Another large change in this protocol compared to the '95 report is the redefinition of the air kerma strength and the slight change in the dose rate constant. So those are some new things that we'll cover in greater depth this morning. Also covered and presented new will be the methodology upon how the AAPM will is. issue a consensus data set instead of author A or author B preparing data and saying mine's the best…No, mine's the best. And there's some competition going on here. We believe we've developed an objective methodology and how we can have a society promulgated and supported consensus data sets for use with brachytherapy, treatment planning software vendors, as well as those physicists who will check such data if it's pre-entered into the software planning data. Here's some other. I say other, we. we'll discuss this in greater detail, other, I won't say minor improvements but just too many to summarize on this one slide. And then some what I like be. being an investigator who in turn calculates some of these dose distributions or measures them, we have some recommendations to assist the efforts of reviewing future articles. There's been a great disparity and a gr. large variety in the level of detail that people will include in publications of various parameters, be the requisite brachytherapy dosimetry parameters, or summary of, you know, clinical experience, there needs to be some minimum de. description. That's to permit people to scientifically assess what has been done and how to compare with future efforts. So in addition to, let's say retrospective reviews of clinical data, we also make recommendations on how individuals should. how institutions perhaps, should implement this report and what levels of clinical QA, etc , should be included. So one of. the next to the last topics covered will be some published comments on the pros and cons of this approach. Let's say this TG-43 like approach in comparison to let's say along and away tables. And then also some criticisms of it and then we'll cover some corrections to it. Nothing's perfect and this 40+ paper has a few mistakes that we'll gladly share with you preceding a publication of an erratum which should come out in a few months So here's the 2D brachytherapy dosimetry formalism. I imagine you all took the initiative to come in so early in the morning, you're probably interested and perhaps even well versed in the previous protocol of the '95 TG-43 report and may even be well versed in the updates and what's being implemented here and…So we have the. so I'll only cover this relatively briefly and focus on the differences mainly of how this improves upon the '95 report. So the dose rates again calculated as a function of distance and polar angle is determined based on the mul. multiplication, I guess the division of one term, primarily the multiplication of a variety of parameters. Now there. some of these terms may be compared to physical properties. You may say oh, well the geometry function that generally has a sense for the solid angle, that term merely follows the solid angle and the source strength here, kerma strength, that seems to be related to apparent activity or. or other terms which have been used in the past as well as, let's say, tissue attenuation ratio. In the past that seems to be maybe similar to the radial dose function. Or perhaps a _______. But we. we do not claim that. that any of these parameters will follow the exact response or behavior of any physical parameters. Rather, we believe that this protocol presented here has two advantages in comparison to implementing, let's say, a variety of physical effects. One, it's relatively simple and you can imagine that we have some publications that a variety of authors have put forth. You can imagine if you very rigorously try to have any one of these parameters model the physical effect, there would be an increase in the complexity of this equation or any one of the parameters. So one thing that. th. this is easy to do. This is relatively easy to implement and it's not asking a lot from the diversity of brachytherapy treatment planning software vendors as many of them would need to attest and assure that this is followed properly. So we didn't want to make significant changes or large changes from the previous report, the '95 report. The. you know, just want to keep back. go back to the focus and keep to why these, you know, what these parameters are and how they differ from the '95 report. I'll explain in a subsequent slide the improvement to the air kerma strength parameter and the dose rate constants. The radial dose function as presented here, there was. I. it might be equation

two or three of the 1995 report, I don't remember, but it was early on and it was similarly a 2D dosimetry formalism, but what was present was the. there was no clarification as to what the radial dose function was based upon. The radial dose function was defined to be related to the dose rate, let's say on a transverse plane, with a removal of the geometry function as it's now called instead of geometry factor, it is a function of two parameters. Well, the. you could have the same radial dose function as you used in both the 1D and 2D dosimetry formalisms. And what would happen is you would think that if you actually calculated dose rate distributions and then found out what the appropriate parameters would be and then within the planning software you'd want the system to reproduce, be. be it calculated or measured dose rate distribution. Well, there'd be some errors. There'd be increasingly significant errors the closer you get to the

