Interview with Keith Baverstock
"Emergency response system and public health measures for the nuclear power plant accidents."

Note: A Japanese translation of this e-mail interview was published in the April issue of "Kagaku" journal by Iwanami Shoten. The original English version, not intended for publication at first, was editied below, mainly for clarification of the questions. Questions by CSRP, in bold, are followed by answers by Baverstock.

1. **First, can you please talk about emergency response programs you developed in the past, including the one you were involved with at the WHO Regional Office for Europe?**

My work on emergency response systems started in the early 1970s when I was working for the Medical Research Council in the UK. One of the first nuclear accidents was in 1957 at the Windscale plant in Cumbria. At that time, there were no plans as to how to deal with a nuclear accident. In the weeks that followed the accident numerous reports of measurements of radioactivity in the environment appeared in scientific journals. In 1971, it was decided to evaluate this material and propose what were then called Emergency Reference Levels (ERLs) for Nuclear Accidents with the aim of protecting public health. This work was published in an HMSO (Her Majesty's Stationary Office) booklet[1] and in papers in the journal Health Physics in 1976.

At that time, the Medical Research Council was advised by a committee, the Committee on Protection against Ionising Radiation (PIRC), and this committee considered the question of what dose of radiation would it be reasonable to allow the public to receive in the event of an accident. The nuclear reactors in the UK at that time were exclusively gas-cooled reactors, for which loss of cooling did not have the rapid consequences that are associated with water-cooled reactors. The philosophy applied was that at the time of the accident there may well be relatively few persons on-site available to manage, for example, an evacuation of the public. So there would be an interval, while additional resources were brought to the site, where there would be a conflict between evacuating the public and trying to minimize the longer-term consequences of the loss of cooling. It was therefore deemed appropriate that resources were initially dedicated to minimizing the consequences at the expense of somewhat higher doses to the public. Therefore,

[1] http://discovery.nationalarchives.gov.uk/details/r/C623392

the ERLs were set relatively high, but would only apply for a few hours, after which time the normal requirements of radiological protection, namely, to reduce doses to as low as reasonably achievable, would come into play.

In the later 1970s and early 1980s, responsibility for practical issues to do with radiological protection passed from the Medical Research Council to the NRPB, the National Radiological Protection Board. By the time of the Chernobyl accident in 1986 the NRPB had taken full responsibility for handling the response to nuclear accidents. The thinking behind ERLs never envisaged the possibility that the UK would be affected by radiation released from another country; this in spite of the fact that on the north coast of France there are many nuclear facilities within 50km of the UK coastline. Thus, at the end of April 1986, there were no national plans to deal with the fallout from the Chernobyl accident, and chaos reigned. Much the same was true of other European nations and the IAEA took the initiative of setting up an international nuclear emergency response system with the cooperation of other international agencies, most notably the World Health Organisation (WHO) and the Food and Agriculture Organisation (FAO).

In 1994, the Regional Office for Europe of the WHO (EURO) held a ministerial meeting in Helsinki and half a day was devoted to discussing the psychosocial effect of the Chernobyl accident. At that meeting, EURO was mandated to set up a system within Europe to harmonize the responses of the different countries: a prominent feature of the response to the Chernobyl accident in Europe was disparities in remedial actions at national boundaries. For example, at the boundary between Austria and Italy, milk was banned in one country but not in the other.

In 1998, a nuclear emergency's response office (WHO Helsinki Project Office) was set up on the premises of STUK (Radiation and Nuclear Safety Authority of Finland) in Helsinki. From that office WHO worked, with STUK as a WHO collaborating centre and in strong cooperation with IAEA's emergency response team led by Malcolm Crick, who is now the secretary of UNSCEAR. One of the main activities of the Helsinki Project Office, in the period 1998 until its closure in 2001, was nuclear emergency exercises. One of the problems identified was the lack of coherence between the National emergency response systems of different countries, Finland being the best and the UK highly indifferent.

