

# 2013 UNSCEAR Report on Fukushima: a critical appraisal<sup>\*1</sup>

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## Introduction

From its inception on 3 December 1955 the remit of the United Nations Scientific Committee on the Effects of Atomic Radiations (UNSCEAR) has been to report to UN Member States and the UN General Assembly, on the levels, effects and risks of radiation in the environment<sup>\*2</sup>. Its scientific expertise has been provided initially by 15 Member States and today by 27, predominantly states with nuclear power programmes. In the late 1950s the principle concern was radioactive fallout from nuclear weapons testing, but subsequent treaties banning atmospheric testing have reduced this threat to public health considerably and since 1986 nuclear accidents (in particular the Chernobyl accident) have consumed much of the Committee's attention.

The Chernobyl accident, where there was widespread environmental contamination, led to the adoption of two international conventions: Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency overseen by the International Atomic Energy Agency (IAEA), which maintains a 24/7/365 coordinating centre for national emergency response centres, in Vienna.

The 2013 UNSCEAR report (herein after **the report**) on TEPCO's Fukushima Daiichi Nuclear Plant Accident (herein after Fukushima accident) on 11 March 2011, is published more than three years after the accident. Part of this delay has been due to disputes between members of the committee and part due, according to committee member Dr Wolfgang Weiss, the need for **the report** to be worded correctly because communication has been a major problem in generating misconceptions<sup>\*3</sup>. **The report** sets out to evaluate the levels of exposure and health effects arising from the accident. It concludes there will be no "*discernable increase*" in risk among the exposed populations. This evaluation is made on the basis of estimates of the doses (effective doses and absorbed doses to the thyroid) to different categories of the population in the first year of the accident and extended to those accumulated in 10 years and 80 years by the use of scaling factors. **The report** acknowledges, but does not emphasise the fact that the accident is not complete, as radioactivity is still leaking into the Pacific Ocean and into the air (as reported by TEPCO on 14 May 2014), albeit at a much lower rate than previously. At present there are no established technologies to stop these releases, or apparently to remove radioactive strontium from vast quantities of stored waste cooling water that is still accumulating in makeshift tanks on the site of the accident. Also the retrieval of spent fuel held in fuel ponds on the reactors is not complete.

\*1—The "first draft" of this assessment was sent to UNSCEAR (Mr Crick, Scientific Secretary and Dr Weiss, Chair of working group for the 2013 UNSCEAR report). They made several comments, the most important of which will be addressed in footnotes herein using italic script. I am assuming that they responded on behalf of UNSCEAR.

\*2—UNSCEAR claim that in **the report** they have adhered strictly to this mandate and that some of the criticism below is more appropriately directed to other organisations. In my view UNSCEAR cannot disassociate itself entirely from the way its statements can be (mis) interpreted and that it should demonstrate much greater awareness of the contexts within which its reports will be viewed by other than the UN General Assembly and its Member States.

## What should the reader expect from this report?

The reader should expect solid estimates of average committed doses to all potentially exposed populations appropriately sub-divided, from the day on which the accident occurred, together with estimates of the uncertainties and ranges applicable to

\*3—Personal communication

average values. The information would ideally be in tabular form prominently in the main body of **the report** and easily accessible to the less than fully committed reader. **The report** should also extract the lessons of the accident for the future of nuclear energy generation globally and, therefore, the future impacts on health and environment of the nuclear industry\*<sup>4</sup>. Additionally, a more timely report (with, for example, 6 months of the Fukushima accident) might have provided a basis for countering public anxiety and, therefore, have ameliorated any potential psychosocial effect. Three years on from the accident would be too late for this objective, even if the response to the accident by the Japanese authorities and the international agencies had followed the much debated and rehearsed plans for such events initiated after the Chernobyl accident. However, in the case of the Fukushima accident even this plan was not properly implemented.

I\*<sup>5</sup> argue here that this 2013 report has not achieved the above objectives. Further, I argue that given the actual circumstances it is impossible to agree with or to contest some of the estimates of levels (of dose) made in **the report** because the information that should, through the IAEA led international emergency response programme, have been available to make the necessary estimates has not been made generally available. Additionally, many of the supposedly authoritative (by, for example, the Japanese authorities and IAEA) statements made at the time and shortly after the accident, have proved to be palpably unreliable and therefore it is not possible to have confidence that UNSCEAR has had access to reliable data, or indeed to know whether reliable data even exists.