brachytherapy source and that would be because the ambiguity in what the geometry function as used in the radial dose function, be it the 1D or the 2D, that would become more and more significant. So now we believe it's very important to not only profess or state what radial dose function you're using, that is based on a 1D or a 2D geometry function, but similarly that these radial dose functions would need to be calculated separately. Thus, you would have, let's say, two radial dose functions as you would have two geometry functions, be it line and point for that as well as line and point for the radial dose function So let. let. I've said a lot about this. Let me just elaborate somewhat further. There was also ambiguity as far as what. in the previous '95 report as far as what geometry function one would elect to use. And in fact, there were variations from treatment planning system to treatment planning system on how to properly

implement the 2D formalism with regards to basically dividing by a normalized 1/r squared or including something more sophisticated as, you know, not very sophisticated as the line source approximation, the line segment. So these things have been clarified in the current report as far as what you would use and why. And then finally we just simply for clarity we renamed the anisotropy function factor and constant to be the 2D anisotropy function, the 1D anisotropy function, and we actually removed the constant which I'll discuss in greater detail later So here are the 1D formalism. This is our recommended 1D formalism. I'll explain to you why you might see line source models used for the geometry function, the radial dose function, I'll explain that shortly. So we see as is follows here, and as I had mentioned, the only change really from the previous report other than the changes to these two parameters is the 1D anisotropy

function previously was termed the anisotropy factor. So the good, the bad and the ugly. We have three different approaches to how the 1D formalism could be implemented. It's not just, you know, simply permu. permutations and combinations, rather there was a variety of ways in which this could have been implemented due to ambiguities in the previous report. And you'll find, you know, basically all these equations will come out to the same value if you're 10 or 20 centimeters away, but we don't really care about dose rate distributions that far. We increasingly care about these the closer you get to the brachytherapy source. And that is because the dose rate increases even though there's a larger volume further out, we care about these. the accuracy of these formalisms at relatively close distances. Not on the order of a millimeter but on the order of, let. let's say, half to one cm So based on that concern and that radial range of interest, here

are a variety of what methods or ways in which folks have expressed the 1D brachytherapy dosimetry formalism and we believe the following. the final equation produces the most accurate results for processing and producing interpolated dose rate distributions. That is, if you should have a radial dose function tab. tabulated, you may not specify 0 1 mm or, you know, 0 1 cm,. 2 cm,. 3, etc. Typically folks will either measure or calculate these and they won't have an infinitesimally small mesh or grid over which they'll calculate the dose rates and then subsequently determine what the dosimetry parameters are. So let me also mention, a. as these things are typically calculated or measured, and then the investigator would determine what the appropriate parameters are. The purpose of this dance, if we will, is to go from the calculated or measured dose rates to these parameters as calculated and used in your planning system and is

subsequently for you to be able to produce dose rate distributions. So therefore it's very important that you use not only the same parameters and the same equations as used by the investigators, but also that you try and use, you know, the one that would produce the smallest errors upon performing, let's say, bi-linear interpolation, it's commonly performed in brachytherapy train. planning software systems. So as you see here, the ease that, it may seem surprising, but using a line source geometry function as well as a subsequent radial dose function, well, that even for a 1D. 1. 1D brachytherapy dosimetry formalism the approach to use the line source for bulk in turn pro. produces the most accurate linear interpolation over this. But that only becomes increasingly significant very close to the source. That is, maybe within one active length So the revised air kerma strength definition is presented here. It was. this topic, this

concept was briefly discussed in the previous report as well as in some subsequent papers by our group. And, as you can see here, there's a new definition with a threshold, perhaps like restricted stopping power, and that for our applications we will exclude photons with energies less than 5 keV and furthermore we will specify the conditions, be it the distance and the be it humidity of the air, we'll discuss the conditions in which this is specified for the evaluation of the air kerma rate. And then we see here in this table that for the eight sources included in our paper that there are listed consensus, dose rate constant values. These values based on the new definition of the air kerma. air kerma strength shown here and typically be it measurements or calculations for evaluation of air kerma rate. So this is presented here. You see a quite close grouping for the platinum sources and maybe ranging from 95 to 105. 0 95 to 0. 1 05 would be