From the experience with the outbreak of childhood thyroid cancer after the Chernobyl accident, it was clear that a revision of the existing advice on the use of iodine prophylaxis was required. With the help of two STUK researchers and in collaboration with IAEA, revised Guidelines on Stable Iodine Prophylaxis were prepared, which significantly lowered the intervention level for children from 100 mGy to 10 mGy.

From 2001 onwards I played no role in the emergency response systems for WHO, except to run occasional tutorials on the revised guidelines for iodine prophylaxis.

1-1. Please go over some of the main points of the public health framework of the emergency response system.

I still believe that the philosophy underlying ERLs, namely that there is a balance to be struck between protecting the public and minimizing the long-term consequences of the accident. For this reason, the normal public dose limit of 1 mSv per year is not applicable to the areas immediately adjacent to a nuclear power plant at the time of an accident.

The initial responsibility for dealing with the public health consequences of an accident lies with the power plant owner and his responsibility applies up to some 10 to 20 km from the plant boundary. The plant owner has, therefore, to have detailed plans of how to respond in terms of sheltering and evacuation of that population in the event of an accident, or in anticipation of an accident. Those plans should include the issuing of iodine tablets extremely rapidly to all children.

At greater distances, local authorities, and ultimately the national government, are responsible for the detailed response to the accident. Once again, detailed plans should have been prepared, but the availability of these is not an excuse not to have a national emergency response centre that can call on expertise at very short notice in order to formulate the best response under the specific circumstances of the accident, most notably the weather conditions. For example, in the case of Finland the National Authority STUK retains 24:365 facilities which can be brought into action within minutes of the notification of an accident anywhere in the world. Its purpose is primarily to advise the Finnish population. In my view, manuals and guidebooks, however well prepared, being available to bureaucrats is not a solution to this problem.

1-2. "Guidelines for Iodine Prophylaxis following Nuclear Accidents Update 1999[1]," published by WHO in 1999, states "the latest information suggests that stable iodine prophylaxis for children up to the age of 18 years be considered at 10 mGy." Do you still recommend the same criteria given any updated findings or knowledge currently available? Also, this publication lists Shigenobu Nagataki in Acknowledgements as a formal reviewer. However, Nagataki has never made such a recommendation to the Japanese government since the Fukushima accident, all the way up to now. How were the guidelines established--developed, reviewed, and approved?

I see no reason, by way of evidence, to change the 10 mGy absorbed dose to the thyroid for children under the age of 18 years, as the iodine prophylaxis intervention limit. Many countries have adopted it successfully. I understand that there has been pressure on WHO in Geneva to revise this guideline upwards, but as far as I'm aware no action has been taken. Although the current guidelines were prepared by EURO they are officially endorsed by the WHO and now the IAEA.

The guidelines were prepared by a small group of two EURO consultants and IAEA technical staff. An expert group meeting was called with representatives from many countries to discuss the formulation of the guidelines prior to the completion. Before the guidelines were issued they were circulated to the four regional Thyroid Associations for comments and approval. I believe Professor Nagataki responded on the behalf of the Asian region.

When the guidelines were first ready for publication, the IAEA, at the management level, tried to prevent them from being issued. WHO in Geneva took the side of IAEA, but the WHO (EURO) insisted on issuing them from Copenhagen. WHO (Geneva)/IAEA then issued a statement to the effect that the guidelines were only being issued for consultation, but ultimately the IAEA convened a technical meeting in 2001 where the guidelines were approved as joint advice from WHO and IAEA. It transpired at that technical meeting that France was opposed to the guidelines on the grounds that it would be very expensive for them as a number of their reactors were close to large populations.

[1] http://www.who.int/ionizing_radiation/pub_meet/Iodine_Prophylaxis_guide.pdf

1-3. Within the public health framework of the emergency response system for nuclear facilities you have previously been involved with, what criteria were used for evacuation? Were there any problems between the technical staff and the management level?

