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TO DISCUSS RADIATION WITHOUT THE USE OF UNITS AND FIGURES

Abstract

The public is unreasonably concerned and anxious about ionizing radiation. This undefined, irrational, but still real fear of something you know is there even if you cannot perceive it with your five senses is one of the greatest problems the nuclear industry has to attack today. The major problem in this case may be the tehcnical language used by experts. The man in the street has no idea of the technical terms experts use. However, it is possible to make our message clear without the use of any units or figures. A lot can be done for the understanding and confidence by making comparisons to familiar concepts and situations, by taking off our doctors' coats and stepping down to the grass-root level to talk with people in their own everyday language.

1. INTRODUCTION

The theme of this session is Information on Nuclear Energy and Radiation: Striving for a two-way confidence and understanding. - But how can we earn confidence if we talk in terms which Mr. Public or Mrs. Mass Media do not know? How can our message be understood, if what we say is all Greek to our listeners?

I am not a PR expert. I got my education in radiation physics and I have been working professionally with radiation protection and health physics at a nuclear power station since 1973, so I will concentrate on the radiation part of this session. I know how bad we technical people are at expressing our thoughts in everyday language. Maybe other nuclear people have got the same problem, too. And if we cannot clearly express what it's all about - be sure the message will change several times before it reaches the broad public.

2. AN EXAMPLE

Let me start with an example.

Mr. Public or Mrs. Mass Media may ask us about our plants' radioactive releases to the sea. He or she asks because people living on the coast are concerned about this matter. We (the experts) very correctly and frankly tell them that our plant releases some 50,000 m^3 of contaminated process water annually. Concentration of the corrosion products averages a few hundred kBq/m^3 and the content of fission products is well below 1000 Bq/m^3. So the annual release of gamma and beta emitters is some 10 GBq, i.e. ten billions Bq. The content of alfa emitting transuranes is insignificant.

We think we made well. But Mr. Public and Mrs. Mass Media didn't understand anything of what we said! We used words and units which they never learnt in school nor later. Our answer was completely confusing to them. They just heard us name a lot of dangerous substances and huge figures. So their irrational but still real fear of something they know is there even if they cannot perceive it with the five senses was once again confirmed.

Why not make a comparison to drinking water! We know or we can look up the limits for all radionuclides in question. So we could have told the anxious man in the street that our releases <u>well meet the criteria for drinking water</u>, as far as radioactivity is concerned. This comparison to something familiar and well-known would at once make the whole thing clear.

If, for some plants, the water to be released contains significantly more activity than in the example above, we may say that "there's no reason to be very concerned about our releases, because they contain so minute amounts of radioactive substances that the <u>sea water already at a distance of ten meters from the outlet spot fullfills the criteria for drinking water</u>."

3.

THE TECHNICAL JARGON

All of us know that experts would need two languages - the technical one to be used among colleagues and another for public communication. The technical jargon used by experts surely is useful and exact for their own professional needs, but it is completely incomprehensible to people who haven't studied those things - and most people haven't.

Nuclear people use technical terms such as dose-equivalent, nuclide, doserate, contamination, uptake, intake, fission product, neutron activation, isotope, nucleus, alfa, beta, gamma, etc. These words are very familiar to the professional, but this is all Greek to the public.

Experts use units which are unknown to laymen. We talk in terms of mSv and mrem, maybe μSv and μrem. We talk about gray, rad, roentgen, mSv/h or μSv/s, Bq, Ci, cpm, cps and ppm. No wonder the outsider cannot grasp our message!

Our language is crowded with abbreviations and acronyms which cannot be found in a dictionary. ICRP, IAEA, NRC, TLD, BEIR, NRPB, N-16, Cs-137, LWR, UNCSEAR, PWR, BWR, LMFBR.... To most of our fellow-men these look like hieroglyphs.

We use very small and very large figures, sometimes replaced with prefixes: nano, micro, Mega, Giga, Tera, billion, one per billion, 3.7×10^{10}, 10^{-6}, etc. How could the man in the street get the idea, if he doesn't even know the meaning of negative exponents?

4.

COMPARISON TO FAMILIAR CONCEPTS

We must avoid that technical jargon when we talk to laymen. So do the anti-nuclear groups. And when the public can understand the anti-nuces but not us, they will rather listen to the formers and believe what they can understand - even if it's wrong. Any individual in any situation more easily identifies himself with a group the language of which he can understand.

However, when we leave out technical concepts it means at the same time, that we have to sacrifice a little of the scientific exactness for the sake of clearness. When looking for a good method to help our message get across we will find comparisons to familiar concepts most useful. For instance, we cannot make Mr. Public convinced that there is no reason to be afraid of catching cancer because of our stack releases by telling him that they "cause an annual collective dose of less than 0.1 man-Sv to all inhabitants in the region, and that the mortality risk factor for radiation-induced cancers is about 10^{-2}/man-Sv, according to ICRP 26."

Mr. Public will understand what it is all about if we tell him that the radioactive releases to the atmosphere have less influence on radiation than have the changes in the weather and the seasons.

Mr. Public knows that he will get no cancer just because the snow melts (which causes an increase in natural radiation of the earth), or because it is steadily raining (which takes down natural radon daughters from the atmosphere). The wind, depending on direction, transports air masses from different areas with varying concentration of natural radionuclides, and variations in the atmospheric pressure affect the release of radioactive radon gas from the earth. The effects of these factors are tens or hundreds of times greater than the effects of our stack releases.