inclusive of the range for the dose rate constants 0 94 for the iodine sources. Then there was, I don't believe we'll. we'll cover it in too great of a detail here as it is. is clearly described in the paper as well as there is a very nice reference in the paper to this report of the 1999 WAFAC anomaly in which the wide angle free-air ionization chamber at NIST had some unusual and peculiar changes in its output in the year 1999 and. and a little bit afterwards. And this impacted the calculation of the reported dose rate constant. And here you can see the impact. I wouldn't. wouldn't say that these are small but these are just on the border of our levels of insignificance. Our group is working to determine the level of change which may be important. If we told you well, this changed by 0 1%, you'd say come on, how do you know that you can do things that accurately?. Well, we don't claim to at this time but we will determine some thresholds and

guidelines upon which we will not, let's say, bother the community for very minor changes but rather if there over a period of time are a bunch of those changes which may produce ch. differences in the clinically used parameters and how patients are treated, at that time we probably would have a summary report listing what those would be. But again, we. we will develop that. those thresholds in the future So just to show you the. I guess it's nuisance, '95, but this has been out for, you know, I believe around six years. This is the missed wide angle free-air ionization chamber and the plates here, this chamber expands and has a. has two electrodes which. which expand and contract, and of course not doing the measurement, it allows you to change the collecting volume. So one of the, let's say more salient aspects of this presentation is the methodology in which we. we will determine and the AAPM will present consensus data

sets. Data sets, that is, with do. let's say 1D or 2D dose rate distributions as determined from the reported brachytherapy dosimetry parameters. So how this was done. Well, we. as you saw from a previous slide, we had studied eight different sources and simply did a thorough literature search as well as contacted. you had to contact the authors and the investigators in instances where the papers wo. did not have sufficient detail in them to understand what actually was done. So we wanted to be comprehensive and definitive in our statements and declarations of what radial symmetry parameters should be and how things should proceed So I'll present to you here how the, you know, what some of the methodology. consensus methodology is. If there were, let say six different evaluations of a dose rate constant using Monte Carlo techniques and then let's say only one evaluation, perhaps using TLD, some luminescent dosimeters, you would take the

average of those six, add it to the experimental, divide by two and get the consensus. We decided on that approached based on the variety and the diversity upon which groups had both calculated and measured the dose rate constants as well as then these two parameters, calculations and experiments being very different techniques, we decided to weight their merits equally. So that is the consensus methodology for evaluating the dose rate constant. Then the radial dose function and the 2D anisotropy function, to determine these I'll explain shortly, to down here, to determine these. As you would imagine with investigator-driven research in which perhaps some folks had opened up a seed or taken x-rays or autoradiographs of seeds, there was a, let's say discrepancies between the reported active lengths that individual investigators and their papers had presented and used. Well, small changes in the active length

will make, let's say small changes in the calculated dose rate distributions at large distances. However, the closer you get, you know, there's generally let's say 1/r squared or at really close distances you might not always run over our dependence of the approximation of the dose rate fallout. So for instances in which it was not entirely obvious and there were, let's say not a line segment source like perhaps the 6711 Amersham source, iodine source, but perhaps there were a variety of pellets or radioactive entities within the source, non-continuously distributed, let's say as the Northern American Scientific Model 3631 A/M. In that instance it would be relatively hard to calculate and have consistency without, in derivation of the active length, without having the recommended methodology. So this is by, I believe it's Monroe and Williamson from their paper on how the effective active length for those types of sources may be calculated where you