As noted above, in the context of ERLs the criteria were primarily the balance between being able to minimize the longer term consequences of the accident as against the public health protection criteria. That subsequently changed to the balance between the risk of the health of the exposure to a specific dose of radiation compared to the social costs and disruptions caused by the evacuation. I think, up to the time of the Fukushima accident, evacuations were thought to be likely only for a very limited time period. The creation of the exclusion zone around the Chernobyl power plant was considered to be a most unlikely event anywhere else. That was most likely wishful thinking because it was realized that very few countries could tolerate a 30 km exclusion zone over a prolonged period of time.

It seems to me that these are issues which need to be rethought. Proposals from organisations like the IAEA are likely to be biased in favor of the nuclear industry and against interests of public health.

1-4. In addition, what were your thoughts back then in regards to criteria for recommending relocation or resettlement?

This is an area that needs further discussion. The Chernobyl accident was the first accident when relocation of substantial populations took place. Relocation, for many different reasons was a common policy in the former Soviet Union and therefore it was not considered exceptional that it should be applied in the case of the Chernobyl accident. In that case, there are most probably examples where it was an over-reaction to the environmental situation that applied and perhaps, as some claim, it did more damage than good.

Today we know much more about the long-term consequences of exposure to ionizing radiation and about the psychological consequences of relocation. I think it is now necessary to debate the issue of what should be the criteria in terms of lifetime doses for relocation, as opposed to temporary evacuation.

1-5. A concept of "lifetime (cumulative) dose" has never been brought up by either the government or the government-related experts ever since the Tokyo Electric Fukushima Daiichi nuclear power plant accident (referred to as the "TEPCO nuclear disaster" hereafter). The sole exception is the Food Safety Committee, established by the Cabinet Ministry, which touches on lifetime cumulative doses. *"Questions and Answers Regarding Health Effects Due to Food Containing Radioactive Substances*[2]," issued by the Food Safety Committee, says, "In the *'Evaluation of health effects from radioactive substances contained within food*,' it says health effects are detected above 100 mSv as an additional lifetime cumulative effective dose in both emergency and ordinary times. It was determined that discussing health effects below 100 mSv would be too difficult, based on currently available information."**
What do you think about how they refer to 'lifetime cumulative dose'? What is your opinion on the fact that lifetime cumulative dose is limited to "evaluation of health effects from food"?

I am not aware of any evaluation of a lifetime cumulative dose based on a risk deemed to be acceptable in the context of the response to a nuclear emergency. It is clearly an issue that deserves consideration in the case of Fukushima as some of the evacuated areas are designated to be reoccupied in due course and an annual external dose limit applying to the immediate vicinity of a dwelling is not an adequate criterion. Neither can it be confined to internal doses through the regular food chain. Temporary restrictions such as sheltering, minimising outdoor activities for children, access to forest areas and natural foods, etc., can only be maintained for a relatively short period otherwise they inhibit and restrict what would be described as a normal life and therefore should not apply to permanent dwellings.

1-6. In a policy released on nuclear disaster measures on September 5, 2013, Nuclear Regulation Authority, established after the TEPCO nuclear disaster, uses an early phase standard of 500μh/h (air dose rate at 1 m above ground) as the "criteria for evacuation and indoor sheltering in

[2] https://www.fsc.go.jp/sonota/emerg/radio_hyoka_qa.pdf

case of emergency (OIL1)[4]. What do you think about this standard from a viewpoint of public health protection?

I have never thought about evacuation in terms of dose rates. This is a technicalconsideration and a derivation of an action level which should be based on some kind of total dose and therefore risk, to the population. I'm not really qualified to discuss these technical action levels.

What is an unacceptable risk to be taken by the population in order to accommodate nuclear power generation in society is a societal, therefore political, decision and needs to be debated by the affected populations and will not necessarily apply more widely than any specific local population. I would, therefore, recommend that nuclear plant owners hold that debate with the people that live in their vicinity and reach an agreement with them in terms of the total risk the population is prepared to accept, and then translate that into technical action levels for use in the immediate aftermath of the accident, with later modification when sufficient expertise can be brought to bear on the problem.

