sir?

VOICE: Has there ever been any recorded cataract from radio frequency?

MODERATOR GLASER: The question was: has there ever been any recorded cataracts from radio frequency? Yes, there have been radio frequency of frequency up in the microwave region. I can't think specifically of the reference, but there have been reports. I expect, however, that what you meant to ask was radio frequency energy at the frequency used by sealers and heaters and gluers and so on, that of three to 70 or 100 megahertz. And I can't recall any reports at this point, unless there is somebody else who can think of that.

Now, please keep in mind that I came here sort of cold. I didn't plan to talk about this. What I have in front of me is chapter of the draft of the criteria document, and I am just taking pieces out of it. But I didn't feel that it was proper to say no, we can't or won't talk about it. So I am doing the best I can off the top of my head.

Item number eight, thermal regulation and metabolism,

is an important consideration, I think, because, to this gathering because, we acknowledge the fact that the body has only so much capability to maintain its homeostasis, its core temperature constancy, and to vary too much outside the range leads to some very severe and adverse, and sometimes irreversible, effects.

So since we are dealing with devices that can heat the body, and of course we have already acknowledged that the devices themselves give off heat, whether or not the heat is absorbed by the body in the form of radio frequency energy or heat in other forms, such as infrared energy, we have to be concerned with that.

I think we could go on to the next slide. And again, here in the item 12 environmental factors, we have to be concerned with things like what is the effect of radio frequency energy on the body when coupled with other stresses such as high heat or high humidity, or, as you have heard, other stresses or pollutants, such as I saw in one plant that I went into, a furniture plant, in which not only was there RF energy present around the sealers, but there was high noise levels, high dust levels, in my mind insufficient amounts of light of the visible type, and there were fumes from solvents, glues, paints, and other factors.

So item 12, environmental factors, temperature, humidity, and other stressers, is important.

Well, I will skip on to the, well, continuing on here I will read to you a section.

"Radio frequency and microwave radiation may cause

heating of the body at power densities in excess of ten milliwatts per square centimeter. At certain frequencies, burns may result and a heating sensation may be experienced at high RF and microwave exposure levels. At levels below about ten milliwatts per square centimeter, incident RF and microwave radiation may not be perceived and adequate warning of exposure may not be given. The recommended standard is designed to protect workers from potential hazards resulting from RF- and microwave-induced heating and from other possible bio-effects that have been described in the literature.

"The reported effects include ocular changes, alterations in neuro-endrocrine functions, alternations in the central nervous system, behavioral changes, changes in cardiac rate and hemodynamics, alterations in blood composition, changes in immunologic system, embryotoxic effects, and reproductive effects.

"Further research is needed to more clearly determine the risks attributable to the effects of exposure of RF and microwave energy."

Now, one of the considerations that went into this was that the world literature includes many reports of effects that are alleged to result from very, very low levels of exposure to RF energy. And by "RF energy" I am using that term in the generic sense to include radiation between 300 kilohertz and 300 gigahertz. So it includes the microwave and millimeter wave regions.

Some judgment was exercised in the relative weighting of the biologic effects. The scientists and engineers involved in the review of the literature, the review of the various drafts of the document, and so on, felt that reports that did not contain sufficient information to allow replication and thorough understanding and so on would not be weighted as heavily as would other data.

We have been criticized, by both sides of the fence, people on both sides of the fence, some people saying, "Well, don't you realize that to lower the standard will make it tougher on those of us who operate the equipment and other people?" And then we have also been criticized by people who say, "Well, you haven't, in view of the wide variety of the literature and the wide range of effects and the low levels at which these effects are alleged to occur, you haven't set your proposal low enough."

So it is sort of a damned-if-you-do-and-damned-if-you-don't situation.

A gentleman had his hand up back there.

MR. WEINER: I just have a general question. In the common study of radar interactions in the military it is generally conceded that long wave lengths relative to the dimensions of the object or the interface over which you are interested generally have very high transmission capabilities and the absorption within that object or interface is really very small.

Now, it seemed to me that the proceedings today were

directed at a frequency which was corresponding to a wavelength which is much greater than the human body's. And I am just wondering unless you lay a lot of human bodies end to end, based on that kind of consideration, how you can theoretically justify all this great deposit of energy such as to cause burns and what have you inside of somebody.

MODERATOR GLASER: Well, you must remember that I was using radio frequency in the generic sense and that the burns, the reports of burns have mostly been at the higher frequency, the shorter wavelength.

However, your other comment about absorption as a function of wavelength, the depth of penetration indeed varies greatly with wavelength. I think the next slide shows that. And if we could have that --

THE REPORTER: Excuse me. Do you want to call out your last name.

MR. WEINER: Me? Weiner, Sheldon Weiner.

THE REPORTER: Spell it.

MR. WEINER: W-e-i-n-e-r.

MODERATOR GLASER: From OSHA, if I recall.

MR. WEINER: Yes, that is right.

MODERATOR GLASER: Okay. This is just the cover of that report of the bibliography that we mentioned. And this is a compilation of world standards, at least as we saw them a year or so ago when we prepared a paper for publication.

And this is a statement of the current ANSI and ACGIH guidelines. And I already have referred to that. We might want to back up and see these, but this is the figure in particular that I was referring to. And this, this figure, is the average specific absorption rate on the Y axis as a function of the frequency. And the curve is, again, for a model of man, but if you will accept the modeling, you will notice that the curve is somewhat flat up here in the region above 1000 megahertz, above a gigahertz, and then begins to increase at frequencies below a gigahertz and goes through a maximum somewhere in the region of about 50 to 100 megahertz.

Now, this is absorption based on modeling, but that there is some data that suggests that this model is reasonably good first approximation.