\*4—UNSCEAR would dispute this statement as it being outside its remit, but it is hardly credible to assume that Nation States are only concerned with the “levels” outside the context of public health. It can be argued that the test ban treaty resulted in response to knowledge about the increasing public health detriment from atmospheric testing.

\*5—My credentials for expressing this opinion are based on my professional activities from the early 1970s, firstly with the UK Medical Research Council on an examination of the Wind-scale accident and the formulation for emergency reference levels for reactor accidents, secondly, with the World Health Organisation on the follow-up to the Chernobyl accident and on the development of the IAEA led emergency preparedness and response network, including the setting up of a WHO emergency response centre in collaboration with the Finnish Nuclear and Radiation Safety Authority (STUK) in 1998.

## The failure of the international emergency response system

A factor (not mentioned in **the report**) is that the international emergency response system, led by the IAEA, apparently did not start functioning until around 14 March (according to my observations of the IAEA website at the time), three days after the accident, in spite of the fact that according to the report (Table 1) the Japanese authorities (and presumably the IAEA) were well aware of the seriousness of the accident but failed to declare a level 7 emergency (with trans-boundary implications) until 12 April\*<sup>6</sup>, that is the highest level implying trans-boundary considerations. In fact, there is a flavour of history re-written in Table 1 of **the report**. For several days after the accident the media consistently carried reports that there had been no damage to the reactors and therefore no releases and these reports were not corrected at the time by the IAEA\*<sup>7</sup>. Even later on 25 March I summarised the ground deposition values reported on the MEXT website (Japanese Government) for the Iitate region. I noted that the values for <sup>131</sup>I were up to 3 to 5 times the maximum depositions recorded after Chernobyl in Belarus and <sup>137</sup>Cs level ranged from 0.5 to 1 times Chernobyl levels. In the final sentence of my note I said “*What amazes me is that there still seems to be denial that there have been substantial releases and some of the values reported are from beyond the areas evacuated.*” The inhabitants of Iitate had still not been evacuated on 12 April when I met Dr. Katsumi Furitsu in Berlin. On 31 March 2011, twenty days after the accident, in an editorial, the journal *Nature* says: “*Despite reassuring early reports, it is clear that significant amounts of radioisotopes have been released from the plant, and some workers there face severe radiation exposure as they try to cool the overheated nuclear fuel.*”

The fact is that for at least two weeks after the first releases of radioactivity the position the authorities, including the international agencies, presented to the global public was that there had been no releases.

Had the above Conventions functioned as envis-

\*6—I have evidence that the IAEA website was not active on 13 March in an email to my colleague Dillwyn Williams.

\*7—On 18 March I gave a talk to the Bonn Science Café and at that time there were no reports of released radioactivity, indeed there were denials of releases, but we now know that on 14/15 March major releases occurred.

aged, UNSCEAR should have been in a position to provide a much more credible account of the accident and the potential consequences for human health and possibly in time to mitigate any psychosocial effect caused by the attempts to deny the severity of the accident at the outset.

### The unreliability of estimates of population doses proposed by the report

My reason for dwelling on the issue of the failure of the IAEA led emergency response system is that it is surely relevant that an international emergency response plan, developed over some 25 years by the UN agency with primary responsibilities in this area, should fail to operate properly on the first occasion that it is called upon in a real situation (as opposed to an exercise). As I will show, the greatest uncertainty (addressed in an annex to **the report**) in **the report's** findings regarding doses, are those received in the early days of the accident. The earthquake and tsunami no doubt contributed to the difficulties in making the appropriate dose-rate measurements, but the emergency response plan, had it been fulfilled, could have called upon and coordinated, the assistance from several other countries. This would have ensured a much more comprehensive data set of environmental exposures from which to estimate doses, particularly in the first few weeks.

The question is then how, out of the morass of orchestrated mis-information, can doses be reliably reconstructed, however good the models to be deployed might be? I don't believe it is possible and so I must assume that UNSCEAR's (and for that matter WHO's) dose estimates are highly unreliable, even fictional and that the delay in producing **the report** has been due in part to the difficulty in deciding exactly which unreliable/fictional piece of information should be included to give the most credible interpretation. Perhaps this is what Weiss really meant when he told me that communication was of the essence.