1-7. Ever since the TEPCO nuclear disaster, it is reported in Japan as if it were scientific to perceive 100 mSv as a threshold or distinguishing line, and the following expressions have been widely used: "There is no evidence of health effects at 100 mSv or below"; "It is unlikely for health effects to occur"; "Increase in cancer will be hidden by other factors"; and "Increase in cancer is not significant." In addition, Nuclear Regulation Authority appears to be formulating policies for resettlement and emergency reference levels based on these ideas. What is your opinion on this?

On the basis of current scientific knowledge there is no argument in favour of any kind of distinguishing line or threshold at 100mSv. The evidence from epidemiological studies on exposed populations points strongly to a linear no-threshold response, i.e., LNT. The epidemiological evidence for a proportionate effect below 100 mSv, down to less than 10mSv, is strong. Realistic risks for various age groups can be calculated from data provided by the BEIR VII report using a dose and dose-rate effectiveness factor (DDREF) of one (as opposed to 1.5) as now

[4] https://www.nsr.go.jp/data/000024441.pdf#37

recommended by the United Nations Scientific Committee on the Effects of Ionising Radiation, UNSCEAR.

2. **You mentioned earlier that the emergency response program was developed by those with technical expertise from both WHO and IAEA. During the November 2014 press conference at the Foreign Correspondence Club of Japan (FCCJ)[3], you said, "There is no problem with working at the technical level between the two organizations. People at my level, without managerial responsibility, get on fine and we use our expertise in a collegiate way. But when it comes to issues of policy concerning nuclear energy, there is a problem." Did IAEA or WHO interfere with or put pressure on the program developed at the technical level, or even yourself, when the program was being incorporated into policy making?**

The development of the emergency response system across the UN Organisations was covered by two legally binding conventions on early warning[6] and assistance[4]. WHO's role from the European Regional Office was to harmonize the public health response across the European region. There were, therefore, no conflicts between the interests of the WHO and the IAEA. The contexts in which conflicts did arise were in the preparation of the iodine prophylaxis guidelines. However, even here, the initial work by two WHO appointed consultants from Finland and the IAEA proceeded without conflicts. It was only when it came to the publication of the guidelines and therefore the agreement to the text by the management of the IAEA that conflicts arose and the origin was clearly political influence from a UN member state.

2-1. Many NGOs (Non-governmental organizations) claim the 1959 agreement[8] between IAEA and WHO should be dissolved. In particular,

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3 https://www.youtube.com/watch?v=VoBLa2K7_6Y

6 https://www.iaea.org/publications/documents/treaties/convention-early-notification-nuclear-accident

4 https://www.iaea.org/publications/documents/treaties/convention-assistance-case-nuclear-accident-or-radiological-emergency

8 http://www.crms-jpn.org/doc/IAEA-WHO1959.pdf

Article 1 Clause 3 states, "3. Whenever either organization proposes to initiate a program or activity on a subject in which the other organization has or may have a substantial interest, the first party shall consult the other with a view to adjusting the matter by mutual agreement." It is pointed out that this clause threatens independence of WHO and opposes the principle of the Constitution of World Health Organization[5]. What is your opinion on this?

There are agreements between all UN agencies and it is true that the agreement between the IAEA and WHO has attracted a lot of comments and suspicion. One of the purposes it serves is to protect the confidentiality of WHO information which might involve the release of personal medical data. It does not allow one organization to prohibit activities of the other, but it does call for a degree of consultation and even cooperation – the two organisations should not duplicate the work of one another. In my early days in the WHO, I met with a senior IAEA manager (Mr. Rosen) and proposed that IAEA should confine itself to dosimetric issues and the WHO to health effects issues. This was never taken seriously as my position did not allow me to intervene at that policy level. In practice, both organisations have crossed that demarcation line. The WHO did a dose assessment of the Fukushima accident and I understand that the IAEA will release a health effects assessment later this year. This does involve a lot of duplication since both organisations employ consultants and they are largely drawn from the same group of experts: so one could say that the agreement is not working as it was intended.