Okay. While this is up here, let me remind you again of the general shape of the curve, that it is somewhat flat over here, it begins rises, peaks somewhere in the region of about 50 to 100 megahertz, and then drops off steeply at lower frequencies, and that different size subjects shift the position of that peak, so that small animals peak out here about a gigahertz and medium-size animals peak somewhere in the middle and animals the size of man peak down around 50 to 100 megahertz.

MR. SWICORD: For standing on a ground plane I think the peak is at 35 megahertz, something like that.

MODERATOR GLASER: Okay. That was a good point that --

THE REPORTER: I didn't hear it.

MODERATOR GLASER: -- Mays just made: that for a man standing on a ground plane in which you have imaging, the frequency at which the curve peaks is shifted to half the frequency, roughly, and that peak seems to be around 33, 35, 40 megahertz, which is pretty close to 27 megahertz.

MR. WEINER: But if I understood you, you also said from the size of a medium-sized animal to a man you went down several orders of magnitude. Did I misunderstand you?

MODERATOR GLASER: That is correct.

MR. WEINER: Well, that doesn't make any sense to me, to be honest with you. I don't know what the model says, but since it is a geometric effect, I don't understand how that small change in size brings about that enormous change in the absorption capability.

THE REPORTER: Mr. Weiner, can you move about 15 giant steps forward.

MR. WEINER: Well, I have said everything I know how to say, I think.

MODERATOR GLASER: If I may, I will not address that directly at this point. I will, if you would permit, I will chat with you after this, and we can talk about some of the studies and some of the references. And anyone else who is interested please join us.

What I would like to get to is the next speaker. But I

still have a few more things that I would like to mention here.

Okay. There are three terms that I think deserve to be defined. The first is "occupational exposure to radio frequency and microwave radiation," is defined as a exposure in any work place where RF and microwave energy in the frequency range of 300 kilohertz to 300 gigahertz is used or emitted above one-tenth of the occupational exposure limit as defined in the draft of the document.

Okay? So the levels here, the definition of occupational exposure is a level one-tenth of the exposure level.

Okay? Exposures below a tenth of that value are not counted as occupational exposure. In other words, a person who happens to be sitting at his desk, and on the 87th floor of some office building, and walks over to the window and looks out and happens to be receiving through the window energy from a broadcast transmission tower some distance away, coming in through the window at extremely low levels, even though that person is doing his job and is at work, that wouldn't be counted as occupational exposure.

Okay. The recommended values in the draft document apply to both continuous-wave and pulsed-wave radiation. And there are some statements of what the various portions, the frequence spectrum was broken down into segments, and I think that is shown on the next slide. Yes, it is. And of particular interest -- okay, and the reason it was broken down into segments

is for the reason I showed you on that absorption curve, where the curve is flat at the higher frequencies and then begins to rise and then peaks at somewhere between 50 and 100 megahertz and then drops off steeply.

Okay, the place where it is flat is, we have interpreted as about 2000 to 300,000 megahertz, or two gigahertz to 300 gigahertz. Between, moving down in frequency, between two gigahertz and 400 megahertz, the curve is, the absorption curve is increasing. So the reverse of that is that the recommended standard would be decreasing in that range. And the standard does just that.

Let's switch to the next slide, and we can come back to this. And again let me remind you that this is a draft; these numbers may bear no resemblance to the final document.

Okay. On the top is the -- let's look at this one -- the equivalent plane wave power density. And could you focus on the lower portion of the slide, please? Thank you. Equivalent plane wave power density, in milliwatts per square centimeter, is a function of frequency. This curve is the reverse of the absorption curve, in a sense, in that it is flat out at long wavelength, high frequency, it decreases, and you remember the absorption curve went flat this way and began to rise and then dropped down steeply, so it is flat out here at high frequency, it drops down in the region of frequency between about 2000 megahertz and 400 megahertz. And then you remember the absorption

curve went through a maximum, but because the position of that maximum is shifted by body size and ratio of fat to muscle to bone and other considerations, and the fact that the peak, which is about here, I guess about here, is moved to half of the frequency for a grounded man, so it would be over to here, the people working on this draft and the recommendation felt that instead of a curve that came down to a minimum and then started up again, that the minimum should be broadened to include these other considerations.

Now, some of the standard-setting organizations have felt that somewhere about 30 megahertz is the region that the curve should begin to rise. And because of the uses, heavy uses, in portions of the frequency spectrum below 30 megahertz, such as the ISM bands at 27 and 13 megahertz, the NIOSH draft was felt to extend this portion over to ten megahertz and then continue rising.

Now, we realize that there are some devices that operate just below ten megahertz, like around six megahertz, and this portion of the rising curve is slowly rising, so that six wouldn't be too far different than this base.

Okay? And then the curve rises up to a value at two megahertz and then levels off, because the people involved in working on this document didn't feel that to allow it to continue to extend without limit was appropriate; there was desired an upper boundary.

Now, also shown on this curve on this graph are the mean squared magnetic and mean squared electric field strengths, because it is felt that that is really the quantity that is desired to be measured.

And you may be wondering why the curve is solid out here and dotted out here. And that is because measurement of power density alone is not sufficient below 400 megahertz, it is felt, to determine whether or not a device or an exposure situation is in compliance or out of compliance.

And that refers us up to the other two curves. You will notice that for the mean squared magnetic field strength, that is solid below 400 megahertz. And it is felt that magnetic field strength measurements are the desired measurements below 400 megahertz. And the curve is dotted above that. And the same thing up in the electric field strength: that that curve is solid all the way across, because that is the desired measurement throughout the entire region.

I did see a question or two. I will tell you, let me continue with a few more of the comments. We will, if time permits, take a few questions. I hate to be in the position of deciding whether or not I answer questions; I think that is a bad policy. I perhaps should have asked Frank or Mays to be the moderator at this point. But we do have a couple of more formally constituted presentations. I would like to get them in; I would like to finish by five. And also I didn't, as I say,

really come here prepared to present this and discuss this, but I would be willing, to the extent of my ability.