5.

RADIOACTIVE RELEASES AND SMALL DOSES

It is always possible to make comparisons to familiar things like the natural activity in your own body or in a ton of soil or a cubic meter of sea water, to the natural radiation in your home, on a hill, in a plane, to the radiation dose you get from an X-ray examination or when visiting a friend living in a brickhouse. It may be a good idea to find out on beforehand a few examples to fit the needs of your special situation or of a certain NPS.

For instance, when talking about things like releases of radioactive noble gases, radioactive iodine or radioactive particles, about radiation doses caused by releases - or about plutonium - we may use comparisons like the following:

NOBLE GAS. The concentration of the natural noble gas radon-222 outdoors at ground level is between 4 and 40 Bq/m^3. The concentration of radioactive noble gases caused by normal releases from a NPS is a fraction of a promille of that, at the location of the site fence and further away still lower, of course.

RADIO-IODINE. The total amount of radioactive iodine released during a whole year from the stack of an operating NPS could be compared to the amount of radioactive iodine which is given to a person when he gets thyroid therapy.

RADIOACTIVE PARTICLES. In many cases the realease of radioactive particles from a nuclear power plant is of the same order of magnitude - or smaller - than the radioactive release of a plant burning fossile fuel.

RADIATION DOSE. The dose Mr. Public gets from the radioactive releases of a nuclear power plant during one year is about the same as he gets in a few hours in his home or at his job or in the street or anywhere. He may get a bigger extra dose by spending an evening in his friend's house, by moving to another floor or by moving his bed one meter or so.

PLUTONIUM. When critics say that "one microgram of plutonium can kill a man" we may remind them that 5 tons of that very same plutonium was planted out in the atmosphere in the nuclear bomb tests in the 1960's. During the years since that nearly all of it has fallen down to the earth, but mankind hasn't died 1000 times over. This sounds rude but it will make it clear that one microgram of plutonium can be fatal only in very special theoretical cases.

6.

OCCUPATIONAL EXPOSURE AND HIGH DOSES

When telling about occupational radiation doses or acute health effects of a heavy overexposure, the introduction of Sv or mSv into the discussion makes no sense. It would be better to say, for instance, that if the acute dose leaving you a 50-50 chance to survive or to die is as high as the Eiffel tower, the annual dose limit for the exposed personnel is a telephone pole and the dose limit for the public is as high as a suitcase. Doses between the lowest and the highest platforms of the Eiffel tower would lead to a temporary acute radiation illness if received in a short time but not if collected at constant rate during a period of several years.

A typical, annual occupational dose in the nuclear industry corresponds to the dose of cosmic radiation that aircraft personnel receives - without any dose control. Radon in houses often causes higher doses. Radon exposure in homes sometimes exceeds the dose limit for the occupationally exposed personnel. It is quite possible that a person's exposure decreases each time he leaves his home for his job in a nuclear power plant. The highest doses normally received in the nuclear industry correspond to the dose the man in the street receives in an X-ray examination of the abdomen.

7.

NATURAL AND ARTIFICIAL RADIOACTIVITY

Maybe our listener can accept X-ray radiation and other external radiation, but he is very afraid of internal exposure caused by intake of fall-out nuclides, e.g. in contaminated food. In this case we must take our listener with us and jump into the micro-world in between the atoms and molecules in our bodies to watch how an atom is hit by a gamma quantum, to cause an ionization. Neither the atom nor the cell can tell from what direction that gamma came! Therefore gamma doses caused by internal and external exposure are equivalent.- If you are shot in the heart, it makes no difference whether the bullet entered through your chest or through your back.

Sometimes we may hear that nature or mankind has got used to the natural background radiation but suffers from radiation caused by the artificial radionuclides in our releases. Again we can look into the micro-world. The atom hit by a gamma cannot know the name or the origin of the nucleus which emitted it. And it really doesn't matter.

We may also like to stress that radioactivity is natural for the nature, but chemical pollution is not. There has always been some 70 naturally radioactive nuclides in the nature, and in you and me. We have radioactive radium and polonium in our skeleton, radioactive potassium and carbon in our muscles, tritium and radioactive noble gases in our lungs, etc. The natural radiation from the human body is strong enough to be measured with proper measuring equipment.

We may also make comparisons without units. We can describe the variation of natural radiation by postulating that the value in a certain spot is "1". Then maybe one mile away the value is "2" and around the corner "0.8". In some regions it may be "10" and in radon houses even "100". In this same scale a nuclear power plant is allowed to cause a maximum of "0.1" and the real additional dose caused by normal releases is often less than "0.005". This presentation is perfectly clear even if we never tell the listener that the unit in question is named millisivert per year, mSv/a.

8.

CONCLUSIONS

The present situation in the nuclear power field shows two things:

1) We have succeeded in making nuclear power a reliable and safe source of power.
2) We have not succeeded in communicating these facts to the public.

If we like to broaden our support we must make much effort to make ourselves clear, to avoid to many datas, facts, figures and details. Just concentrate on the message! We have to sacrifice a little of the scientific exactness for the sake of clearness.

Because the science is not always simple, we have to make some simplifications and generalizations - as in this speech. If they are made in an honest way, i.e. just to make the idea claer, not to change the truth, the public will thank you - and your scientific colleagues will forgive you.