It is a pretty pedestrian exercise to calculate average external whole body doses to large populations several months after the fallout was deposited, on the basis of measured ground deposition levels of radioactive isotopes. This much UNSCEAR (and WHO) has achieved. While **the report** makes some effort to assess the uncertainties this is mainly to be found deeply buried in an appendix and a series of attachments that are not yet available for inspection (at the time of writing August 2014). In this early

period internal doses are important and can add considerably to the external dose component for some population groups.

Very few whole body measurements were made before July 2011 allegedly due to contamination of detectors by fallout. What few measurements that had been reported at that time included very few children. When food controls were introduced (March/April) they no doubt contributed to reducing considerably the potential for internal dose. A published report by Hayano et al. [1], showing very low levels of internal Cs from whole body counting specifically states that measurements were made 7 – 20 months after the accident. Radioactive caesium has a biological half-life of some 10 days in an infant and 100 days in an adult. If food controls were introduced in month 2 after the accident, then several half-lives will have elapsed for children and 1.5 for adults, before any whole body measurements were made. Hayano's results testify to the effectiveness of the food controls, but say nothing about internal doses in the first few weeks of the accident. **The report** acknowledges the lack of whole body measurements for Cs and says that it accordingly based its estimates on dietary models and measurements of  $^{137}\text{Cs}$  "in foodstuffs as marketed", assuming 10 Bq/kg\*8 if no other data were available. The effect of eating a local diet without food restrictions is addressed in an appendix. There appears to be no means to estimate how many people would have been exposed to these significantly higher doses.

Other features of **the report** lead one in this direction. Crucial to the dose estimates, particularly in the early days is the source term, the quantity of radioactivity released and then how it was distributed between the land and the ocean. According to **the report** several papers reporting on the source term were available to the Committee and they were all reviewed before one was chosen to be the basis for dose estimation. The one chosen was that published by the Japan Atomic Energy Agency (JAEA), the body presumably with primary responsibility for regulating the industry in Japan† and, therefore, the body that allowed TEPCO to make so many failures in safety culture\*9 and, therefore, a body that has a

\*8—Food controls banned foodstuffs with more than 100 Bq/kg.

\*†—[Editor's note] The author's suspicion expressed in this passage is confirmed by the fact that there is presumably no denying JAEA's conflicts of interest; in fact, JAEA's "revolving door" with Government authorities (such as the Atomic Power Division of the MEXT and the Nuclear and Industrial Safety Agency), as well as with power companies like TEPCO, has been a matter of open secret.

degree of responsibility for the consequences of the accident. It is likely no accident then that the JAEA estimates of the source term are among the lowest of those published. Stohl et al.[2] estimated the  $^{137}\text{Cs}$  release to have been 35.6 (23.3; 50.1) PBq compared to the JAEA [3] estimate of 8.8 PBq, that is a factor of up to 6 times. Stohl et al. estimate the release of  $^{133}\text{Xe}$  as 15.3 EBq, twice the amount released at Chernobyl: JAEA's estimate according to UNSCEAR is half that. Beyond the numerical difference the choice betrays **the report's** apparent overall aim to down-play the seriousness of the accident (see also above the assumptions concerning internal dose) and, therefore, testifies to its lack of scientific integrity, impartiality and independence (see below).

**The report**, as noted above, gives only average doses for broad classifications of the population of Japan into four regions/groups: a) evacuated settlements; b) districts in Fukushima Prefecture not evacuated; c) selected Prefectures in Eastern Japan; and d) the rest of Japan. It is well known that such averages can be based on highly skewed dose distributions. Since the main body of **the report** gives only average doses and no information on the dose distribution, especially in the first two groups, there is no means of knowing the upper range of doses within a group. The use of averages from highly skewed distributions is a well known and potentially misleading presentational (communication?) strategy entailing the so called "helium balloon effect", where large numbers of lightly exposed people bring down the average for the whole population markedly.

Using UNSCEAR 2000 methodology applied to the Chernobyl accident (Annex J) on the region of highest contamination by  $^{137}\text{Cs}$  and  $^{134}\text{Cs}$  combined of  $\sim 30$  million Bq/m<sup>2</sup> (applicable to Iitate<sup>\*10</sup>, where inhabitants were not evacuated until after 12 April) one can deduce internal exposures during that one month period of 12 to 50 mSv. **The report**, however, assigns a dose from 0 to 3.3 mSv to 1-year-old children for the period before and during evacuation.