Another, well, we could back up one slide. And this is a statement of the curves you just saw, the mean squared electric field strength, mean squared magnetic field strength, equivalent plane wave power density. You can plug values in, or you can extract from these numbers and these terms the value. "F" stands for the frequency in megahertz, so that you can do this on a computational basis.

Okay, the exposure standard, of course, is based on absorption. And it is different, indeed, from an emission standard, which is based on the amount of radiation emanating from the source, such as a microwave oven.

I have defined "occupational exposure" to you. I now would like to define, well, we have already addressed the action level. And Dave West made some excellent comments on that. So I won't go into that, other than to say that the action level is a value which was put in for two reasons, at least: one, because it is felt that because of the errors in measurement and the possibilities of difficulties, and the statistical considerations that a value should exist which to exceed would mean the likelihood is that there might be a value exceeding that or exceeding even the exposure level, the occupational standard, if this does develop into a standard, that there should be a value. The other reason is that the action level is meant to be sort of an

inducement for employers to want to keep the exposure levels as low as possible.

And why? The reason is that if you maintain your exposure below the action level, then a number of requirements that the standard discusses will not be necessary. And the action level is used to trigger personnel and medical monitoring activities that are not required for employees exposed to smaller, lower intensities of RF and microwave energy. And I think that is an important consideration.

Okay? It is recognized that the standard does impose, or the proposed standard imposes an additional burden on employers, on the plant owners and so on. And if they can, indeed, show that the exposure is below this level, there will not be necessary the detailed medical monitoring and record-keeping and so on.

Okay. The document contains a recommendation for what should be included in medical monitoring. The document talks about labeling and posting of signs around RF-emitting devices. It talks about informing employees of the potential for a hazard. There are recommendations for work practices. There are recommendations for engineering controls. There are requirements for monitoring and record-keeping, monitoring of E and H fields, power densities, and so on.

And I said there were three terms I wanted to define and describe. The third one was the occupational exposure level,

and that is what was up on the slides.

I think, in the the essence of time, I will stop at that point.

Oh, I would like to say a few other things. One, that I am sure you are all aware that there are other groups that are working on and thinking about standards and modifying the standard. One is the ANSI, American National Standards Institute, C95.4 group, which has a draft of a standard that is being considered by the committee. Our good neighbors to the north, the government of Canada has recently come forth with a standard. And Dr. Maria Stuchly, who you heard from today, is one of the people involved. I asked if she had copies of that standard with her, and she did not, but she said that anyone who desired it could write to her and she would be happy to send a copy to them or whatever is necessary to get a copy. And I can leave her name and address for you.

And there are other proposals and recommendations. Could we have the slides back on? I think there was another figure. Skip over the next one and go beyond that. Okay, this is a proposal by the Australian government. And you will notice that the general shape of the curve is much similar to that that ANSI, that the NIOSH draft is looking at: it is flat out at high frequency, it goes through a decreasing quantity down to a plateau below 100 megahertz, and it is essentially flat between 100 megahertz and about 30 megahertz, and then it rises steeply below

that.

The values on the Y axis are a little bit different than other countries' values. This is lower than the NIOSH and the ANSI proposal. But I believe this is meant to be a general population standard, not an occupational exposure standard.

I will stop at this point. And I saw a few hands, I saw a couple of people walking to the mike. Mays, would you moderate at this point, please. And would you leave enough time so that your presentation can be accommodated.

Oh, and there was one other thing, and I owe an apology to Mr. Rothstein: I had wanted to give you the time to say some comments. So, Mays, will you consider two presentations, please.

MR. HUANG: Hank Huang, DuPont Company. I would like to comment again concerning the action level. So far the reason presented appears to be it is under the, it was set up under the presumption non-ionizing radiation is carcinogenic. And I don't think there has been report proving that is the case.

Comparison to trace chemical cases I don't think is applicable here.

That is point number one.

The next point --

MODERATOR GLASER: My response to that is that the recommendation is not based on the assumption that it is carcinogenic.

MR. HUANG: Well, the next point is that the reason, it

also had been reasoned that it is a statistical concept used in enforcing or making sure that it is safe.

I would like to think our agency would set up a standard such as statistical error in instrumentation measurement or even the knowledge of safety level should be already taken into account when a maximum exposure level is set up.

So if that is the case, then why should we apply the same statistical concept again to set up a new level, action level?

MODERATOR GLASER: I will accept that as a comment and not a question.

MR. HUANG: Right, a comment. The next, third comment I had, is the need of certain level to entice, or, shall we say, force, industry to keep their exposure level to lower than, far lower than exposure level. We feel in practice the dose item should be left to the discretion of individual management of individual plant, because it is regarding the administrative control procedure.

When a government standard is issued to industry it is known each individual industry will set up their own administrative control procedure to make their exposure a lot lower than what the government procedure has set, the standard government has set. Therefore, if government agency do that for the industry, it will force the industry to further add another safety margin onto action level and push it into substantially lower

level, which may make the economics of any new application unattractive.

MODERATOR GLASER: I will also assume that that was meant to be a comment. But I will add to that that there are many representatives of environmental groups and representatives of labor who will debate, I believe, the point you just raised. I won't say anything further about that.

MR. DUERR: Yes. Lorenz Duerr, W. T. LaRosa and Associates. In light of all your data shows that unshielded dielectric heaters show significant higher radiation levels, will all manufacturers who only supply shielded equipment have to comply with the proposed amendment as defined in Docket 79N 0260?

MODERATOR GLASER: I think what --

MR. SWICORD: He is talking about what, an OSHA requirement?

