

Low Dose Radiation Conference Notes

October 3, 2018

8:00A

Plenary Session #7 : Continuing Needs in Low Dose Radiation Biology for Medicine and Industry [Chair : Isaf Al-Nabulsi]

First speaker will be Dr. Robin Elgart who will be speaking on "Space Radiation Operations at NASA". Robin would like to thank the organizers. She will be talking about something a little bit different. However in space, we aren't always talking about low doses. She will start by provided some common answers to questions that she typically gets, then she will follow-up by asking some questions. The opinions and views expressed here are her own and not reflective of NASA or the university she represents. Space is a radiation environment, NASA was given authority by congress to effectively, "do what we want" with regards to operations in space, but we still have to operate by standards. OSHA standards do not apply in space, so we came up with our own standards.

8:07A

Space radiation is mostly made up of high energy particles. There are Galactic Cosmic Rays (GCRs), which are mainly protons (90%), then there is 9% Helium particles and 1% heavier particles. There is the South Atlantic Anomaly which is a series of belts that are centered over the south pacific, passing through it does result in an acute dose over the span of minutes. Also, the sun sometimes decides to give out a healthy dose to people. What are the expected dose rates for people in NASA. The expected dose rates depend on mission parameters and what the sun is doing. The biggest thing we can control is the length of the flight. The next thing we can control is trajectory and shielding.

8:12A

The sun goes through 11 year cycles. When the sun goes through solar minimum, it doesn't protect us from much GCR, however, when it is at a solar maximum more GCR is blocked, but there are higher chances for solar events. Doses that are expecting on the ISS, we are looking 300-450 uGy/day. Th ISS trapped is 0.1-20 uGy/min. Out in space, you get 250-550 uGy/day, in a 1972 event in free space there would be a dose of 200-400 mSv, the sheltered 1972 event to ~80 mSv. What do we do, NASA has ionizing Radiation Limits, there are Dose and risk limits as informed by the NCRP 132 (2000). There are

short term SPELs and career/lifetime SPELs. We take dose and convert it to risk, using the Epidemiological low LET risk models (LSS). The dose limit per person is different.

8:19A

The cohort for astronauts is very small, maybe about 500 people. Part of the challenges in risk assessment are that the astronauts are super healthy people. We also have limited knowledge of biological effects. Unfortunately, all we can do is to rely on animal studies in the range of exposures that our astronauts have to deal with. So her first question is, how can we best model radiation quality for the unique space radiation environment? How can we best use animal and cellular models? How can we best use epidemiological data and radiation response models to ACCURATELY estimate risk with high PRECISION? Janet Ulch from UC Irvine would like to comment/respond; one of her observations is that the space radiation program is finally going into a much better direction. Now we are planning for the first time to do GCR sim or mixed beam exposures. Where these animals are being exposed to mixed beams over 30 days. We are working with a cohort of mice. She would like to suggest that these risk models will change as we get more relevant data from these experiments.

8:24A

Next we will have Dr. Edward Bramlitt speaking on "Low Dose Radiation in the Airline Industry". He got started in this business in 1981, by a nuclear accident exercise. They said that they would be spreading a radioactive material at the site to simulate plutonium, but that it would expose people to less radiation than a flight from Chicago to San Francisco. This was the NUWAX-1981. The FAA 1978 report showed that flight attendants were receiving 1.60 mSv per flight and pilots were receiving 1.58 mSv per flight. The 1985 dose > 1978 dose. He petitioned the FAA to regulate crew member radiation safety. The FAA denied the petition in 1986, but it did agree to advise in the following ways. Advise airlines to promote radiation safety. Here is the first FAA advisory circular.

8:30A

Dying to Fly, FAA 1990 AC. They predicted 6 flying deaths resulting from this additional annual dose (over 20 years). They showed this value compared to the number of these people who would have died had they just stayed on the ground, 220 Males. Edward also included the equivalent number for women, 188 deaths. This calculation assumes that the attendants only work for 20 years, and indeed they used to retire at twenty years, but that has gone away following deregulation. Regarding sources exposing flights, there is the GCR which is continuous and was first realized in 1912. There are SNE and SGE events, which are experienced with satellites. There is also TGF, which results from lightning. The radiation that hits earth. Protons from GCR tend to go towards the poles, whereas neutrons and gamma

rays tend to go towards the equator. It is also important to note, that the higher the flight level is, the less shielding that they get from air.

8:36A

Starting in 2001, was the first long haul flight which was a 16 hour flight from Hong Kong to Newark. These flights go over high latitude areas, which results in higher doses. Since the FAA doesn't want us to know the dose, we have to calculate it ourselves. We need the flux, exposure time and fluence-to-dose factor. He will show us how to calculate the dose for SGE over the USA. The Fermi satellite detected an SGE over the equator. The Fermi satellite was traveling right over San Juan when it experienced the SGE. The solar gamma rays that are coming from the sun are parallel beams. the smallest one is at 45 MeV. That is the sort of flux we are dealing with. He showed the air pressure shielding over the course of a flight, but the radiation window is six hours long. Since the sun moves west at 28 km/min versus a plane 15/km/min. Anyhow, the summary is that the 2018 Dose is greater than the 1985 dose. He wants to point out that flight attendants are the contemporary radium dial painters of our time.

8:41A

One question, there was a study which investigated a group of flight attendants who were exposed to additional radiation, included an SGE, and that group of people experienced a reduced rate of mortality. One study done by Canadian air pilots found an excess of a factor of 6 incidents of leukemia.

Plenary Session #8 : Risk Communication, Fear and Regulations [Chair : Anthony Hooker]

The first speaker in this session will be Jaques Lochar, who will be speaking on Fear and Regulations.

8:46A

He has been working with people via dialog meetings on the rehabilitation of living conditions after the Fukushima accident. The experience of the Suetsugi community. What is at stake in the management of a nuclear accident? The irruption of radioactivity into peoples everyday lives and its long term persistence, create an unprecedented complex situation which profoundly upsets daily life, raises many question and concerns, generates numerous views, and exacerbates conflicts. What is at state is to protect the population against radiation risk but also to preserve as much as possible decent working

conditions on accident site and living conditions for the affected people. The next slide summarizes the human dimension of nuclear accidents.

8:49A

The testimonies of Fukushima residents have confirmed what we already knew from areas affected by the Chernobyl accident, namely: The collapse of trust in authorities and experts, the loss of control over everyday life, the disintegration of family and social ties and the breakdown of the economic fabric, the apprehension about the future particularly that of children. Why communication about radiation risk is a challenge? There is no direct sensorial relationship with radiation. Experts and professionals use the scientific language to communicate, which is not easily understood by the populace. The perception of radiation risk is largely dominated by the images and narratives of Hiroshima-Nagashaki, as well as of the cold war. The loss of trust in the authorities and experts combined with the lack of radiological protection culture, the images of the past and the avalanche of conflicting views of the media and experts, makes conventional communication about radiation risk inoperative.

8:53A

Experience shows that the most effective way to engage people in a post-accident situation is to engage affected people in the characterization of the individual radiological situation in relation to their daily concerns and to help them interpret the results together with people in their community. Key things are to: listen and understand the concerns expressed, engage them in measurements so they can understand how they were exposed, proceed step by step from source to effects, use as much as possible common language and narratives, and never forget that risk communication only works if there is trust. When communicating risk, experts should: Try to manage risk based on the ALARA principle, promote protective actions improving the wellbeing of individuals and the quality of the living together of the community they belong to, respect their individual decisions while preserving their autonomy of choice, keep in mind that the issue at stake is not to make people accept the risk but to allow them to help... The co-expertise process emerged in the late 1990's. This process is consistent with the Trust, Confidence, and Cooperation model.

8:57A

the co-expertise process is as follows: establish dialog -> engage affected people in measurements -> identify self-help protective actions -> implement local projects with support of experts. The co-expertise process allows to develop a practical radiological protection culture allowing people to interpret the results of the measurements of radiation, to build their own benchmarks in relation to the radioactivity present in their daily life, to make their own decisions to protect themselves and their

loved ones, and to judge the effectiveness of the protective actions. The ethical dimensions of the co-expertises process has shown that credible experts must: be accountable, be transparent, exercise empathy, be inclusive, speak prudently and equitably and to make sure not to compromise the dignity of people. It is possible to communication with people following an accident like Fukushima on the topic of radiation. It requires the mobilization of specific skills, adapted means of measure radiation and the support of authorities, it also takes time. The key to success is to put science and tech at the service of resolving the concrete problems, to ensure respect for peoples freedom of choice without manipulating them in any way, but also not to abandon them. It is important to work WITH people and not work FOR people.