have the spacing, the difference in the spacing amongst the various pellets, and then simply the number of pellets and multiply that. So if you had let's say three pellets and they were spaced center to center 2 mm apart, the spacing would be two and you'd have three pellets. Two times three would be let's say 6 mm. . Well, gosh, that's actually longer than the active li. then. then the encapsulation of the source. Well, in our report for those instances we have recommendations on the maximum threshold, I believe it's 5 mm over which the active length, you know, should be Just a slightly tangent, what our group is also doing is we're trying to determine, you know, possible improvements on this methodology but, you know, these things will not come out for awhile but just to let you know there is ongoing research to let us more accurately determine those rate distributions and improve consensus across the land. So with

these. with the appropriate active length then there's choices for the radial dose function and the 2D anisotropy function and the 1D anisotropy function, you know, beyond the dose rate constant that's previously explained. So for the 2D. for the radial dose function what we had typically done just, you know, to summarize is we had typically taken the Monte Car. the reported Monte Carlo derived radial dose function. Well, there were two or three different Monte Carlo studies. How did we then proceed?. Well, we chose the one that seemed to have the best agreements with the other reports in general. If there many, but similarly if there was two reports, Monte Carlo derived radial dose functions, we would similarly then chose that. that study which covered the largest radial distance range. You know, in cases where. when that was not possible, I believe in the tabulated data we have italicized candidate data sets which were included for inclusion as the.

as a consensus data set parameters. And that process that I've described for the radial dose function was also done for the 2D anisotropy function. And that we had made many, many comparisons, a variety of distances for all the investigators, even contacting investigators after the fact if there were ambiguities, on how to, you know, better understand what was reported on these parameters and how to implement them. So with that in mind, as we say typically taken from the Monte Carlo results, though I admit, you know, there were. there were at least a couple instances in which they were taken from experimental measurements. With. with that data in hand then the 1D anisotropy function data was calculated from the 2D anisotropy function data set. So we didn't necessarily adopt or use the data as presented by the investigator, and you can imagine that there were instances in which the investigators had an active length which differs

from the recommended or consensus active length within our report. And the, you know, the justification for that is that we wanted to have a consistent manner and method in which the. the either or the effective active length was determined as well as consistency amongst the various investigators. So what that would require, by the way, is it require a reprocessing of the data. Very. this. this technique would be very susceptible to mistakes. So as I showed to you that, you know, the bad, good and best equations you would have to understand what the investigator had done from going from, let's say, the measurements or calculations of their dose rate distributions to determine the. determining their parameters and then with that in hand. go back, determine what dose rates they had, use now a new active length, find out the parameters. and then those new parameters are presented in our report. So we'll call that a reprocessing of the data as the

investigators had initially presented it So some other corrections and. and. and errors in the previous report. Let's say improvements here in the '95 report and then I'll cover briefly some errors in the current report since March. So we're trying to catch a lot of these and welcome some input. I'll cover on that later. So we. we clarified the radial dose function as it will be fit with the fifth order polynomial perhaps, but in fact we did not in our report, as you may note, include all these values for the, you know, Rsub0, Rsub1…I'm sorry, Asub0, Asub1, etc. to Asub5. And the reason for that is that the, be it the treatment planning software vendors, as well as the individual physicists, we believe that we should not set, let's say a certain level of precision with perhaps four or five or eight significant digits of what these parameters should be because, you know, this fitting here, the polynomial should be because not all software versions

can accommodate perhaps eight different significant digits. And why is this important?. Well, this becomes important at perhaps larger distances where we would find the. if you had eight significant digits, let's say our A0, and your system only lets you pu. use four sig. significant, or three significant digits, well you would have quite different. quite different calculated dose rate results. And to minimize the likelihood of an error being implemented with our consensus data, we present the dose rate distribution, we have a table on that, as well as the parameters and rely and ask the treatment planning software vendors to, with knowledge of their limitations, to include whatever model, be it fifth order polynomial, there's a variety of lovely fitting techniques that one can use, even better than this. So we rely on the vendor to typically use this within their planning system and then it is the responsibility with clinical QA of the physicists to confirm and