MODERATOR GLASER: What is 79N --

MR. DUERR: This docket that was just handed out this morning.

MODERATOR GLASER: This is the reporting requirement for RF devices? I am not really in a position to respond to that.

MR. DUERR: Is anyone?

(Pause)

MODERATOR GLASER: Is the BRH reporting?

MR. SWICORD: What are you reading from, sir?

MR. DUERR: It is the one that you made available.

MR. SWICORD: What is the title on that?

Oh. This is the reporting requirement? All right, fine. Yes, everyone will be required. It doesn't matter whether you have shielding or not. If you are a manufacturer that fits that category, then you will be required to report.

MR. DUERR: But the categories really then only say RF sealers and electromagnetic induction heating equipment.

MR. SWICORD: That is correct.

MR. DUERR: Okay.

THE REPORTER: Sir, would you spell your last name?

MR. DUERR: D-u-e-r-r.

THE REPORTER: Thank you.

MODERATOR GLASER: We will have one more question here. Lee?

MR. TUDBURY: My name is Tudbury, T-u-d-b-u-r-y. I represent Thermo Tool Company in Stanford Connecticut.

In going down to 300 kilohertz, I would like to point out that you are opening the field to induction heating, the heating of metals. Most of the induction heating, or much, much of the induction heating takes place up to about a half a megacycle, 490 kilocycles.

I wonder, my first question is, is it necessary to go that low? Because this industry involves maybe 5,000,000 kilowatts of installed capacity. It is a big industry.

MODERATOR GLASER: Well, I think you just hit on the reason why it is felt that there is a need to go to that low a frequency. The reason is that there is no standard at the present time, but there is a great deal of equipment capable of producing exposure of individuals.

Now, the people involved in working on this draft recommendation felt that because of the fact that there is the equipment, there is the potential for the exposure, there is no standard, and there is biological data which suggests that there may be some interaction and some effects, that that should be addressed. And that is the reason why the frequency was pushed down to that, then.

MR. TUDBURY: Then may I ask, on the Australian curve it continued on up and it stopped at one megacycle, on the curve that you showed that was similar to it before you came up to a maximum, I believe, of 25 milliwatts per square centimeter, and then went horizontally, had you gone along with that curve it would have been much more realistic from the standpoint of that industry.

MODERATOR GLASER: I think what you have just said is that there are high exposure levels and that --

MR. TUDBURY: Magnetic fields, yes.

MODERATOR GLASER: Yes, sir. And the feeling of many scientists was that magnetic fields are capable of coupling with biological tissue and that the value should not be allowed to

rise without limit.

MR. TUDBURY: This is the first time we have seen anything in the two days here that was below in the order of ten megacycles.

MODERATOR GLASER: This, what you just saw, was not really meant to be a part of this workshop. The only reason I put it up there was to respond to the questions that were asked about what will be happening in the three-to-100 megahertz region.

So I don't think we should really consider that a fact in this proceeding. I don't mean to be rude to you. It just was not intended to be that type of involvement.

MR. VASSALLO: Just one question. Angelo Vassallo, Solidyne. I would like to know if copies of the slides which have been shown within this two-day seminar would be made part of the transcript.

MODERATOR GLASER: I had requested that all of the people making the presentations provide us with copies of those slides. I would hope that people will do that. I don't think it will be part of the formal transcript that is going to be immediately available. But perhaps if the agencies involved feel that that is possible, that it can be --

MR. VASSALLO: We would like to have copies of one of the charts and tables. Thank you.

MR. TIPTON: I can answer that, to the extent that the

speakers submit photocopy-able graphics, we can make them available from our docket office.

MR. VASSALLO: Thank you.

MR. SWICORD: I see we have nine minutes left. That is four minutes for me and five minutes for a second speaker.

Most of the remarks that I had to make really have been made, in one form or another. So that I will simply make a brief review.

The RLG committee, which I discussed yesterday, has outlined a plan of action which requests various agencies to perform various functions. These functions have been discussed with you, for the most part, today.

For example, the BRH is to continue development of a RF radiation survey technique for RF sealers, to come up with a simple, inexpensive, and useful an instrument package and procedure as possible.

There were many questions concerning instrumentation this morning and throughout the day. We recognize these limitations. We also briefly recognize that the problem of measurement of both the electric field and the magnetic field would not go away, and we are bound to have to measure both of these quantities, as well as report, probably, both of these quantities. A lump quantity may not be possible.

But it will be our task to give lead role in that development. And some of the schedule that will follow is as

follows.

We will try to have a draft, or we will try to, first of all, find out what industry can do, possibly support a contract in the development of instrumentation, and that will be initiated immediately.

We will complete a prototype survey procedure by December the 1st of this year, hopefully, and forward this to OSHA, who will then evaluate this procedure in the field by February the 1st.

The second general item will be that the BRH will continue with their contacts with the RF sealer manufacturers and users to document the exact types of equipment already in use and now being manufactured, to document existing provisions made to shield against emissions of unwanted RF radiation, and to document the difficulties encountered in applying and manufacturing various types of protective shielding.

Under that we will try to have a report on shielding techniques by February the 15th. These are goals which are not always met, but you get some feeling for our objectives.

For example, the goal for this meeting was to be held on July the 30th.

All right. Under that item, OSHA, as reported earlier, will brief, and they have already begun to brief, their field staff on the hazards of RF sealers, et cetera, on the possible hazards of RF sealers.

Next, OSHA will continue to respond to their inquiries as Bob Curtis elaborated. And I won't go into detail on that, except someone asked for a benchmark or goals: we will try to have by March the 1st from OSHA a training film produced for their field inspectors and a survey instrument ordered for their field inspectors.