9:03A

One question will be allowed. He said that he has crystallized what has been going around in his head the past couple of days, one thing that is missing is the that element of communication with the people. He will suggest that one of the concepts we should put on the table is the development of an ambassadorship with the occupational workforce. Wherever we go, when we come to some conclusion, we need to go to some workforce, the hospitals, to the DOE, work with them to help us work with the public. He said that he is not a trusted employee because he works for the government. The question is, do you agree?

9:06A

The next speaker will be Ryoko Ando and she will be speaking on Connecting Science and Life with Trust. Ryoko said she lives south west from Fukushima and that originally, she grew up in Hiroshima. She didn't know much about radiation originally. She knew that some people had died from atomic bombs, but she also knew that there were plenty of people who survived well into their 80's and 90's. Distrust of Government/experts has intensified after the accident. Before the accident, we were told "NPP accident will never happen in Japan". Then the accident happened, and explanations went back and forth, originally the outlook was positive and then the situation got worse than expected. A criterion was establish for resuming schools and a government advisor resigned in protest. Later in April 2012, their was a revision of food safety standards; it was reduced from 500 bq/kg -> 100 bq/kg. And a lower standard of 50 bq/kg for milk.

9:11A

One side effect of this lowering of food safety limits was to further make people distrust the government. After the fact changes: it intensified distrust that they changed what they said without further explanation. Activity of Suetsugi. Where is Suetsugi, Iwaki-shi. Shuetsugi is located 27 km south

from the Fukushima power plant. 100 plush households were advised to shat indoors for about a month. She started interviewing people from that area. Apparently the people who lived there were unable to get the sort of information that they wanted, information about their daily lives, information from people that they trusted. What kind of trust was lost by the accident, they lost trust in the environment that they lived in. This was not a thought that had ever crossed our minds, but now we didn't trust our environment. Without such trust, you must constantly check the environment you live in.

9:17A

Around here, you now have to think about whether or not you should drink tap water, whether it is okay to open the window for air, or whether it is a huge issue that a dog has dragged dirt into the house. It is impossible to remove all risks from our lives, but once we have a reasonable estimate of the risk, we can resume our regular lives. This event has certainly resulted in a loss of trust in human relationships. It has caused disputes even within families. This has even resulted in some breakups of families (i.e., divorce). One can't continue smooth communication with neighbor who meets everyday in face-to-face. Three measurement activities worked on Suetsugi. Since 2012 we have started working on external exposure management. People in the community wore dosimeters and we saw that almost nobody in Suetsugi received a dose that exceeded 1 mSv/yr.

9:21A

The community did a whole body counter measurement. Throughout the whole period 99% of people were less than 300 bq/body. Foodstuff measurement, every Tuesday measurements have been done at a community center in Suetsugi. The experts say that there should not be any effect on health from this level of radiation. Its hard to understand why they are till concerned. The residents say okay i see it is a low level, but it still affects our lives greatly. These residents who live here are still receiving additional dose than they were before the accident. Unfortunately, the affect area is left in an unjust situation following the accident. We have to live in an unwanted situation, we have to be careful with our food, human relationships have changed in daily life. Also, people in other places in Japan doesn't have to be careful in the way that we do. Only we suffer, isn't this unfair. Are the experts suggesting that we should all just accept this unjust situation?

9:26A

We need to bridge the gap between experts and residents with trust. Dr. Makoto Miyazaki and Jacques Lochard, kept coming back to Suetsui and spent time listening to residents. They gave professional advice to understand the unjust situation. They developed trust with the residents and the residents now hold them in high regard. Tony Hooker let Ryoko, go a bit over time but she must now stop.

9:29A

Next will be Yuliya Lyamzina, who will be talking on "the importance of risk perception factors for the development of effective risk communication after a nuclear accident". She points out the importance of risk perception factors. Effective risk communication is a determinant in accompanying remediation and waste management projects. Most risk communication efforts based on knowledge and trust building campaigns. Fundamental to effective risk communication is the design of accurate risk message based on actual risk assessment. The IAEA safety standards all contain the basic message of "Basic principles of successful stakeholder involvement". However, how are we actually supposed to do it.

9:32A

We do measure the dose, and then we go straight to risk assessment. This didn't work in Chernobyl, and it still didn't work in Fukushima. Our old approach is that we say, why don't the public understand, the public is being stupid. Then I suppose we should publish another document. The thing is the public, doesn't receive the answers that they are looking for from these papers that talk about flights on planes and bananas. The new approach should be to have bidirectional communication with people. We need to address perceived risk, communication actual risk by sharing scientific results is necessary but is not sufficient to respond to public concerns. Communications also need to address the emotions, fears, anxieties, perceptions and affects of the stakeholders.

9:35A

When she says actual risk, she is talking about does and the probabilities of cancer/leukemia. Perceived risk is subjective for the individuals and quantifiable in a population and single individuals. The study of actual versus perceived risk, especially regarding nuclear issues is actually well established. Taking into account perceived risk for public communications is situations involving radiation risk is still in its infancy. Risk perception factors are actually very complex, there are about 18 risk perception factors. We need to check with the communities, to see which of these risk perception factors exist for the community, normally it wont be all of them but more like 6-8, then we can develop risk messages which are tailored specifically to their concerns.

9:38A

She believes that this sort of approach should be incorporated into typical practices. There are multiple consequences of an accident: fear of cancer and medical complications, rumors and anecdotal reports, intelligible communication about radiation, contradictory information from "reliable sources", distrust in authorities, ecological and socioeconomic disruption, social stigma, media coverage, and psychological consequences. For the Fukushima case, it was actually a triple disaster. From interviews, the people said that the nuclear accident abruptly deprived us of our peaceful everyday lives. Fukushima has a massive amount of prefecture monitoring data. The data is being used to try to convince people that things are safe but it still isn't working.

9:43A

The perceived risks of an activity is greater when the activity is seen as poorly understood, unknown or uncertain. At this point, many people are still concerned about internal and external exposure. They are asking simple questions like, can we even drink our tap water. Currently we are only addressing the risk, but the issue is that things are still not perceived as safe. There is a lot of psychological distress. The main report that we have been creating is the "Report of the Fukushima Health Management Survey". The current challenges of Fukushima are: technical challenges of decommissions of NPPs, site selection for the final disposal facility, reducing the volume of waste, remaining evacuees, perceptions of radiation risks, health problems, thyroid and mainly mental health problems, there is more school bullying and subsequently, more suicides. There is also stress and PTSD, there is substance abuse and obesity, also divorces do happen. Also mental health of mothers is affected.

9:48A

We need to take a more holistic approach to addressing concerns of risk. The science of risk perception psychometrics on par with the science of physical actual risk. WE need to understand how different people and different demographic groups perceive risk to address it. Risk management should be a two way street, just as the public should take the experts assessments, but also the experts should take the concerns of the public. The next speaker will be Ohtsra Niwa, who will be speaking on A gap between radiation science and humanity.

9:51A

Niwa said that most of what he wanted to say, has already been said. He showed us a plot of the dose following the accident, but the dose is only about 1-3 mSv/year. He went out to Fukushima to tell people to not worry about this level of dose. However, he failed completely, it was interpreted as here comes this expert telling us not to worry. He may have good knowledge on this, but it didn't work telling them so. At this time, he was one of the main committee members of the ICRP. He was told that we had done

some dialog things elsewhere and that they did work. As a result, we started working having dialog with the people in Fukushima, and he wants to say that it definitely does work.

9:55A

To individuals, you are the center of your own daily life. You believe that you have full control of your daily life, but what happens when radiation comes in. All of these things that you had interactions with become damaged in some way. The radiation causes complications between things. As an example, if a mother is concerned about the radiation and states that they want to move away, the husband might want to stay on account of work. So it may be that the mother and children move away. If their relationship is strong, maybe they will survive, but if there is a crack in the relationship, maybe it will end in a divorce. One thing he learned is that once you loose control of your life, it definitely ends in depression. Niwa himself was depressed for about three years.

9:58A

We learned what had to be done. we needed to help people to regain their position in life, having people with dosimeters come out and train people is important because it helps to reduce risk. They took measurements of dose of kids in Fukushima, and compared it against the national average, and compared it against kids in Europe. Actually, dose rates to people in Fukushima are lower than those who live out in France. Dosimetry is something that works very well, but we biologists did very poorly in addressing concerns. There is a very intrinsic gap between science and people. He is one of the people, but science seeks for generic rules, which the public relies on individual rules. Science relies on objective approaches, while the public relies on subjective judgments. Science handles risk handled in a proportion, where as the public perceives the risk as all or none.