attest that in fact calculations of doses to this different points produce the predicted results based on the consensus they have. So that is a little lengthy but. but I think that includes some important details of the responsibilities of the physicists and why we just simply don't have tabular Asub0, 1, 2, 3, 4, 5 for all the sources. Also because, you imagine that the reported data, not all the investigators covered the same radial distance range. So, you know, we'd have different limitations if we'd done it that way. Many reasons actually, lot of fun discussions in our group. So then th. there was in the previous report opportunity for one with. 1D equation to use, and frankly an incorrect and let's say bad, 1D dosimetry formulism. Bad because what would happen is that would give you increasingly large errors at smaller and smaller distances. Errors or differences from the investigator derived dose rate distributions. So we, you know, we

explicitly say no, don't use us, and it's their prime responsibility and we're offering guidance, as you can guess, to the treatment planning software vendors on how they can restructure their planning systems to use the most accurate equation, that is the one that would produce the smallest errors upon linear interpolation of the available data. So, as I've mentioned earlier, that not all investigators had covered the same mesh, if you will, the same radial and angular range of dose rate distribution determinations as well as brachytherapy dosimetry parameter presentations. Well, we inclu. we then had explicit methodology on how one can extrapolate, extrapolate that is at larger distance perhaps or even smaller distances. If. if a investigator had only calculated or measured dose rates at 1 cm from the source, how then would you if you wanted to use for eye plaques perhaps or other applications, how would you be able to use the available data with your planning system and in confidence be able to extrapolate to smaller distances. So that's presented in one of the appendices in great detail So we removed the, you know, these two parameters here have gotten the boot. Apparent activity, this was clearly specified in. in one of the papers from our group preceding this report. But we wanted this to be kind of like a summary statement, this TG-43, your one report. So there based on the choice of your constants that you'd include or might consider if you're using err apparent activity you can have perhaps large dosimetric errors. So that was one of the reasons and. and what I think perhaps a more important reason, though errors are an important reason not to use something, we had specified the usage of the, you know, NIST-based air kerma strength values as the national standard, it's our NIST. So we believed that with the AAPM supporting that that it would be

foolish for us to in turn support a competing parameter so this is highly recommended not to be using apparent activity for let's say the eight sources covered in this current report. Of course, you may have brachythera. One thing, let me just step back and mention something. You may have be it sources that you use not covered in this report, of course you will, as well as a variety of other brachytherapy sources of let's say non-iodine and palladium, non-low dose rate. Well, we certainly to limit the scope of this report to the seeds covered herein, however we believe that the formalism is general enough that we're trying to expand it to additional seeds and additional radionuclides. So we realize obviously at this time that there's no end-all statements for all sources of all types, but we're working on that and. and think it would be fair to consider this as a basis, as a foundation So the final term that. that we removed would be the anisotropic

constants because we believe that it's a very misleading term. For instance, with investigators having a variety of active lengths for given source type you could actually change the value of your anisotropic constants based on the active length you should choose. So if I chose a 1 mm or 2 mm versus a 4 or 5 mm active length, I could perhaps produce a higher anisotropic constant, 0 93 versus 0 97, and maybe with the 97 some vendors were saying our seed must be better, look at this high anisotropic constant value. So that was very misleading, it was not helping with the accuracy of the 1D dose rate calculations as yo. done by the planning software. So we presented a methodology how even if a software vendor does not have the ability to include, let's say five of our the 1D dose rates with the 1D anisotropy function how medical physicists would be advised on how they could include the 1D effects of the anisotropy in their radial dose function.

So that. that's mentioned, I think, a little later in the report. But that's an important advance, we believe. Yeh, as we mentioned to minimize errors and clarify understandings So we make recommendations to dosimetry investigators. Again, primarily using TLDs in which that we believe it important to specify the following parameters. I believe there actually was not one paper in the probably 40ish or 50ish papers that we reviewed for the eight different seeds. There probably was not one paper that included all of these parameters, so…these descriptors let me. shall I say. So what that means is that the, you know, we had to contact investigators and, you know, look up previous references, etc. So, you know, these are some rec. recommended descriptors that the symmetry investigators should include or either cite a clearly described reference in which let's say they have their TLD readout technique say. Well, so as to not repeat