All right. In order to -- we have already announced, and we can discuss after this meeting, I think, since we are running out of time, the fact that the bureau will publish, has published a Federal Register notice requesting information on the listing of RF sealers. And that is, has been made available to you, and we can answer further questions about that perhaps after the time period today.

We are not ignoring the fact that data on biological effects is not complete and sufficient. We are requesting at this time that all the agencies and the collective group include in their plans objectives which will address these problems and, in particular, address the problems of dose rate and dose rate distribution that we discussed earlier and yesterday to some extent.

At the end of this particular proposed program, which will be about March the 15th next, this coming March the 15th, the committee will meet and consider all of the information that is collected from these various aspects of the project and send recommendations to the agencies at that time on what action the

committee feels like is appropriate.

I think that I will cease with these abbreviated remarks right now, unless there are any further questions, and call for -- who is the --

MR. ROTHSTEIN: Mr. Rothstein.

MR. SWICORD: Mr. Rothstein. Would you mind coming forward.

MR. ROTHSTEIN: I will abbreviate as much as I can and leave out a few things.

MODERATOR GLASER: Take all the time you need. No, no, no. We will continue on.

MR. ROTHSTEIN: Some people, or maybe most of you, don't know what it feels like to be heated by RF or to have an RF burn. Essentially, there are these effects. You can get a burn, which you get by touching something that is close to this high frequency machine, and it is an instantaneous burn. It is as hot as the burn you would get from a gas flame or a soldering iron. It is very fast and it is very concentrated. And it hurts temporarily and it heals in a few days; if it is very bad it takes a few weeks. And it does not seem to be serious, from my experience, and I have had lots of them.

The other effect, the heating effect, is a kind of a slow thing. And the closest I can relate it to is heating from an infrared lamp. Your body warms up, or your hand warms up, or your feet get warm, and when they feel pretty warm you just want

to get out of there, get away and stop getting warmed up.

I have had many, many cases of RF heating. And when it gets very uncomfortable I just walk away. Sometimes if I have an ache I will just let my hand stay there and warm up and the ache may go away; it is self-medication, and I know what they say about he who doctors himself, but I am still alive after about 30 or 35 years of this.

But what I want to do is correlate that heating with ten milliwatts per square centimeter. Now, if I touch that, the plate of one of those machines you saw, now, on the pictures, I can feel a warmth in my fingers and up the arm if it is much more than ten milliwatts per square centimeter. When it gets down below that, the feeling goes away; it is just if you know what to look for, you maybe can feel it somewhat below, but if you don't know what to look for, you just won't feel it.

And my thinking is, just from that qualitative data, that ten milliwatts is a good level. I think it is reasonable. And I think it ought to be perpetuated and not squeezed down to a much lower level.

We can relate the heating in the fingers, where we can feel it, perhaps to somewhere in the body where we can't feel it. If the ten milliwatts -- if we are below ten milliwatts in the fingers and we can't feel it, if we have ten milliwatts internally it perhaps won't do any damage either, or, rather, if we have less than ten milliwatts it won't do any damage.

Now, the ten milliwatts is fairly easy to achieve. You saw on some of the pictures how it was done. And I want to give you some idea of the costs.

That shielding you saw in a Solidyne machine is a little bit more elaborate than you need. And that can be done in the order of a few hundred dollars, sometimes as low as a hundred dollars. That is a quite reasonable cost.

You saw that Compo machine: that was a more elaborate shield and that you might say you could estimate maybe would be seven or eight hundred dollars, somewhere in there; and that is on a $20- or $30,000 machine. It is nowhere near 60 percent of the cost of the equipment.

One of the reports showed four milliwatts for one of those auto trim presses. Now, my guess is that when that press was first built it would show zero. And the reason it showed four I don't think was an instrument reason. I think the shielding has gone bad.

Now, that, those phosphor bronze fingers you saw, or springs, break, they also have faulty contact because of dirt that accumulates on that plate, and you get little sparks through the dirt, and the sparks eventually make holes in the phosphor bronze and they destroy the effectiveness. It is like putting those sheets of plastic between the springs and the bed plate: you destroy the shielding.

So somehow after the manufacturer of the equipment gets

through making a machine that meets ten milliwatts or five milliwatts, a decent level, it has got to be checked out, every year or every three years or every six months, depending on the application.

Okay. Our experience with FCC regulations shows that if the regulations are too tight they are not going to be observed. And if the regulations are reasonable they will be observed by reputable manufacturers, and there will be some people who don't, who still don't, observe them. And we have found that the problem is not with the level when it is reasonable but with the policing of the level.

What happens is that some people observe them and others don't, and the FCC doesn't have enough inspectors around to check on who is following the regulations and who isn't. So that if OSHA sets their specifications to a reasonable level, most people will follow them, but there will be some who won't; and if your inspectors are not around to check, these people will be endangering the workers, they will be breaking the law, and you won't be protecting anything in those areas.

You will find there are people who build their own machinery. You won't be able to check them through established manufacturers. So you will have to check these conditions out by your field inspectors.

Now, I don't know how your field inspectors work. Do they, are they working nationally, or do you have state, the

state labor boards generally check on these, don't they?

So all the state labor inspectors will need instrumentation.

A word about instrumentation. And maybe you can help me. I have been using this RAHAM-2 meter made by General Microwave. And it is not too accurate, I gather. But what I try to do, is get the level perhaps ten from -- instead of ten milliwatts per square centimeter, I will get down to five or three, and I consider I am probably within where I ought to be.

Now, on the H field I have a homemade instrument that I rigged up using the NBS model. And that seems to, it gives me a fairly indication, I think, and if I keep the field level to half or a quarter or somewhere low, whether that, if that instrument is off by 20 or 30 percent, I feel I am still within range. And I have my hand to attest to it.