Having said that, the IAEA does exert an undue influence over the WHO. That is largely because WHO appoints managers lacking appropriate expertise of the projects they are managing. For example, the manager in WHO who has made statements on ionising radiation issues (Ms. Deventer) in the context of Fukushima is in fact qualified in non-ionizing radiation science. Such managers face a dilemma when the advice they get from their own staff conflicts with that from IAEA managers. The safer option, from the career point of view, is to accept IAEA advice. This, in my experience is how IAEA influences WHO: essentially exploiting weakness in WHO management staff.

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[5] http://www.who.int/governance/eb/who_constitution_en.pdf

3. **At the time of the TEPCO nuclear disaster on March 11, 2011, there must have been certain responsibilities to be fulfilled by those nations that have ratified the IAEA conventions on early notification of nuclear accidents and assistance in the event of nuclear accidents. What were those responsibilities? Also, your August 2014 paper[6] points to IAEA's failure to fulfill its duties. What were these duties in detail?**

The relevant conventions are on the early notification of an accident, the responsibility of the state in which the accident occurs, and the Convention on assistance which applies to all other signatory states. In the case of Fukushima it was therefore the responsibility of Japan to inform the IAEA that it has, or is expecting, an accident with potentially transboundary implications. I think the situation regarding what happens after that notification is perhaps a little unclear. Usually, UN agencies can only intervene in a national issue when invited. I am not sure what would happen if a state informed the IAEA that an accident had occurred but refused to cooperate.

What was clear over the weekend following the Fukushima accident is that the IAEA, according to their website, was not aware of the accident even on the Sunday (and I think the Monday) Western European Time. Whether they were informed by Japan or not is not known: that they showed no indication that they were aware of the accident is clear.

However, the document entitled *"Unleashing the Nuclear Watchdog[7],"* authored by Trevor Findlay and published in 2012, claims that the emergency response system at IAEA responded even before the tsunami, making contact with Japan and offering assistance in case a nuclear emergency occurred. Findlay says:

> "On Friday, March 11, 2011, 56 minutes after the earthquake struck at 05:46 (Coordinated Universal Time), the Agency's International Seismic Safety Centre (ISSC) (see Safety of Nuclear Facilities and Material section) notified the IEC of the event and the potential for damage to nuclear power

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6 http://csrp.jp/wp-content/uploads/2014/09/2013-UNSCEAR-Report-on-Fukushima-a-critical-appraisal1.pdf

7 https://www.cigionline.org/publications/2012/6/unleashing-nuclear-watchdog-strengthening-and-reform-of-iaea

plants on the northeast coast of Japan (including Fukushima Daiichi) and the possibility of a tsunami. Within two hours, the IEC was in touch with Japan's Nuclear and Industrial Safety Agency (NISA), the contact point designated by Japan under the nuclear accident conventions. An offer of Agency assistance was sent shortly afterwards to NISA and the Japanese permanent mission in Vienna. By 08:20, the IEC was activated, declared in Full Response Mode, and staffed continuously 24 hours a day thereafter."

Findlay goes on to claim that the WHO was alerted by the IAEA and their emergency response system kicked into action the same day. This is patently not true as I had established that neither IAEA nor WHO had information on their websites about the nuclear accident on Monday morning Western European Time following the accident on the Friday. It is also the case that Crick did not contest what I said in the draft of my UNSCEAR critique[8] and has told me privately in the strongest possible terms that the IAEA response was a disgrace. Whether it is the case that Findlay is being economical with the truth, or has been misled by the IAEA is not clear. That history has been rewritten here is clear.

4. **Presence of the emergency response program, referred to in question 1, and its implementation based on the established protocol, might be necessary "in order to minimize damage." However, in the case of the TEPCO nuclear disaster, conflicts of interest were apparent amongst member states and international organizations carrying out the emergency response program, with the obvious lack of intention to implement the program. Clearly, their legal responsibilities must be addressed. In the current framework, how can their "legal responsibilities" be pursued?**

The area of international law is extremely complex and I am certainly no expert. I suspect what would be required in the first place is an enquiry by the UN into the role that its agencies played. If that was found to have fallen short of legal requirements, action at the UN level may then be taken.