and. and lengthen the. the new paper, perhaps they should clearly reference their previous work in which that may be mentioned. But these parameters and some other items. mentioned in the report are we believed required now for investigators who have experimental measurements of the dose rate distributions of brachytherapy sources in general. As well as we set forth some requirements for those who will use be it analytical or Monte Carlo techniques in their evaluation of the calculated dose rate distributions and you can see these specified here. Again these are pretty much taken straight out of the report So additionally we set the bar pretty high as we realize that the consensus methodology has a bent or inclination to generally accept the Monte Carlo data. And. and another reason perhaps I should mention of why that's the case and why it may appear some bias, though we had a nice diversity on our committee at the time of those in

favor and experienced with Monte Carlo and experimental techniques. It. you can very much more readily sample and have a finer and more thorough mesh or grid with Monte Carlo techniques in comparison to the very laborious task of perhaps putting more than one TLD at a given position about a brachytherapy source as well as, let's say, volume averaging that would complicate accurate measurements of dose rates very close to the source. So knowing that, you know, you may have some errors or uncertainties with your Monte Carlo approach but a lot of these terms are. are normalized parameters, like the radial dose function, you know, the 2D anisotropy function, there that's normalized at a given distance and also fixed at a given distance and normalized to the value on the transverse plane. So there's a lot of intrinsically forgiving aspects that would make you want to include the Monte Carlo results as your consensus

approach as compared to experimental. So here you see some of these, you know, recommended good practices So regarding clinical implementation, I'll point out that these values here, these first four values differ somewhat from the reported data, I believe these are 1D dose rate distribution tables, so there's some corrections and these are corrected data which I'll present to you shortly. So, you know, know you planning system algorithm, know, you know, what it does, know which let's say of the best of the good, or maybe something even different that it may be doing. So you should know the equation, the formulism that is use and deal with its limitations, don't just say well, that's wha. what I got what I got. You should actively as a medical physicist try and produce the most accurate, you know, calculations of your dose rate distributions so you reflect reality as well as to, you know, inform your group of what's going on So acceptance

testing commissioning. We didn't really have a. any significant changes from. from the recommendations in these three reports. We generally supported these, however we had a few paragraphs outlined in. in light of today's standards and today's needs where the salient aspects of these recommendations come in today. And then how one should compare and validate, you can use all. all these terms and concern very much so with how accurate is your dose rate constants in your planning system. How accurate does your results on radial dose function come out. But in the end, with QA you should actually then process all those parameters and calculate, let's say a hypothetical patient for perhaps a single source and determine what the dose rates should be at a variety of distances. And then compare with a hand calc or compare with those presented here. Otherwise you'd be so confident with the parts but in the whole there can be

some gross mistakes. As well as finally that we have some further recommendations which I would say clarify, they don't necessarily change but they clarify previous TGs on how one should perform calibrations for sources as well as have traceability within their institution So preceding this, yes, we apologize. The report took, you know, probably about four and a half years to produce. For not being a formal task group it was the. I thought it was pretty timely. We're currently working on a supplement to this and that will include more seeds but not. not any significant changes to the formalism. But we, you know, in the process of this there was a wonderful point by point in. in medical physics about the pros and cons of why should you use this TG-43 polar angle based approach anyway?. Why not just use along the way tables?. So the, you know, I want to inform the interested audience here of. of this paper and, you know, we

briefly summarized what was covered here and there. there was a nice, I'd say lively discussion and, you know, maybe slightly biased but I think the statement was made strong in the end of why we should be using the TG-43 brachytherapy dosimetry formalism. And you can see that is stated here Largely again based on the interpolation errors. Of course, the lo. along and away tables as. if reported properly as well as the TG-43 formalism if reported properly will both produce the ex. should both produce the exact same dose rate distributions at. at a given point. However, for points in which the investigator had not calculated or measured the dose rate, there then would be opportunities for errors, be it through linear interpolation,. And let's say by removing the large gradients of perhaps the geometry function, then the interpolation errors would be typically smaller with the TG-43 methodology as compared to the let's say along and