When I get that range, when I get it down low enough and I touch the machine and I don't feel anything, I feel pretty safe. And one of the ways I have for testing before, and as a matter of fact I used this for years and years before there were any instruments: I would put my hand on a machine and if it didn't get warm I felt it was safe.

And I have had lots of tests and lots of heating. I play the piano. My fingers haven't been hurt. I think the ten milliwatts is a good number.

But these instruments, it seems to me, ought to get

down for much below $2- or $3,000. Then, if we had that, if we had them at a low enough cost, perhaps we can even get users to buy the instruments and check and keep their own maintenance, do their own maintenance. It is possible.

I have an objection to what Dr. Stuchly mentioned before. She said when they get above one milliwatt they have to worry about all this damage that is going on. Now, that seems to me is a wrong attitude. They should think about possible damage but not say that above one there is a serious problem and we had better look into it very carefully. Maybe we should be looking into it carefully, but not as a serious problem -- as a serious potential problem perhaps.

I was at Solidyne for about 30 years. And in all of that time I had no health case reported whatever. I had accident cases, but no real serious, no serious health problem. Now, I don't know what that proves, or we had thousands and thousands of machines and maybe there were cases of some kind of health problem caused by these machines and nobody knew what to ascribe them to, but there really were no serious problems.

Now, I don't know if that kind of data can help you any. But that really I would say constitutes 75 percent of the heat sealing machines in the country, a large number.

Okay. Now, I had one other comment. Their Dr. Schneider -- was it? Mr. Schneider? -- mentioned that in a low, a small sample you could not use, you could not use a small

sample for meaningful calculation. He said that he could predict in 20 years with 25 people one case of cancer due to 50 rads radiation. But nobody here has said that there has been any sort of disease, whether cancer or common cold or anything, from these machines. There has been no such data at all. I just, I have not heard it, and nobody here has reported it. Is that correct?

Okay, I think that is as far as I want to go. I will answer any questions.

MR. HUANG: Hank Huang, of DuPont Company. I want to add one more comment.

Mr. Rothstein mentioned unnecessarily low safety standard will make it highly costly, or it will increase the manufacturing costs. I would like to point out all the survey results reported so far shows that a good shield can reduce the exposure level or worker exposure level to substantially less than ten milliwatts per centimeter square. However, none can keep exposure to below 0.5 milliwatts per centimeter square action level over long term, or I haven't seen any data as shown in these two days say a reasonable and simple shielding technique can keep exposure level of the worker working around heat sealer to keep it way below the 0.5 milliwatt level which the current NIOSH criteria document seems to be going toward.

What really I am saying is, to reduce shielding to a certain level is, there are technique and it is a lot easier.

But once you push it to way, way very, very low level, it is and it could get below the level of ability of the state of art.

MR. ROTHSTEIN: I agree with you. And this, these low levels could be set up in the original machine, but because maintenance would have to be on a daily basis, or hourly basis maybe, to keep the thing in proper shape, you couldn't maintain it.

MODERATOR GLASER: Paul, would you care to comment on the ability to get down below a certain level? I don't mean to put you on the spot, but I guess I did.

MR. RUGGERA: No, I would like to see it done cheaper. You see, when I came into this meeting two days ago I thought that it was going to cost, you know, the two-thirds of the cost of the machine to shield. But all of a sudden I got, when I visited Solidyne, I think they were talking maybe 20 percent of the machine. Now I just heard it is down to $2- to $300. Gee, we are doing good if you can keep the numbers up like I showed on the thing, we will have it down to a very nice thing pretty quickly.

MR. ROTHSTEIN: I left out a few things.

MR. RUGGERA: Oh.

MR. HUANG: If I may add -- Hank Huang again -- Paul, I believe, meant for, not for the case which the pieces is smaller than the box. I meant something bigger than the press. So you would have to continuously feed it. And I think during these two

day I have yet to see data show or convince me that the design could keep the exposure level to less than 0.5 milliwatt per centimeter square over long term, say, let's say, 25 year or lifetime of a radio frequency heat sealer. I haven't seen one in these two days.

MR. RUGGERA: Well, actually I did show a picture of one. The wood dryer machines certainly were below the level. I had no problem with those. They were very big machines; and I don't know how long they had been in press.

MR. HUANG: It is a wood dryer, not heat sealer.

MR. RUGGERA: Well, it operated at 13 instead of 27. But --

MR. HUANG: No, no, no, I think a lot of my colleagues here from industry, most of us operate processing machines which are automated and which we can provide radio frequency choke, kind of keep it way below. And I agree on that case you can keep it very low. But for a heat sealer the situation is quite different, and you do see there are pieces being heat sealed by radio frequency which is a lot bigger than the press. And I don't think there has been a case you have cited is such a case like real big one.

For instance, your data showing putting 20 mil plastic sheet on both side is enough to increase it little bit, and that is already adding to 0.5 milliwatts centimeter square.

MODERATOR GLASER: I would respond to your earlier

comment. And I will do again not as the moderator but, instead, as having received comments and criticisms on the draft of the NIOSH document.

One of the criticisms was that there is a whole body of bio-effects literature, much of it from the Soviet and some East European countries, that claim there are effects at extremely low levels: in view of that, how can you consider a standard, a recommendation of a standard so high?

Now, there doesn't seem to be anybody from an environmental group or a labor group that came forward to say that. I am only telling you what has been said to me. And again, I guess we could consider that in the form of a comment, not a question or an answer to a question.

I would like to thank Dr. Rothstein for his --

MR. ROTHSTEIN: Not Doctor.

MODERATOR GLASER: Mr. ROthstein -- excuse me -- for his valuable comments, and to say that we didn't mean to put him last on the program. But maybe I can say we saved the best for last.

If you need more time to elaborate, please feel free to take it. I would also like to ask if there is anyone else who would care to make a statement or care to make a comment, to please do so.