5. **During the Roundtable Discussion at the Fourth Citizen-Scientist International**

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8 http://csrp.jp/wp-content/uploads/2014/09/2013-UNSCEAR-Report-on-Fukushima-a-critical-appraisal1.pdf

Symposium held in November 2014, Yoko Matsuda, a regional disaster prevention specialist, explained that, within the general framework of disaster prevention, "risk communication" is a pre-disaster measure to be carried out bilaterally with residents in order to minimize damage. The symposium covered the realities of "risk communication" currently conducted in Fukushima Prefecture. What did you think about it? Also, in your opinion, what are the communication factors necessary to minimize psychosocial effects?

I believe risk communication has to be an ongoing process between the power plant operator, the local authorities and the local populations. It is too late to start that process once an accident has occurred. It is not irrational to fear exposure to ionizing radiation: in fact it is irrational not to fear it. It has to be recognized by populations living close to nuclear power plants that some risk may be unavoidable. However, it should be made clear to those populations that the power plant operator has contingency plans to minimize the risk to local populations. Potentially affected populations need to be able to trust in the power plant operator and the local authorities to protect their health and not the nuclear industry. The psychosocial effect, namely pathological effects, contingent on the fear and lack of trust in the appropriate authorities, should in theory be preventable. However, the IAEA's role in promoting nuclear energy undermines this basis of trust, which is essential.

Indeed, I have made this point in the past in the context of the situation in the UK that there have been so many abuses of trust with respect to exposure to radiation, for example, the nuclear test veterans, and Chernobyl fallout, among others, that the "well of trust" in politicians has been poisoned and the population is highly distrustful of the authorities (at that time the National Radiological Protection Board). This is a very serious situation for public health.

5-1. On January 23, 2014, IAEA released "Final Report: The Follow-up IAEA International Mission on Remediation of Large Contaminated Areas Off-Site the Fukushima Daiichi Nuclear Power Plant[9]." Advice Point 2 on page 18 says, "Japanese institutions are encouraged to increase efforts to communicate that in remediation situations, any level of individual radiation dose in the range of 1 to 20 mSv per year

[9] https://www.iaea.org/sites/default/files/final_report230114.pdf

is acceptable and in line with the international standards and with the recommendations from the relevant international organisations, e.g. ICRP, IAEA, UNSCEAR and WHO." Is this an appropriate advice?

I have not worked within the UN system since 2003 and I ceased to have responsibility for nuclear emergency issues at the end of 2001. The IAEA issued advice on dose limits for use in the event of nuclear emergencies in May 2013. This document[14] says that an annual doses of 20 mSv is safe for the whole population including children and pregnant women. How this limit is derived is not clear and it certainly would entail some considerable risk especially to children. 20 mSv per year, the limit proposed for permanent occupation of contaminated ground is the annual worker dose limit averaged over five years. In my view, this May 2013 document has been written to fix the regulations around the Fukushima accident and not as an objective assessment of acceptable risks to the public.

6. **On March 14-18, the UN World Congress on Disaster Risk Prevention will be held in Sendai City. Nuclear accidents will be covered in the section "Natural hazards and related environmental and technological hazards." Japanese Civil Society Organization (CSO) network, EU and Italy have requested the Japanese government delete the word, "related," and call the section, "Natural hazards and Technological hazards (Note 1)." What is your take on this?**

In my judgment nuclear accidents should not be considered as related to natural disasters. It can be argued that in the case of Fukushima it was the natural disaster, earthquake and tsunami that led to the Fukushima accident. However, if nuclear power plants cannot be constructed in such a way as to be immune from likely natural disasters then they should be phased out. Many other factors that led to the Fukushima accident were faults of the operational management of the facility and nothing to do with the natural disaster.

6-1. In Hyogo Framework Action, or HFA, Priority Action 4[15] is "Reduce the

[14] http://www-pub.iaea.org/MTCD/publications/PDF/EPR-NPP_PPA_web.pdf
[15] http://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf#13

Underlying Risk Factors" which refers to prior evaluation and pre-assessment as well as investments for reducing such risks. They are considered to include "efforts for removing preventable manmade disaster ahead of time." Some groups from Japan Civil Society Organization Coalition for 2015 WCDRR (the UN World Congress on Disaster Risk Prevention) demand that the HFA Priority Action 4 also take into consideration the issue of de-nuclearization. Is this a reasonable demand? Would it be possible to build a framework to minimize damages from expectant nuclear accidents? Can such a framework be properly implemented?