10:02A

Scientists should be aware of this gap. The gap is filled by empathy on the scientific side and the gap is filled by trust on the public side. Rod Adams had a question. He wanted to ask if a conservative approach to radiation risk models, make people crazy? In other words, if we are taking conservative risks, then we are slightly exaggerating what will happen to them. Does that exaggeration contribute to those mental issues and depression? Niwa said that he has been listening to this LNT discussion and he thinks that there is one thing quite wrong. LNT is usually coupled with relative risk, which goes from zero to infinity, we use so called LNT as a tool to tell the people, that this dose is low and the risk is low. If the dose is zero, the risk is zero. IT is a kind a device we use to determine if we should worry about it.

10:05A

Unfortunately, with LNT you are telling people that there is no safe dose, which causes people to think all or none, and there will be panic. If you are going to use LNT then you need to be careful about using relative risks, That is a tool of activists. One comment was that, unlike the US, in Japan the normal practice is for the utility and the government to pay villages...

BREAK

10:35A

Thomas Hansen will speak next on "Risk Trade-offs in Policy Making". There is an ongoing presentation from a health physicist. Thinking about policy makers, if we had perfect knowledge, we would probably do the right thing, but the trouble is that we don't have perfect knowledge on the subject. What we have is a case of moral disengagement, it allows moral justification and palliative comparison. There is also displacement of responsibility going on. There is a concept of risk trade-off, it is encountered in every day decision making. There was a chance of having an accident on the way here. If we had this conference two weeks ago in Charlotte CA, there would be a completely different set of risks then.

10:39A

Choosing one risk over another is called a risk trade-off, there is a framework for comparative analysis of risk trade-offs proposed by Graham and Weiner in 1995. This differs from a cost benefit analysis in that this is risk versus risk rather than risk versus monetary benefit. This concept of risk trade-off analysis isn't new. It is already required by some nations laws. for example the 1990 clean air act. Sources of risk trade-off.

10:42A

We are not a cross section of society, and the speakers this morning demonstrated that. I would go farther to say that we aren't even a cross section of our community. We are talking about trying to make some decisions from this conference, but it is too soon, and we aren't enough of a cross section to make

that. Some sources of risk trade-off are Omitted Voice, Heuristics, and Old Technology Bias. is LNT an old technology,... yes, but so is hormesis. We need to finally need to make some interpretations of that data and those curves. There are also some Bounded Rules, and Human Behavioral Responses, which are sources of risk trade-off. Today even though BRC, might be the best option, nobody is going to recommend that. The NRC is already been beat up for that.

10:45A

Looking at these sources of risk trade-offs, we can see how it is applicable to radiation protection policy. We will now look at the risk trade-off typology. As an example, if we went out into this field to measure the activity of this field. There is a risk trade-off, because they want to remove some radiation contamination. We are reducing cancer in a (theoretical) critical group, but we are trading of risk to other people, this is called a risk transfer. We are transferring the risk from the theoretical group over to the workers. We may have occupational injuries. There will be non-radiation cancer that we should be concerned about from burning all the diesel fuel required to re-mediate this place. There are also transportation accidents resulting from moving this dirt and also, topsoil is something that doesn't get made instantly, we will have to move some over from somewhere else which will cause some other ecological damage.

10:50A

Now for a draft conceptual model, people are going to make decisions within their jurisdictions. If you are only concerned with reducing radioactive cancers, you wouldn't be concerned with how much diesel fuel is burned instead. So when we have risk trade-offs that are outside of a groups jurisdictions, these decisions get made without considering the result. So if the NRC had to count diesel receipts, then they would do it. To summarize, risk trade-offs are a normal consequence of everyday decision making, radiation policy making is conducted in a manner leading to important risk trade-offs. There has been some talk in this room about moving forward with recommendations, maybe as soon as this afternoon, This scares me as many of these people are already responsible for trade-offs in radiation policy making. What impact is this consensus that we are going to come up with, how will it impact us.

10:54A

Now I have some questions. Rigid dose limits prohibit considerations of risk vs risk than "flexible" dose limits would. Dose limits should reflect risks in a manner that can be weighted against other risks. Research should be done on trade-off analysis: Application to the framework to radiation and quantification of weighing measures. The EPA even did a study in 1978 and found that remediation is hazardous. This isn't a new risk in my opinion. He is ready for questions.

10:57A

Question/Comment: I work for the IAEA in Vienna, I am listening to what you said that everything you have advocated is already in the standards of the IAEA, the problem is that regulators are not implementing them. The issues are justification, optimization, and The standards of the IAEA is full of flexibility, the problem is that people aren't using it properly. We don't talk about ALARA, we talk about optimization. But yes, how do you trade-off risks versus costs. You need to consult with stakeholders, but we are not doing that. He wants regulators to not do this a little bit more, but to do it a lot more. Question/Comment: If there is hormesis, then there is no risk involved, then there is no reason to remediate low dose sites. The reason the BRC comment failed is because we have LNT.

11:01A

He thinks that we should declare the LNT model as no good, and it should be done by the representatives of IAEA, NCRP, ICRP and the DOE, unless they can prove that the model is true. One last question... Chuck Miller from a remediation company, one issue that we struggle with is what is a low dose. Over the course of a couple days, 100 mrem/year used to be a low dose, what we are considering, our groundwater cleanup standards are most typically the groundwater drinking standards. On the bottom line at the left is the clean water drinking standard. How many people know that the clean water standard is a dose rate. We struggle with this, at Hanford, we have over 300 well locations that exceed this drinking water standard and 3 that exceed the 100 mrem/year standard.

11:04A

We really need to focus on convincing people that if we know better now, then we need to change those limits for that reason. We need to get a consensus understanding of what the low dose limits are that we should address.

11:04A

Panel #5: Communication and Policy [Moderated by : Paul Locke]

The following panelists are involved:

- Thomas Hansen
- Bonne Posma
- M Paul Locke
- Ryoko Ando
- Ohtsra Nima
- John Dunn

The panelist were introduced by Paul Locke.

11:10A

Bonne will be the first to speak. He started in nuclear five years ago. He visits south Africa nearly every year. The old government was in favor of nuclear energy, but the new government is in favor of green energy. We have had success in Zambia and Kenya. We started a group called campaign for truth in energy. In the case of wind energy, you draw tremendous quantities of energy from the atmosphere, has anybody studied what sort of effect this has. Also, there is a significant cost in avian deaths. The problems with solar energy include birds thinking that solar panels are pools of water and diving into them and dying. The current plan is that wind and solar will be large percentages of the future power production in Africa.

11:13A

Next will be Ryoko will speak. I will read a short statement instead. The order to evacuate from the Japanese government came immediately after the accident. This area was for areas where the dose rate would be over 50 mSv/year. The government used distance from the plant for the evacuation, all areas within 20km of the plant were to be evacuated. Even though dose rates were later available, the government continued to use the 20 km area. It took the government 4 years to start lifting the evacuation orders. Finally three conditions were set for lifting the evacuation zones. It took over three years to lift the evacuation order not because of the 20 mSv limit, but because the actual dose readings were not used in lifting that evacuation zone.

11:17A

On to Thomas Hansen. There was a magician who offered 1M to anybody who could show a supernatural power. He would like to offer a new challenge. He would like you to show him the use of the word conservative in a sense that will hold up against a panel of risk assessors. Please strike the word conservative from your vocabulary. When I read conservatism, I interpret it as somebody being lazy, there are steps that you can take to reduce conservatism and if you don't take them you are being lazy. On to John Dunn, he said that he listened to the presentations this morning and he would like to ask a couple of questions of the audience. If there are people who do not believe there is a safe threshold, he would like to know how to do the risk trade-off.

11:20A

There are some rules that we have to expect from science, it has to be testable, the techniques and methods must be known and the statistical analysis and methodology have to be evaluated. The illegal human experiments that were done by the EPA, which exposed people to air pollution (small particles). When we found out about the experiment in 2011, I tried to put a stop to it. The EPA was taking part in human experimentation. Our group sued to stop the experimentation but our lawsuit was thrown out because we were not part of the test subjects. The National Research Council said after two years, that they didn't see any problem with the testing.