away table approach. And this was discussed by our group, I'd say about a year and a half ago, with a letter to the editor from Jerome Melly and Dr. Melly took a similar approach of, you know, why. why would you need to. now why would you need not a. an along and away table approach but why not just get rid of the active length entirely and use a length of zero, use a point source formalism, and build into that the. the 1D and the 2D approach. Well, we. we similarly tried to profess and. and explain why we did not think that was appropriate and, you know, sim. simply again calculations of dose rate distributions would perhaps be identical at points that investigators had provided, but given the paucity of. of data sets there was not. never any publication of an in. infinitesimal mesh of these dose rate distributions. We found that, you know, that again we had actually shown in a figure that the interpolation errors would be less

using our approach than either our along and away table or using a simple point source. And. and we further, and maybe to my chagrin, we further stated that we're not presenting parameters here that are based on first, you know, physics principles like let's say Mirovarow, rather we're just using a common set of data and a reasonable methodology that would remove effects more and more getting towards the anisotropy function So that I'll say is a summary of. of. of the paper in it. in its own right and the formalism. So now today is a new day and we have some improvements we need to make on it because there needs to be corrections as well as additions to this report, so we list some of these corrections here. These are corrections where we simply forgot the capital M on Megabechtrol, and then also upon looking, I looked very carefully at the references. It was very hard to read the lower case "1" in compared to the lower case "l" in the

reference 150 at the end of the paper. So we're. we're telling you how you can access that missed link which has a lot of the details of the WAFAC as well as the. a very nice explanation of the anomaly. Third, there was a mistake as far as we misreferenced something here, that's relatively minor. And then there. there was, you know, the word liquid did not. the. the text should read as. as presented here. I believe this said. it used to say "in solid water or other solid water substitutes ". Well, it should have read "liquid water ". So that's, you know, not too important but we want you to know that we've gone through this again very thoroughly. And we've received a lot of kind input from others. So some other, you know, minor text there was an Rsub0 here so we got rid of that because maybe this is taken out of context but in that sum the subscript is not required, should not be listed in fact. And then more of a correction, more of an

important correction, we had typographical errors. I believe this used to say 0 367 and 0 354. I think that's what was in the paper, and it was just simply wrong. That. we didn't catch that typo with all the thousands of numbers in the paper. So that was don. that was used incorrectly and subsequently we had, you know, data that was incorrect downstream. Calculation of the 1D dose rate distribution then was incorrect so we had to revise these parameters as well, give the dose rates at these distances. So this is the dose rate at half a cm, at 1 cm, etc. So this will be coming out in that corrigendum and Best is. the company Best is aware of this and they are working with us to phrase kind manner, as well as, you know, in addition is that the origin for the methodology, you know, who thought of this and where did it come from and. and some descriptors on that. That's described briefly in a paper by Chan, Nath and Williamson and then

they issue this here. So what we. we will literally in our. our letter to the editor have, you know, this slide and, let me go back up, and this slide, I think that's it. Yeh, so this slide and then going forward, this slide. All the data here will be in our letter to the editor, but if you should find any mistakes of course you're welcome to write your own letter but we'd appreciate it for consistency if you could send us something in a timely manner and let us include it as this one go-to for improvements on that paper So in conclusion, we pro. pre. present a revised, also slightly revised, I think the '95 report was very, very good and that this 2004 version of the report should be seen as an improvement but not a huge improvement and also maybe not a minor improvement. Just a. a medium, middle of the road improvement that you'd expect over eleven years, nine years I guess. And then we cover eight seeds. We're going to have a

supplement to our report. We don't know what the acronym will be, TG-43U2, or. or there's all these silly things that we could name it, but that will include many more seeds. I believe we're looking at currently 15 or so. Then we have some clearly defined guidance for investigators who perform experimental or. experimental or calculas, efforts to determine the dose rate distributions as well as we clarify the protocol and remove what we think are inappropriate terms So thank you very much