\*9—For example, inadequate protection from tsunamis, the location of the emergency generators and the absence of means to prevent hydrogen explosions.

\*10—Summary of the Fukushima accident's impact on the environment in Japan, one year after the accident. IRSN 28 February 2012: [http://www.irsn.fr/EN/publications/thematic/fukushima/Documents/IRSN\\_Fukushima-Environment-consequences\\_28022012.pdf](http://www.irsn.fr/EN/publications/thematic/fukushima/Documents/IRSN_Fukushima-Environment-consequences_28022012.pdf)

**The report** has apparently adopted a calculation procedure for urban populations, ignoring rural populations. In cities the radioactivity gets washed off tarmac and roofs leaving relatively low external dose rates and internal exposures are primarily due to marketed rather than locally grown foodstuffs. However, that washed off radioactivity has to go somewhere. In fact, much of it gets washed into ground water, rivers and lakes and what does not, accumulates in ditches, roadsides, derelict land, in drains, around buildings, etc., as what is known as "black substances". A sample of this material collected in the 20km evacuation zone and in more remote, but highly contaminated areas, has been found to contain actinides (Pu, Cm and Am) as well as Cs isotopes[4]<sup>\*11</sup>. This makes the distribution of exposures in the urban environment highly non-uniform and therefore unpredictable – people are living in an environment where they cannot know whether they, or more importantly, their children, are exposed or not. **The report** does not address this problem; maybe I am overestimating the hazard but I cannot find that out from **the report**. This is particularly important because it is the policy of the Japanese government to return evacuated families to their home settlements as soon as the external dose rate falls below 20 mSv/y. The risks almost certainly include actinide contamination of the lung due to resuspension of these residues, especially for children.

Thus, as far as **the report's** evaluation of projected effective doses to the public is concerned we can conclude that a) for the evacuated populations (particularly those evacuated later on) there are uncertainties due to a lack of information concerning internal doses and b) when the evacuees ultimately return to their settlements they will face unpredictable exposures of unknown dimensions from actinide contamination of the urban environment.

## The unprofessional provenance of the report

This brings me to my most serious criticism of **the report**, namely that it is NOT a scientifically unbiased or even a truly scientific, report<sup>\*12</sup>. I adduce the following flaws:

- 1) the committee is not balanced in respect of pro- and anti- nuclear sympathies of the membership;
- 2) the membership of the committee is not overt-

\*11—UNSCEAR claims there is no evidence of exposure to actinides during the releases.

\*12—The "S" in UNSCEAR stands for "Scientific"

- ly based on expertise or merit;
- 3) the concept of “no discernable increase” in risk is not a valid public health concept;
- 4) while collective dose was estimated it was not used to estimate health detriment and no logical argument is given to support that omission;
- 5) **the report** is “evasive” on the issue of a dose threshold below which risk is zero.

### Balance of the Committee<sup>\*13</sup>

Polarization of views between those in favour and those opposed to nuclear power has been a dominant feature of radiological protection throughout my professional career since 1971, i.e., the last 43 years. Ideally, this should not affect the evaluation of scientific issues<sup>\*14</sup>, but history shows that it has and does, with faults on both sides<sup>5</sup>. If the “playing field” were level in financial terms this polarity would be less important, but as things stand today the nuclear industry, governments with NP facilities and the IAEA, with their huge financial clout, call the shots. While I could say that I only know professionally some 15% of the listed committee and expert group members, those I do know are mainly, to some degree or other (I would say with a very few exceptions), pro-nuclear in their outlook and there are no candidates who are on record as either being critical of the nuclear industry or openly anti-nuclear. For example, the names of Hoffmann, Mousseau, Busby, Schmitz-Feuerhake, Wing, Richardson, Fairlie, Rosen, Körblein, etc. do not figure among the more than 100 names listed in **the report**. Whereas well known (to me) sympathizers with nuclear power, Gonzáles, Harrison, Salomaa, Bouffler, Wakeford, Mettler, Niwa, etc., are listed as either members of the Committee or of expert groups. The reason for this is of course that members of the Committee are nominated by their governments, who are predominantly in favour of nuclear power and, therefore, choose members accordingly: those members appoint the expert groups. The assumption, even before reading the body of **the report**, that its conclusions are highly likely to be “rigged” in favour of protecting the interests of nuclear power from criticism would almost certainly be correct. There ap-

pears to be no mechanism whereby members could be appointed on merit alone or whereby members declare conflicts of interest. These facts alone negate the standing of **the report** as an independent assessment of the accident.