I don't think it will be possible at this stage to get an agreement to de-nuclearisation at a global level although some states are moving in that direction, Germany for example. My view is that organisations such as CSRP should lobby actively to improve the safety of existing facilities by:

1) calling for a truly independent international body in place of IAEA to oversee nuclear safety with the power to apply strong penalties for violations whether or not they lead to accidents.

2) requiring operators to discuss the safety issues of their plants with the local population, not only through political agencies, but including organisations such as CSRP and the many other citizen organisations set up for that purpose not only in Japan, but in many other countries as well, for example USA, Switzerland and France. Where governments have failed in their responsibility to protect public health, citizens have to take on that responsibility themselves. That means, as CSRP is already doing, educating themselves so that they can debate and negotiate with nuclear operators on a "level technical playing field".

7. Here is the final question in two parts:

A) From the viewpoint of emergency response/preparedness and radiation protection, what is the necessity for cooperation and collaboration between citizens and scientists in public health policy?

B) After the TEPCO nuclear disaster, numerous committees and councils were established regarding public health policies, and the government ministries selected most members from the same group of experts. This pattern of using the same group of experts is also seen in international organizations such as UN. What is your thought about how to secure the "level playing field" with these

committees and councils?

A) Given that we face the possibility that national and international authorities may not fulfill the necessary role of protecting public health in the event of a nuclear emergency, there is a clear need for collaboration between citizens and scientists, but this has to be at the initiative of the citizens. They need to educate themselves to the degree necessary in order to recruit the appropriate scientific expertise and then to build a collaborative structure. This will be an iterative process, one of trial and error, because not all scientists can be relied upon to be independent or to admit their prejudices.

   This may mean hard work on the part of the citizens, but the biggest hurdle to be overcome is psychological: the belief that gaining the appropriate expertise is nearly impossible. This is not true; by careful and critical reading of numerous sources freely available over the Internet (many US universities have put all their course material on the Internet) it is possible to acquire a good working knowledge of just about any subject. The important thing is to be highly critical and discerning because there is also much “propaganda” posing as science on the Internet.

   By working in groups and discussing various information sources, it is possible to reach an independent and scientifically credible understanding of the subject and then build collaborative structures between citizens and appropriate scientists.

B) The problem is that the nuclear industry holds nearly all the resources and the scientists they train and employ are not, therefore, independent and these are the majority used by, for example, UNSCEAR and other UN agencies, as well as the national authorities, who of course have a financial interest in nuclear power. In that sense it will never be possible to have a level playing field because citizen-scientist groups will always be less well resourced: there will always be more pro-nuclear scientists. However, the responsibility for protecting public health lies primarily with the national authorities and if there are well-informed citizen groups challenging their decisions and advice, this will go some way to leveling the playing field, especially if the media hold those authorities to account.

   The problem is that on both sides of this “nuclear pro/anti” divide there is a lot of “bad science”, which detracts and deflects from the true debate. The truly “scientific”

position lies in the middle, and exercises skepticism about the most extreme claims made by either side. This middle ground is difficult to hold because both sides represent it as antagonistic to their point of view. However, there are independent organisations which deal with this problem at the national level, for example, the National Academy of Sciences in the USA and they provide a good example of the way ahead, namely through careful debate by a committee of mainly independent scientists, but with a diverse range of views. I think the citizen scientist groups could follow this model by setting up such a committee to advise them. This would require much more cooperation between the many citizen-scientist groups not only in Japan, but Japan could and should take the lead given its experience with Fukushima.

Note 1: As of January 16, 2015, it was revised to "natural or man-made hazards as well as related environmental, technological and biological hazards and risks" in the "Post-2015 framework for disaster risk reduction."