There is one situation that I would like to ask your opinion on. And I think it is in line with what you said.

Could we have that slide, please. And would it be possible to darken the room?

This is a situation on a sealer. I don't think the manufacturer of the sealer provided this; I don't know it for a fact. But it seems to me that someone rigged up a die. And I have a couple of other shots which perhaps show it better. I just grabbed this first one. This was meant to allow -- and what it is are two plates that are connected to the active electrode in the base plate, I guess, which convey the energy out from between what the manufacturer called the active electrode in the base plate, bring that energy out about 18 inches beyond the edge of the machine. And apparantly the reason for this is so that the people who are using the machine would be able to get a seal in the bottom of something like a bag, like a pocketbook; and I think that is what this was used for.

Now, I don't remember what the measurements around here were, except that they were pretty high, measurements of the field strength. Perhaps other do.

Paul, I think you were there making some of those measurements. And again, I don't mean to put you on the spot, so I won't ask you.

I would like to ask Mr. Rothstein if that is the sort of thing you were referring to, that when the sealer leaves the manufacturer's plant it may have been designed in some way and here is a modification which either the manufacturer said could

be done or somebody else said, it doesn't matter who said, it was done. And this complicates the situation.

Now, maybe this is the sort of situation that the exposure level needs to be concerned with, and maybe this is why OSHA might want to take a look at that.

MR. ROTHSTEIN: This surely needs an exposure level check, because while it looks as if there is a way to shield this, there really isn't. What isn't shown here is the product that goes into those dies. That product will hang out in such a way that you just will not, probably won't be able to put shielding on it.

But there is an answer. And the answer is to use one of those turntable devices. And it makes the equipment somewhat more expensive initially. But probably on a productivity basis for the user it will be less expensive in the long run.

What would be done here is, these, this die would be on a turntable which the operator would drop material onto, and then the die would rotate into the sealing press and where shielding could come down and cover it up.

I want to add to what Hank Huang pointed out that oil boom picture you saw shows a very difficult shielding problem. That kind of machine could not be shielded for two or three hundred dollars. That would take a totally different kind of treatment. And that might cost many thousands of dollars to solve the radiation problem. But that is an oddball; there

aren't many of those.

I heard these statistics from time to time. And I didn't want to tell this, but I will give you some idea of the statistics problem that could arise.

In the first few years of working with this equipment, I got married and I had a son, and a year later I had another son. And after a few years I had another one and then another one. That was four. And then we looked around at all the people working in the proximity of these machines, and we added up 23 boys and three girls. And I said, "Oh, boy, we are going to sell a machine for under every bed in the country. What a market." But the girls then came along and they kind of evened out.

So the statistics, I don't know, the Russian statistics are, I would say, in doubt. There are not really many pieces of equipment operating in Russia doing this heat sealing, that I know of. And many of them, or maybe most of them, are made outside of Russia. And they are using equipment like what we have here or like European equipment. And they are not, I don't think they are enforcing those very, very low levels.

MODERATOR GLASER: Another good observation. This is a second slide in the same series showing the same sealer with the same plates. And since you said it is hard to visualize what the situation is, this, I think, does show what you can see just off to the right corner at the bottom is the chair of the

operator. And this shows that the RF energy is brought out on those two jaws out about 15 or 18 inches, I believe, over the edge of the machine to just about the lap of the operator.

I am sorry, I didn't mean to belabor that point. But I did want to bring it in.

Was there any other question or comment on Mr.Rothstein's point? I noticed that Mr. Vassallo was coming to the mike before.

MR. VASSALLO: Angelo Vassallo, of Solidyne. The only thing I wanted to say, and I am sure Mr. Rothstein agrees with me, that the figure for shielding of $100 to $300 is a very, very simple way of shielding which we would not recommend for most of the applications.

MR. ROTHSTEIN: You would not recommend?

MR. VASSALLO: Well --.

MR. ROTHSTEIN: What you showed on your picture is fine.

MR. VASSALLO: What we showed on our picture, I don't know, I was not here at the very beginning, I don't know if they showed it complete, that definitely cannot be done for $300; it is much more. We are using one-eighth of an inch aluminum.

MR. ROTHSTEIN: Well, it is a little more complicated.

MR. VASSALLO: It is more complicated, right. So very simple shielding might not do the trick all the times. And I am sure you agree with me.

MR. ROTHSTEIN: Well, no, it did -- on your machines. We made those measurements.

MR. VASSALLO: Yes, but that was more, the one that was in the picture was much more than --

(Pause)

MR. FRANK: I would like to make a comment next, if I may. May I make a comment? Robert Frank again.

That number 17 on that machine is my handwriting. I can get the record straight. That gadget was not on the machine when I tested it.

(General laughter)

MODERATOR GLASER: Thank you for that firsthand report. We might even say first right-hand report.

MR. HUANG: May I add on -- Hank Huang, DuPont -- I was commenting that machine certainly doesn't look like only cost $300 to complete those sheets of shielding. It looks like going to cost more than $300.

But what I came up here to comment on, on the Russian low level standard, which Mr. Rothstein said maybe Russia is not avoiding, but I would like to comment on the fact that the both groups, one in U.S. and one in Western Europe and one in Eastern Europe, the philosophy of setting an exposure standard are quite different. We tend to look at it as if it is safe then it should be, the safe standard should be the level which show statistically if a worker is exposed to less than that level it will be safe

But in Russian they tend to select the standard so there is no effect whatsoever; whether it is damage or whether it is a beneficial effect, they do not take that into consideration, because the philosophy of their approach is, well, if there is an effect, then we might not know what the long-term end result is. Maybe it is beneficial now but may be bad later.

But in Western Europe we don't look at it that way. We look at, say, okay, the safety standard should be the level statistically picked so if worker is work below that, based on all known existing data, they are safe.