11:24A

This is similar to the situation for LNT, is because John Sammit in 2006, wrote an essay, he said "there is no safe level of small particles, so essentially we can expect that the EPA will continue to grind down on the air standards". If there are no safe levels of radiation, then... Bonne will speak again for a moment more. He said that we were going to make reactors safer. Which is negative priming, when you say we will make them safer, people assume that they aren't already safe. One of the things we are telling people in south Africa, please don't use the word nuclear safety. Nuclear power is so safe, we don't need to talk about making it any safer. If we try to make it more safe, we will only make it more expensive. Also, don't talk about the concept of nuclear waste, we prefer to call it, unused fuel. This unused fuel could be recycled. Now on to questions...

11:28A

Craig Little, said that his job was to conduct surveys of 13K locations where they moved sand from one location to another. IN many places, property owners thought these surveys were a crock. Economics plays a big role in risk trade-offs, also economics plays a big role in the \$2B Ontra contract.

Thomas Hansen said that there certainly isn't an issue in considering economic issues as the risk. He wasn't saying that costs weren't a risk, sorry if that wasn't clear.

I do work in nuclear transportation, you need to have numbers that are as real as you get them. Also, saying that diesel fumes kill X number of people per year. That is derived from studies that say that particles of a certain size cause cancer. She used to do tons of air quality problems. If you are going to do especially comparative risk assessment, you need to look at numbers that you can really rely on. The one example that immediately comes to mind, we have speed limits, those are numbers that you can calculate and if you lower speeds from X to Y, you can reduce the number of accidents. The thing is if you are doing comparative analysis using cancer risks, it's not something you can quantify (especially at low doses).

John Dunn said that regarding air pollution studies, nobody can tell people what the actual doses to people, they talk about outdoor pollution readings and use it on people who might be spending 90% of their time indoors.

There was a solicitation of feedback, for a concerned employee who had a shallow exposure of 10 mSv?

Paul Locke said that he will try and answer that question, he needs to trust you and can you provide him with the information he wants, also can you afford to give him the time to answer all his questions. He would like to give you that approach.

Hansen, said that he has been asked this before and he said that I have a 10 year old daughter and that I wouldn't be concerned if she were exposed to that level of radiation. However, if you aren't comfortable in telling that individual that you are comfortable with it, then don't. However, what I would tell them is that I would be okay with my daughter receiving that level of dose.

Question from Bill Beale, he works in emergency response which makes him a bit out of place. He deals more in guidance. So he really enjoyed the earlier speakers who spoke on engaging the public. His question is, have the speakers from earlier, is there any difference in the approach to take when communicating with the public when you don't have a disaster to looming, or if times are okay?

Niwa said that, in the case of an emergency, probably you don't have to worry about their response, they are really absorbed in fear and they will behave. Once things start to settle down though, that is where discrepancies start to show up. While policymakers are always going with the generic group, you cant make a rule to be individualized. This is where these two things become separated, now my experience is very small but I can certainly rely on face to face communication instead of public

communication. Only by using face to face communication can you gain trust. On the researchers side, we have to approach with empathy and that will develop trust within the public.

11:41A

The issue is that nobody has ever really solved this problem it is really a comparison of society versus the individual. Ryoko said that you really need to be prepared with transparency before the an emergency event.

Yoshihiro is a Japanese American, regarding the issues addressed earlier, he would like to publicly state the difference between the perceived high risk siting plans. In the US, there is plenty of siting happening by the government. In Japan, the government gives people money ahead of time as a compensation of possible accidents. It is at that time when communities can try to reject the sites be allowed to the sites. Yoshihiro said that he doesn't want to belittle the plight, but the people who live in those communities are are at least partially responsible for having those plants in their proximity. If we could handle the fear, we could demonstrate our belief by maybe moving in there and living in that area.

The concept of nuclear homesteading was just coined.

A question for Ryoko and John Dunn, reflecting on remarks yesterday from a speech from Bill Magwood, which would say that it would take a long time to sort out what is going on in the low dose region. One thing that he would note, is that it is possible already to use the existing theory and paradigms, to far better effect. When I say that, we were actually challenged to answer what dose rate we would be willing to live with over a full year without moving. He can actually provide an answer to that question based on a J-value. A does of 51 mSv/year was not enough to trigger an evacuation of a town, it resulted in only a reduction in lifetime by 3 months. Had it been a reduction of 4.5 months though, they would have triggered an evacuation. Shouldn't it make more sense to start calculating loss of life expectancy and then to use J-value to calculate the risk.

I think that what has been missed out in this conference, is we didn't talk too much about the weaknesses of the epidemiological studies. There is one reason that people like the LSS study, we really like that cohort. We might get one more chance to study them before they die, but then that is it.

John Dunn, said that the tools are available to apply any new method to this system, but you really have to convince the governing agencies to apply them.

While this topic is on communication and policy. This is all framed in a very antagonistic way (us versus them). It is still a very much an us versus them event, we are talking about trying to communicate with the public, however within this room we have people tuning out to other ideas and playing with their tablets.

John Dunn said that he really likes this group of people and would be willing to talk with anybody here on any of these topics.

Paul Locke would like to thank the ANS and HPS for bringing us together to discuss this. We need to try and develop more common respect between these fields. We need to be able to look beyond our own fields and this would certainly be a first step. He would agree that communication within this group is key.

Niwa would like to say that on behalf of ICRP, the LNT based radiation protection has a long history that has a consensus already built. So it is very nice to have this kind of opportunity to have this variety of peoples opinion, but probably ICRP would be happy to show that the process of the LNT came up. There is a long long history of humans struggling. We have a lot to discuss even after this meeting.

11:55A

Question for people outside of the affected group, Fukushima and south Africa. Do you know of any involvement of people in trying to reach out to local people. Bonne said that one of the troubles in Africa is that people don't really trust nuclear power. Some people don't even want to use electricity generated by nuclear because they are afraid that the radiation will transmit from the plant to the lights within their houses. Wind and Solar have done a much better job in selling the comparative advantages to the public, and we also need to improve on this front.

Niwa said that the people who moved away from Fukushima experienced a lot of hardship, and a long time ago there were also issues in Hiroshima, however at this point that stigma is now gone and the place is doing great. Stigma is a very efficient way to cut people out from groups. So once you have this stigma wall, you are very happy for a time, but this happens all over the world in schoolyards and in bullying. There are many aspects of our life which are being tainted by our own egos, which has caused homosapiens to evolve to their current state.

Grant Tell, said that he likes John Sammat, and he has a comment on John's comment on John Sammat. One, when he says that there is no safe level of small particles. As an epidemiologist, we cant say that it is safe. We can say that something isn't dangerous, but we can't say that it is safe. In order to manage

this risk, should we take a lot of money. When he said there isn't a safe level, he didn't say that we should try and reduce it to zero.

John Dunn said that Dr Sammat is a smart guy and he knows what the public and legislators will think say and do when he makes a statement like that. What he is saying is that there are plenty of safe levels of things, you just have to look for them, we need to find those points.

One comment, is that we try not to use the word safe. My question is, is safe a good word to use or not. Paul Locke said that he doesn't use it in his risk communication.

One thing he hasn't heard is the topic of citizen science, has anybody in the panel had experience with that.

John Dunn asked people all the time who come and see him because they are sick. I think that this is exactly the sort of communication that would help us to get information and policy into the minds of people.

Follow-up on the comment on IAEA, do you believe that the approach of driving down radiation doses beyond reasonable levels is driving confidence in the public or breeding it.

John Dunn said that there is a social license to operate. How do we give the public the confidence. Fear and confidence, we have the information to make people confident. There is such a thing a fear that prevents people form making good medical decisions. We need to promote the reduction of fear.

LUNCH BREAK

1:20P

Plenary Session #9 : Scientific Needs to Move Forward [Chair : Gayle Wallaceck]

First speaker will be Paul Locke who will be speaking on "INcorporating Low Dose Information into U.S. Laws, Regulations and Policy". First he will start on his background and perspective. Then he will do a quick tour of U.S. laws. Then he will cover an evolving view of risk assessment. finally he will cover a potential way forward (including opportunities and challenges).

1:23P

He is started out working in the world trade center in wall street, after working there for three years he switched over to environmental law. During this law practice, he completed a doctorate in Radiation Protection practices. During his career he covered a variety of radiation related issues, including low-dose radiation issues. His disclosures are as follows. He has no financial conflict of interest to disclose he is a member of EPRI's low dose radiation advisory committee, He chairs the Columbia Universities advisory council for its center for radiological research. Now to cover current US laws regulation and policies on ionizing radiation. He will be covering Nuclear Fuel Cycle, Medicine, Workers , Naturally Occurring, Compensation, Emergencies, Waste/disposal and Air/Water/Land. These are the broad categories in which US law covers. Also note that he is only looking at federal laws.