Just wanted to make that comment.

MODERATOR GLASER: Thank you. Is there anyone else who would care to make a comment? I would remind you that the Federal Register notice of this workshop indicated that it would be possible to submit written information, into the hearing clerk, I believe, and the date that that could be submitted up until, I believe it is, October 12th. Is that correct, Frank? I remembered that date because it happens to be my birthday.

Thank you. You might remember that it used to be Columbus's birthday, too, until they changed it.

I would like to ask that if you haven't already picked up one of these comment sheets, that we really would like your comments on this workshop -- comments, criticisms, hopefully, in a constructive sense. We would like to know if we did something of value here in the last two days.

I can't think of too many other things to say, except that Frank Tipton has a few closing remarks that he would like to share with us. And so this may be my last turn at the mike. And you are probably glad of that.

Thank you.

MR. TIPTON: Before we close this afternoon I did want to make a few more comments. I want to clarify a few things.

There was a remark made somewhat earlier about our commitment to a new proposed standard. I can assure you that there is no commitment on the part of the OSHA health standards programs office to any specific new proposed standard at this time.

However, I think I should point out a few current realities. As Chuck Gordon discussed yesterday, there is, or, if you will, may be, a problem with the enforceability of our current standard. I think we could all agree, based purely on logic, if nothing else, that RF energy, RF radiation, is hazardous at some level. Therefore, it would appear that since the working population is exposed to this energy that some standard is needed.

In addition, I think we should be mindful that there are many person in this country now calling for a new standard or for a look at, a reexamination of, the current standards.

In that context, I would like to quote, admittedly off the top of my head, from the OSHA act. Chuck Gordon mentioned

that our authority for promulgating new standards derives from section 6B of that act. If you were to consult that you would find language something to the effect that we are to protect workers' safety and health to the extent feasible and based on the best available evidence. As I have remarked to others many times in the past but never before on the record, it says "best available evidence"; it does not say piled the highest. I consider that a crucial distinction.

I would like to comment on our standard proceedings a little, if I may. One of the things that we do as a standard proceeding, if you will, is examine whether or not a new standard is needed, even if there is a somewhat indicated need would it warrant the work involved in view of competing priorities for the agency.

In pursuing a standards project, the result of such a project may be that the same exposure levels are contained in a new standard which may also have other provisions. A standard proceeding may result in no change in a standard because of the evidence accumulated on the record.

It is also possible that once a proposal has been published -- proposed, if you will -- that no final may result. I am the proud project officer of just such a case.

But remember: for OSHA, under the Occupational Safety and Health Act, the crucial terms are on the record. I not only ask you, I implore you to not let the record be one-sided in your

judgment, particularly if it is one-sided because of something you did not submit.

If you believe that there are data, views, or arguments that are not properly reflected in the record of an OSHA rule-making, correct that situation.

There is only one way that OSHA can justify its standard before the Court of Appeals. That is on information that is in the record.

The record includes transcripts such as this one, such as of the formal rule-making hearings. It includes submissions that any of you may send in and includes any reference works that we can find.

I would also like to take a moment to comment on the concept of an action level. In my personal judgment, the best justification for an action level has not been mentioned.

Consider the compliance effort, the enforcement of a standard. A person walks into your plant, into your place of employment, and has to make some decisions. One of those decisions is, is there exposure. The next question is, is the exposure too high?

I believe that you will find several of our standards, both on the books now and in draft form, contain many provisions which are prefaced by the comment "when there is exposure." How are we to define that? I submit to you that the action level provides that definition.

If you are below an action level, regardless of how it is defined, then you are, essentially, not in an exposure situation.

Remember the action level does not constitute a new exposure level. It is a level separate from what is considered permissible for any employee exposure at any time.

I would like to point out for you that those sign-in sheets which you, presumably, have signed up on have now been copied and are available in the anterooms at the rear of the auditorium. I would invite you to take one. They are as good as xerography will permit.

On behalf of OSHA and BRH, I would like to thank you all for your participation here at this workshop.

As we have mentioned more than once, we would appreciate receiving your comments concerning this workshop. It could be questions, criticism, even compliments if they are to be had. Either submit them now or even by mail upon your return home.

For my part, as a part of the office of standards, I can say that I find a meeting like this most useful. And for any of you that have attended a rule-making hearing of our agency, I think you can easily detect a slight difference in approach and a slight difference in the way that information can be presented.

Both the Bureau of Radiological Health and OSHA would like to have any specific information or opinions that you would like to share with us. I think I can speak for Zory and the

bureau when I say that our mailbox is open.

Now, the directorate of health standards programs in OSHA, which is the office responsible for the development and the promulgation of OSHA standards, is, of course, looking for the views, the data, the arguments of anyone concerning RF sealers or, in the general case, dielectric heaters. I would invite any of you at any time to pick up the phone and call myself or David Lee also in my office. My phone number is in the notice. It is 523-7174. Dave's phone number is 523-7151.

At the same time, you should feel free to call Zory Glaser for information about the BRH program or comment upon it. His phone number is 443-3429.

Once again I would like to thank you all for being here and spending your time with us. And on behalf of the two agencies, I certainly hope that you, too, feel it has been worthwhile.

Thank you very much.

(Thereupon, at 5:45 p.m., the conference concluded.)

CERTIFICATION

HEARING TITLE: JOINT BRH-OSHA PUBLIC WORKSHOP ON RADIOFREQUENCY SEALERS, HEATERS, AND GLUERS

HEARING DATE: September 13, 1979

BEFORE THE:

UNITED STATES DEPARMENT OF LABOR

I hereby certify that the proceedings and evidence herein are contained fully and accurately in the material taken by me at the hearing in the United States Department of Labor and that this is a true and correct transcript of the same.

DATE: Sept. 18, 1979

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