1:28P

Now he will turn to some specific examples. Fuel Cycle (NRC licensees) = AEA. 10 CFR Part 20, subpart D - Radiation dose limits to the public. Then you have naturally occurring: Radon - IRAA, Title IV of CERCLA amendments of 1986. There isn't much regulation on naturally occurring radiation. For outdoor air, you have the Clean Air Act, this is a huge 700 page law. Finally, you have compensation - RECA 28 CFR Part 79 (eligibility criteria). What does this all tell us, well a couple of things. The last thing is that almost all of these situations, organizations use almost always two things the ICRP/NCRP conclusions and risk assessment to make decisions.

1:32P

Risk assessment was born out of a shotgun wedding between science and law. There wouldn't be any risk assessment today if it weren't for the Benzene case. In my opinion and it's progeny that risk assessment because its tool of choice. Following this case, the use of risk assessment was viewed as a good idea. The typical environmental risk assessment became outlined in several different book. it as included in the "Red Book" in 1983, (AKA "the misread book"). Now, on to an evolving view on risk assessment. Yesterday we heard on AOP (Adverse Outcome Pathway) process. I won't cover this again, but I will explain why it is worth supporting. for IR dose/response, LNT underpins federal (and international) radiation protection paradigm. It is meant to be protective and conservative, recent epidemiology in low dose range generally supports this but it is not entirely consistent. Recent radio-

biological studies show variability in response at molecular, cellular, and tissues levels that show nonlinearity in certain circumstances.

1:36P

He wants to talk about how to integrate all of this really great science to change how we think about things. One of the major advantages of Low Dose Radiation, is that it gets us closer to systems level biology. A paper is mentioned "Synergies Resulting From a systems biology Approach: Integrating Radiation Epidemiology and Radiobiology to Optimize protection to the public from ionizing radiation". Jumping to conclusions, we need to show that the AOP risk advancement pathway is the right choice and we need to show that it is better than traditional risk assessment. We really need to think about regulatory acceptance. We can't just talk about AOP risk assessment, but we need to show that it will be the regulators' rules under the laws, so that it can be regulatorily accepted. We have some opportunities here, we can begin to incorporate more low dose IR into the development of US laws, regulation and policy.

1:40P

A presentation from Dmitry Klokov will now start on the "Research Needs in Low Dose Biology"....

1:46P

Causes for LDR decline, biological complexity. This is dependent on cell type, tissue type, organism, dose-rate and radiation quality, collaboration is the key. LDR research trends, downward drivers. There is some biological complexity and epidemiological studies that support the LNT. Controversy over the LNT also is one of the things causing the trend. In recent years there has been a new upward trend for LDR. We have new tools and need for mechanistic understanding (in vivo). Now we think we are in a good position to start again. We also have a need for synthesis of current knowledge acknowledged. We also have tissue banks that we can analyze using these new tools. Also it would be fair to say that there is an appreciation of long term relationship of human and anthropogenic LDR (energy, medical, and space). Public concerns and pressure continue to grow, these are some of the drivers for LDR 2.0.

1:51P

Research needs: science. We need real low dose rate studies. Responsible and ethical research communication, effective use of limited LDR facilities. In vivo studies, systematic and holistic approaches - collaboration, mouse-to-human transition. A big bullet is the direct well planned epi-studies on medical LDR exposed cohorts. Millions of people (100x over A-bomb). Avoidance of co-founders/biases/ Requires long-term commitment (e.g. 50+ years and privacy issues). Finally Individual radiosensitivity (iRP?) the LNT argument , lets protect a few people even though we know most people will be okay.

1:54P

Some of the uncertainty of the epidemiological studies is probably resulting from this issue of radiosensitivities. Research goals : high-level. Strategic global agreement on research agenda. It will require global collaboration, no tissue wasted, no assay missed, funding and publication policies and guidelines. Need a public license for research. Individual researcher interests vs. what people are concerned with. Finally we need constant contact and interaction with the regulators. We can learn a lot from each other. Time for questions.

1:56P

Question; you talk about low-dose radiation research, but we don't even know the medium and high-dose mechanisms toward cancer. He thinks that to understand low dose range, you probably need to understand the high dose range first. The trouble with the low dose, is that if you have a risk factor of 1.5 how can you identify which case is the radiogenic case and which isn't.

Next question; After Chernobyl the number of papillary versus non-papillary cancers. Are there any markers in radiogenic cancer?

I am not aware of this at this point, but I think that we will have some information on this fairly soon. Right now, he doesn't think there are signatures in thyroid cancer.

2:02P

Nick priest is now speaking on the "needs in communication". One of the things about empathy was, that he was trained for quite a while, and he belonged to a group of people called Samaritans, which deals with people who are suicidal and you have to handle things right. We are looking again at Slovace work of concern versus risk. Risk acceptance involves a balance between perceived benefit and

perceived hazard. The public is prepared to ignore risks when they perceive benefit from a technology. He looked at different populations of perceptions of a number of polarizing questions.

2:07P

So if we summarize the mean deviations from the opinions of the nuclear experts by population group. The public perceived less benefit and at the same time the public perceived more detriment than the nuclear experts. As an expert, you look at the actual benefit and the actual detriment. However, these two things are not the same as looking at the perceived benefits and the perceived detriments. For one thing, the media probably won't speak about nuclear benefits, but will most likely cover the detriments. Since the media is neutral on medial radiation, the public generally supported it. Messages: Public generally supportable of benefits, much less certain on detriments, but tend to have an exaggerated perception of detriments, overall balance negative to nuclear but not for medical, media attention to detriments to a driver. To star to correct bias, we need to educate our workers, we need to educate the medical community, and finally we need to educate media to overcome media bias.

2:12P

Information sources, If we look at where people get information from, because in order to get people to change their mind, we need to target those sources. Post Fukushima biggest worries were concerned with the perceived risk of genetic effects and of delayed health effects. This means that we will need to start using social media, which is tricky because the industry mostly views social media as a double edged blade which could hurt us. The messenger "because people respond emotionally rather than intellectually to risk information, the risks of radiation exposure: are best communicated by someone who is...". Another thing is that you can train a good communicator to make them an even better communicator, but it is very difficult to train a bad communicator.

2:15P

The next issue is being empathetic, Communicate, tell the people what they want to know. Not what we want them to know nor what we think they want to know. You need to start young. For one thing, even the way you dress communicates something. What sort of things can we tell school children. Radioactive processes produce heat and light that allow plants and animals to live. Simple life may have started deep in the sea close to water spouts heated by radioactivity. Without radioactivity in the earths core would be a dead planet like mars. The decay heat in the core of the planet is what keeps it molten and keeps the solar wind from stripping away our atmosphere. There wouldn't even be floating party balloons without the gas produced by radioactivity underground. We really need to start talking with people to make them realize that we really depend on radioactivity to continue existing.

2:19P

We have been trying to do with with ANS for a generation and it hasn't done a thing. The problem is, people probably won't ask the right question. Next we have Chris Clement from the ICRP. He will be speaking on "ICRP views on radiation risk at low doses through the lens of Fukushima". The ICRP is an international group that works for the public benefit, which tries to protect the public and environment from ionizing radiation without unnecessary detriment. March 11 and 12 initial evacuation to 20 km were not based on scientific evidence did not use numerical dose criteria. Decision makers faced great uncertainty and the possibility of terrible consequences. Later on April 22, after better characterization. Evacuation order for an area NW of Fukushima. On to the meat of the presentation. We will talk about the Fukushima dialog, then he will shift over to LNT. The Fukushima Dialog was done for the following reasons: it promoted practical radiological protection culture, it provided to the authorities ICRP advice on the system of radiological protection, and for the ICRP, we learned from those directory involved to improve recommendation on post-accident recovery.

2:25P

This dialog happened in three phases, there was an Initiative between 2011 and 2015, which was 12 dialog meetings. Next there were 7 dialog meetings that happened between 2016-2018. We started handing over the management of the dialogs to local people. Finally, a third Fukushima dialog (2018->???) which continues with a meeting planned for December. He said to look at this seating plan for for the Fukushima dialog. We invited local stakeholder participants, we had local and international observers, ICRP was there as a facilitator, it was open to the media, we used common language, and there were presentations and structured dialog. The stakeholders would express their views without interruption, Stakeholder express views again in light of what they have heard, then main points are summarized by a rapporteur. We have done 19 dialogs so far.

2:29P

You can get these proceedings from the CIRP website, you can download the Japanese or the English versions of the papers. They are free to download. There is a French web documentary available (French only, sorry):

www.fukushima-dialogues.com

This is the most important slide from the dialog. Nobody in any of these dialogs ever asked about LNT. These are not the sorts of questions that regular people ask, questions on LNT are the questions that we are concerned with. We will now go to more normal ICRP stuff. ICRP tries to promote an appropriate level of radiation to people and the environment. The human health objective is "manage and control exposures to ionizing radiation so that deterministic effects are prevented, and the risks of stochastic effects are reduce to the". The ICRP models for protection are Deterministic (used for tissue reactions) and stochastic (Cancer and heritable effects). We do use the threshold model for Tissue reactions. However, for cancer and heritable effects we are using a model where increasing dose -> increasing probability. There is no threshold, we call this LNT. This classification is a simplification for protection purposes.

2:34P

LNT: is not promoted as a precise biological model to describe dose-response. LNT should not be used as an assumption in scientific studies on low-dose/low-dose-rate response. LNT is used as "a prudent basis for radiological protection at low doses and low dose rates". The LNT is simply a SIMPLIFICATION FOR PROTECTION PURPOSES. Regardless of whether LNT is the honest truth, high doses of radiation increase the risk of cancer, lower doses = lower risks, at very low doses the risk if any is very small. zero additional dose = zero additional risk. LNT as a "prudent basis for radiological protection": it makes summation of doses possible. It also drives optimization of protection, at high doses risk is higher, at low doses risk is lower. Action should be commensurate with dose/risk. At low doses, actions, if any should be modest.

2:38P

So where is the problem? An over-abundance of conservatism. Mis-interpreting OPTIMISATION OF PROTECTION. The ALARA principle, ICRP doesn't use ALARA. Conclusions, the way forward. Encourage and support low-dose and low-dose-rate research. We should improve messaging about risks at very low doses. Promote reasonableness in optimization of protection avoiding over-conservatism in: standards, regulations, and practice (including regulatory practice).

LNT is not meant to be accurate, it is meant to be a reasonable indication for protection. A questioner pointed out that the additive nature of LNT makes no sense because lots of research shows that repair happens within a day and adding subsequent does makes no sense.

2:41P

Panel #6 : Requirements to Update Regulations; moderated by Christopher Clement

This panel includes

- Nick Priest
- Dmitry Klokov
- MOhan Doss
- M Christopher Clement
- Doug Borham
- Dan Stram
- Barrat Fountos
- Paul Locke

Starting with a speech from Doug Boehrem. He put up a picture of radiation scientist drawn by a 7th grader. An innocent child, would certainly have a bias but upon showing them what a radiation scientist actually is, they can change their view. Would you willingly take a child and expose them to radiation if they weren't sick.

2:45P

He took his kids down to the the x-ray machine. He got to get a measure of their bone density. He knows that the does is harmless, so he doesn't have an issue. There is also some extra added value. He also got him and his wife x-rayed as well, which allowed him to put together a nice Christmas card. So in 1961, we started building a new reactor, CANDU reactor. His father died of lung cancer, he was a uranium miner and he was a smoker. He works for Bruce power, they are sustaining 8 units until 2065. The total investment is \$15.3B. Currently it is 65% Nuclear power in Ontario and 25% Hydro.

2:51P

Mohan Doss wanted to make a comment regarding ICRP using LNT for radiation policy. The problem is that the use of LNT leads to fear, and fear subsequently leads to harm of the sort we heard this morning.

Barret said that he doesn't really want to talk about his career. It was to assess epidemiological studies, for setting limits for occupational and public. In total, he has evaluated over 200 studies for risk assessment. The key lesson is that one must examine the weight of evidence, considering the statistical element and the strength of the agent. Also, one cant forget about biological plausibility. So, the strength of the evidence can be supported by multiple studies of the same cohort, or multiple studies of different cohorts. The level of peer review regarding DOE programs in unprecedented, but this is required due to our collaboration with our Russian colleagues. These studies should be reviewed carefully before they are passed on to journals.

Question for Chris, you use the word protection and risk. Why do you not talk about benefit and why protection, from what.

Chris said... yes, you are right, we don't talk about benefits enough. I think however, it is not ICRPs job to promote these benefits. So maybe we should acknowledge it, but we are really more about the protection side of things.

Mark Miller said that he has come to the conclusion that we have been wrapped around the axle with LNT. The question is, what would it take to update these regulations. I guess we just need to drop the word LNT from our discussion. Likewise we should drop ALARA from our vocabulary and use Optimization instead. The moment we say ALARA we are back behind the principle and people are afraid again.

Chris Clement fully agrees with moving towards Optimization instead of ALARA.

Gerry Thomas, she wanted to answer one question. She said there are no bio-markers which lead radio-cancer. We need to engage far more with the media. She has been meeting with tons of people with the media ever since Fukushima. She wants to encourage people to engage with other people and with youngsters.

One of the panelists said that he thinks that it is possible to work with the media fairly reasonably, he worked with the BBC and it seemed like it was quite balanced. He is also on the advisory group for veterans in the UK, and we had a startup meeting. There certainly pitfalls, but it doesn't mean that you should avoid working with the media.

3:03P

He wanted to follow up because we spoke about this in the last panel, can we say, is it safe. The ultimate question is, would you let your child do something, or would you do this thing.

Mohan Doss said that interacting with the media is okay, but we need to get the nuclear industry to make a claim that it is the safest.

Tony said that we need to start working together with the media. He said that, when he presented that low doses were safer than we thought, the journalist said that we can't publish this, however if it was less safe than we thought, we would have our self a front page paper.

Part of the complexity of the low-dose research program, is that all of these programs have their own agendas. The difficulties are really in putting these separate research programs together. He said that the funding of the DOE program really was following the field exhausting itself.

Tony said that he didn't think that the DOE low-dose program wasn't too complex, it was just too unfocused.

An audience member would like to bring up the topic of ALARA, shouldn't it not be as low as any other of type of risk. Shouldn't it be as low as it takes to be safe.

In 1934, there was the ICRP standard based on the tolerance dose, then the ICRP changed in the 1950's to the LNT idea, we need to go back to where we were. Lets go back to the 1934 ICRP, and the level of the limit was the 2 rad /day limit and a 7 rad limit per year.

3:11P

What they could do, is say what is the lowest adverse observable level would be at 100 mSv.

Over the last few days, we heard a lot of science and a lot of opinions, but we haven't heard many people proposing alternatives. What sort of suggestions can we put out for debate?

I tried to do this, but I wasn't an effective communicator. I want to create a level playing field so that radiobiology and epidemiology have a chance to work together. He thinks that we need to evolve risk

assessment to do that. Laws in the US are exceedingly complex. We want these changes to be a series of scalpel cuts, not a hit with a mallet.

Doss said that the question we need to decide is whether low doses create harm or a benefit.

Another panelist said that if you went to the media and said that there are no effects, the media wouldn't pick it up. However, if you framed it as an economic burden that is preventing people from getting CT scans.

What could be done, is to try and transform this discussion to a group like ICRP so that they can review it.

Rosavella, said that she has a problem regarding the consequences of the LNT in the ICRP guidance. We have potential, planned, and emergency situations. She thinks that the potential should be added to the planned. Today in the morning we heard that our job as Health Physicists is to take care of imaginary people with ultraconservative effects. Not only are these people imaginary, not only is it over-conservative, but it also isn't even happening.

Chris said that earlier publications talked about exposure, but we haven't spoken on it recently because we weren't planning on changing it. Maybe another change in the recommendations might come up in about 10 years from now.

Cindy would like to address the comments on ALARA. There was an attempt by the NRC, to change that, however we couldn't adopt changes at the time. The idea of optimization was proposed again, but again the commission decided again that there was not enough evidence to adopt Optimization. It is possible to petition to use Optimization instead of ALARA.

3:20P

A comment regarding the role of the media. There is one guy here. One of our attendees was associate with organizing the Wingspread Conference. He brought major people from the media, but as the meeting went on, he got increasingly agitated. He said that you folks are all wet, we aren't supposed to educate the public. Our job is to put material out there, and the more controversial it is, the better it will sell. Now I put out several papers, and the question is how low is low enough. The question is how low is low enough?

The answer to your question depends on LNT is there or not. I think that LNT plus ALARA plus human psychology leads to what we have now. If you remove LNT and leave the other parts, you will get a different configuration.

John Shanahan is a civil engineer, who has volunteered for 10 years for an org called environmentalists for nuclear. He looks at goals for the world. He has six brief points and then a question. The first observation is that the free market foundation, the point they made is that the middle class is growing faster than they thought. The point of that is that with the growth of the middle class you need reliable energy, which is best served with nuclear, we are here to talk about LNT and collective dose, biological response and dose are the main parts, the other three points that he thinks are lot bigger are the horrific truth of where is the nuclear industry today, it is dead. It is dead in the US and nearly close to dead in France. Last point, how is this organization going to really answer the questions that the public has, in the human game in the world, some countries want other countries to have less energy and that is where the US is ending up. His question to everybody is, are you going to work on these bigger questions, by getting these regulatory organizations working more efficiently, or are you just going to focus on biological response and low-dose.

3:29P

Safe enough can be quantified by the use of the J-value. And he has a question for Chris, you spoke on optimization, but it isn't being picked up enough. How are you going to encourage that take up. Almost every country in the world takes it up except about two.

BREAK

3:48P

Panel #7 : Path Forward - How? and Who will have the action? [Facilitator : Larry Oates]

Panelists include:

- Roger McClellan
- Werner Ruhm
- David Pawel
- Gayle Wolochak
- David Brenner
- Antone Brooks
- Alan Waltar
- Christopher Clement
- Ludwig Feindengen

Roger said, I am going to use three slides from before. Essentially it is the public that drives things. I think there is a lot of confusion regarding the role of various institutions. There is the Creating, the Synthesizing, and the Setting of standards. These are developed and based on statutory authority and based on administrative law structure. Finally, there is the implementation, and I think that is where the Optimization takes place. I've spoken to a lot of laypeople and they have never spoken about Optimization. Showing that Linear No Threshold model is science or policy. The issue is how extra cases due to radiation are identified. We need to change our paradigm, it won't be a single pathway it will need to be a network of a bunch of steps.

3:54P

Werner said that the first data thinks that should be collected is from the major epidemiological studies. I was a bit surprised, that I felt a bit of skepticism from those large studies, like the Russian studies. The first results were released from the child studies of CT scans in children of UK. There are lots of mechanisms to study and it is important to be continued and I think that we need to focus on the endpoint, which is cancer development and leukemia development. We need to get more information on how cancer develops. The third topic I found important was the animal experiments. We now have data from multiple countries, and we should really try to create a network and pool those resources together. Finally, we heard a lot about this adverse outcome pathway as a tool or as an option or opportunity to bridge the gap between epidemiology and radiobiology. I think that this is still a long way off, but we should probably start working on it anyhow.

3:57P

On to David Pawel, he said that his opinion is fairly similar to Werners, so I don't know how much spin I'm going to add. I absolutely agree with the idea that there should be a better integration of epigenetics and radiobiology by using AOP. There are all these nice results coming out of radiobiology, but we need a way to get access to it. Also, I am thinking that this AOP could work out as a great means for communication. Early on Tuesday morning, there was such a good talk by Sujee. My take is really that I think that LNT is a pretty nice model. I know the phrase is overused, every model is wrong but some of them are still useful. If Mike White were here, he might actually have some very intelligent things to say about that.

4:00P

Tony Brooks asked if there was anybody less than 40 in the audience. Because we need to start training the next generation... how, I don't know. Anyhow, there have been three things coming out of this meeting that we are in convergence on. The regulation of 1 mSv to the public per year doesn't seem to be backed up by science, if we could move it to 5 mSv, we could save billions. The other thing is we should never reject a CT scan if it might make sense. The third thing is that we really need to have focused and directed research that will marry epidemiology and radiobiology.

4:03P

Gayle Wallacheck said that LNT does not explain the biology. We are talking about cancer in most cases. We need to be aware that there are studies that show other sorts of adverse problems. For example, there are stochastic effects such as cataracts. There are some biological effects that are more apparent at low doses that aren't at high doses. Not all agents behave in a linear fashion over 6 orders of magnitude and we don't know why. We now have techniques that improve our ability to detect cataracts and cancer much earlier than we can before. Currently the US does not have a strong low dose program. There is a wealth of information in old data sets and we need to have a consortium to combine our data sets together.

4:06P

David Brenner said that he agreed with everything Gayle said. David said that the 1 mSv limit and the 50 mSv limit are not things that directly derived from LNT. If you want to change those, you don't need to focus on the LNT. Furthermore, I don't think we can say with any certainty what is going on at low doses and that we shouldn't pretend otherwise. There is a lot of interesting biology that is going on at LDR. Actually, we are quite a long way away from answering the low dose questions. Also, he would like to echo what Gayle said, all of the other developed countries have low dose programs and yet in this country, we don't. Congress has been working on this and actually there is a low dose research act, and

now it has passed the senate and one of the best things that could come out of this meeting would be if we could press the congress to start it up again.

4:09P

Alan Waltar said that the purpose of this conference wasn't just to have fun, but to try and move the needle forward. Trying to bump up that 1 mSv limit to the public would be an easy target. Also, I think we should also see that collective dose is a horrible idea and should not be used. Whether it is the LNT or not, but the idea that radiation is dangerous at any level is something that is scaring the public. Somehow we have to be able to tell the public that radiation at low levels is not damaging. The reason I got involved here is because of all the unintended consequences. I hadn't realized the magnitude of it until I heard from Ryoko. To say that radiation effects are damaging at zero is not true and we need to have the guts to say it.

4:11P

Chris Clement, he said that there are possible actions in four domains. Research is a domain that the NEA is looking at doing some international research coordination, this is a good direction. We need to know more about what is going on at low dose. Regarding policy, I'm not sure, I'm not an American, but there are certainly things that can be done, be active internationally. In terms of practice, one suggestion I made is that there is over-conservatism in practice. This deserves a look and professional societies need to be looking at this (e.g., ANS). On public understanding, I don't have anything to add. He likes Doug's idea very much about getting to the kids while they are young. Perhaps we can get in touch with public health agencies to make sure that people get CTs when they are needed.

4:14P

Ludwig would like to say that LNT is a stumbling block for future development. What does 1 mGy/year, it means that every cell in your body is hit once per year. We have to evolve to an understanding that the LNT hypothesis that this is dangerous, and that's how we came to recommend the 1 mGy/yr. Please get off this stumbling block function. Admit that we don't know what is going on down at that point, but you could just say that there is a threshold, and that would resolve the issue. My plea is to be reasonable and down to earth, and to get off of recommendations that do more harm than good, such as the LNT.

4:16P

Now there will be a 1 minute summation regarding these future plans. Roger said that we have a broader concern, we haven't heard the overarching concern of a more healthy society. There are other diseases to worry about. I think we need to focus our resources on the diseases that really effect the general population. Somehow this community has to join a more broad community. This discussion would be very different if you had some of the leading researchers of cancer in the audience. we need to join the overall cancer research community with ours. Werner wanted to comment on the 1600 deaths in Japan resulting from LNT. He wanted to know why they happened. First we didn't know what would happen. The second answer was that it was a threefold disaster. The tsunami destroyed a lot of the infrastructure, which should also be taken into consideration when we think about those deaths during the evacuation. Who should do it... since I work with ICRP, UNSCEAR should review the current evidence, then ICRP should convert it to recommendations. If we feel there is a gap in the science, we can do a little bit, but most of the work should come from national funds. Because this is the case, I propose that we need a coordinated action between countries all over the world. The NEA approach from the week before, is an important issue. This should be coordinated, funding should be coordinated.

4:21P

David Pawel, wants to circle back to what we should take away from this. There are some programs that need to happen, but who is actually going to leave this door today and start working on these sorts of things, who will get the ball rolling on these. One thing that we could use is more science, he agrees with what Werner put out just a minute ago. There is quite a bit of disagreement in this room as to what I think should be done. Based upon what I heard so far, I still think that LNT is a decent model. I think it just means we need to be really careful with the sort of statements that we make. We really don't know what is happening at those low dose and low dose rates. I would say that one area where we can come to some agreement would be the need for better science and communication. Tony said that he was formally invited to have an toxicology outreach sort of thing on radiation. These days in toxicology, we don't talk about radiation anymore, we talk about chromium, we talk about herbicides. Back when the low dose program was started, we would fund any organization that was performing the sort of research that we couldn't do ourselves.

4:25P

Gayle said that there are two things that haven't been said. There aren't; many young people in the field. One issue is that there aren't radiation training programs left in the US. If we can do anything, we should make a call for radiation training programs in the US. The second point I want to make is that we do need to start yelling, but science textbooks and lower, don't even mention radiation in them. We need to have some interaction with the companies creating curriculum to make sure that radiation is included. David Brenner said that he worries that there is a bit of chasm between the ideas that have come up in this room, versus what is coming from the radiation research community. How many of these people were at that meeting last week. It would be great if more people from this room could join

that society. The second point again is that it would be great to have an active low dose research program in this country but there is simply no funding right now. So one action item might be to contact senators to urge them to pass the funding for the program. Alan said that one of the items that seems to have some traction, is in implementation. How do we get this working. Even if the EPA wanted to make a change, it would be almost politically impossible for them to change it without having some international organization making a recommendation. We do need to have more research between the epidemiologists and biologist, and get that stuff to UNSCEAR, so that it can then go to ICRP. That is the obvious path

4:29P

Chris said that if you want to have an influence on the ICRP, call up Julian or Gayle and find out who your UNSCEAR representatives are. They don't do science as you'd say but they do review science. If you want to get on the ground floor of scientific research get in touch with Ted about the NEA thing, those are concrete things you can do today. Ludwig said that I think we all agree that the ICRP is the group that sets the rules that make the changes. I think that there is a chance right now to already link this biology to epidemiology and let ICRP open up the gates, so that research can be done. This would keep the ICRP from blocking progress. He thinks that ICRP would probably not lose anything if they moved from the LNT model to a threshold model. It is fairly easy to use. Again, this opportunity is unique and has never happened before, for us to come together. We need to link biology and epidemiology together and then have ICRP take the lead.

4:32P

Larry Oates asked Allen about what Allen's final session would be. He asked if maybe we could just combine them. Allen stated that would be okay.

Rod Adams said that he is an American, and 9 years was as a staff member of a system of government. His question is, what do you think about in the near future, doing the start of what they call expert elicitation and there isn't a really agreed upon answer and there isn't any agreed upon data. We do have data on other things but they aren't humans and they do respond differently. We could vote on a dose that people would be okay with.

It was pointed out that yesterday that it was probably a straw poll.

Rod said that, yes sure maybe it was, but today we can do a real poll and not a straw poll. Larry Oates said that we probably can't do that now. It sounds like we might have a response survey asking people what that sort of limit would be.

There was a comment, on her experience with press. once upon a time she was very active with the press. As long as I was representing the environment, they loved me. They even had me on my own TV program at the university. Then she went to work at congress and she joined the ANS and when that happened, the press wanted nothing to do with me. You would think the press might be a vehicle to motivate people, but I think that they are politically motivated and I wouldn't use them. I would suggest that a proper audience for us, would be the regulatory system. They exist to make regulations, and believe me they talk to the anti-nuclear people, a lot. She was on an NRC advisory committee and it is the regulatory agencies and the groups that advise them that the people to whom anyone from this group should interact. Also the medical dental group is also a good target because they deal with people who get irradiated. Finally lets stop saying it is safe.

Another statement, two weeks ago we had a meeting on global coordination of low dose research and the result was that everybody thought it was a good idea and the NEA is going to start working on that. We want to start working on global networks for tissue databases, we want to look at an all risk approach and we want to work with the AOP people. In terms of research projects going on, we have NEST, which has research project in 2 dozen countries and they are able to exchange and coordinate research together.

I have a word of caution relating to AOPs, if this community is led by advisors. We need to have all of radiobiology. We should create a new workshop on radiobiology with AOPs.

I agree with Allen on how things should move forward, the conference should create a task force group on how to move things forward. What do we agree and what is our position on LNT. Whether or not we all agree, we should probably have an opinion. We should probably keep emails and probably keep this group of people in contact.

Want to support what Ludwig said about the stumbling block that we have to get rid of. We need to get rid of collective dose, as Allen said. Collective dose is a directly derivable concept resulting from LNT. So if you want to get rid of collective dose you have to get rid of LNT.

Having been involved in nuclear energy since the 1940's. One of the problems with nuclear energy is that it is still associated with the bomb. we need some way to counteract that. Back when i worked at the lab pro-hormesis. I found that the repair of chromosomes, two involving DNA and one involving RNA, and it seems to me that hormesis is probably just a result of improving those two processes. One

way to test this would be to look at astronauts and high flying pilots and examining their enzymes. In my opinion one of the worst disasters is not the radiation, it is the perception. If hormesis were true and we could tout it, it would counteract the bad perception.

The house and senate passed the House and Senate bill starting the Low Dose program but there is no funding. We should contact our senators to get that funded.

One person said that he would like everybody to challenge their paradigms. One thing I think that your strategy should be. WE are in our comfort zone and we can come up with our consensus, however your first test of the metal will be the nuclear workforces. Your nuclear technician, x-ray techs, these guys will give you feedback before you get a reaction from the general public. The real question is how could this be utilized and if we can get the nuclear workforces on board, we can get a lot more done.

We have 10 minutes left.

People are concerned about LNT at this meeting, but as a biologist, LNT can be compatible... you could always say that for this dose range, you can not see any observable effect. If you remove LNT, you will have to have some other program. Take hormesis, or something. All you are doing is separating the population into two, that is no good.

I'm going to be brave by saying that I think that LNT is wrong. And there are actually people dying as a result of this. Also hormesis is real, so we shouldn't ignore that. If hormesis is true and high doses are bad, then clearly there is a threshold. Also we should get rid of the term safe. We should have a linear threshold model, with the threshold of 200-300 mSv.

I had a few comments, I think the only thing that we have agreement on is that we need additional resources to do additional low-dose research. I am a lobbyist, and I certainly can lend a hand to lobby congress. Also, we have not outlined a process on which to come up with a consensus. So until we outline a process, I wouldn't be comfortable with coming up with a consensus.

Question for Dr. Brooks. he asked how many people were half his age. What actual items are you wanting from us people under 40. What do you want from us today.

Roger said that I would ask you, what do you think are the important issues in this field and how do those issues relate to broader issues in society and what would compel you to see further training in this

field? When I bring up the issue of radiation, it is normally really lower on there interests. What are the real future job opportunities, and I have no idea. There is a real interest in medicine and in health care delivery. So before you make a call for more training programs, we had better have an idea of the job opportunities for those that complete that program.

4:57P

Tony said that also, I've seen a lot of programs that didn't have funding. We also need to make sure that after they get out that there are jobs available.

David Brenner said that he would suggest that you immerse yourself in the science of radiation research.

Gayle also said to tell people to say yes. When you are asked to go present, say yes, when you are asked to be a reviewer, say yes. These are the sorts of things that get you immersed in the community.

We heard this morning that it doesn't inspire public confidence when experts argue over what is safe and one issue is that the EPA and the NRC have two different limits. Why is there a 4 mrem/year drinking water limit.

In my talk I stated that hormesis is real, and the mechanism involves epigenetic mechanisms. To really get things moving, you are going to have to get epigenetics scientists to move over into radiation biology. That is my suggestion.

If we had a consensus today on a non LNT model, I don't think that society is ready for it and the public probably wouldn't be able to process it. I think that this is an underpinning to all of this. I think that since we don't have answer to that today, we should probably start working on the public, and in the meantime start working on the science to back it up.

5:02P

One of the biggest stumbling blocks for medical imaging is the BIER VII report. It often scares our patients. Larry Oates said that his takeaway from all this is the survey of what everybody thinks is appropriate. Also, how do we come up with a consensus from the group. He is thinking that if we do send out a survey, could we come up with a proposal and send it out to the group for feedback as well.

5:04P

Alan said that we have on the agenda the last word from our honorary chair. We talked a lot about the public saying that they will accept risk if they perceive a benefit. So we cannot live without radiation. We have seen plants do the same thing. I am interested to see what Jerry is doing with radiation and Alzheimer's disease and Parkinson's disease. If we could somehow pursue this sort of research, wow what a difference this would make. Ludwig is now giving the closing remark. He takes this as an honor and a challenge. For the last year or so, I got into a problem. I am experience a problem with vision difficulties. So I cant read the paper I wrote for this conference. Tony will read Ludwig's statement for him: "We have reached the close of this great meeting. I will be brief and to the point. This meeting has reached its goals of open exchange of facts and to optimizing radiation to the benefit of society.... All aspects of th...".