### Competence of the Committee<sup>\*15</sup>

It is claimed that “more than 80 leading scientists” have contributed<sup>\*16</sup> to **the report**. Although the members of the Committee are listed, no details are given that would enable the reader to judge their competence for the task and no declarations of freedom from conflicts of interest (e.g. being paid by or sympathetic to the nuclear industry) have apparently been sought. This is in stark contrast to, for example, the US National Academy of Sciences, which carries out similar tasks. Given the point made above concerning balance on the committee in respect of views on the issue of nuclear power, one must assume that many members of the Committee do have serious conflicts of interest to add to their lack of appropriate qualifications. (I could of course be shown to be wrong on this point if UNSCEAR were to publish the CVs and publication records for the listed Committee and expert group members).

### “No discernable increase in risks”<sup>\*17</sup>

To my personal knowledge the history of radiological protection has been littered with attempts to define a level of risk that might be neglected and none have succeeded in gaining any traction. Small exposures, such as natural background radiation and diagnostic radiology, have in the past been thought to give rise to risks too small to be discernable, but subsequently have been shown to be finite and measurable. If all potentially toxic releases to the environment were permitted to be released up to the point at which their effects were demonstrable by epidemiological studies, life expectancy would be declining dramatically. Let us assume that the risk as-

\* 13—UNSCEAR claims I provide no evidence for a lack of balance and denies that this is the case. It is UNSCEAR's responsibility to convince the reader that it is independent of the nuclear industry – not for the reader to assume that. UNSCEAR needs to provide evidence of independence. There are a number of well recognised ways to do that.

\* 14—In the 1970s the UK's Medical Research Council (MRC) committee's were able to make independent and unbiased scientific assessments of public and occupational risks, even with participation of strongly pro-nuclear committee members from the UK Atomic Energy Authority.

\* 15—Similarly to their last point above UNSCEAR says I provide no evidence for this criticism and again I say it is for the Committee to convince the reader of its competence and I suggest a simple way to do that.

\* 16—<http://www.unis.unvienna.org/unis/en/pressrels/2014/unisous237.html>

\* 17—UNSCEAR claims that this statement merely refers to the fact that epidemiological techniques are unlikely to detect increases in cancer caused by the doses they attribute and therefore that it is a strictly scientific statement and not one having any public health implications. On an equally scientific basis UNSCEAR is in a position to make a good estimate of the risks entailed, but it chooses not to without giving a scientifically based reason – risk is part of their mandate and projected numbers of cancers etc., is a legitimate way to express risk. This statement is either “trivial” although probably scientifically sound or open to misinterpretation.



sociated with 100 mSv (the dose below which UNSCEAR regards the risk to be too small to be discernable), was permitted for all potentially toxic releases to the environment, then according to the BEIR VII average life-time risk estimate of 17%/Sv (95% CIs: 8.5 – 33.5) using a DDREF of 1 (as adopted by UNSCEAR) and just 10 qualifying toxic agents, lifetime cancer risks would be increased by 17% over current values, that is, to around 50%. From a broad public health perspective such a policy is palpably unsustainable. **The report** justifies its strategy by saying that *“although a disease risk in the longer term can be theoretically inferred on the basis of existing risk models, an increased incidence of effects is unlikely in practice to be observed in future disease statistics using currently available methods, because of the combination of the limited size of population exposed and low exposures, i.e. consequences that are small relative to the baseline risk and their uncertainties”* (Paragraph E23). For the individual it is little comfort to know that his/her risk of x% is too small to be acknowledged because of the size of the population with such a risk is so small: the implication being that were more people affected then that individual risk level of x% would receive recognition. There is no rationality in such a position. Furthermore, until computed tomography (CT) came into widespread use the risks of diagnostic radiology (except for pregnant women) were not measurable, but still official advice across the board has been and is, to minimize doses from diagnostic radiology. It is a powerful negative reflection on the competence and scientific integrity of **the report** that this argument and terminology is used.

#### Collective dose<sup>\*18</sup>

**The report** estimates the collective dose to be 48,000 person-Sv<sup>\*19</sup>, but fails to compute the number of health effects that might be expected to arise as a result. It cannot be the complexity of the arithmetic that is getting in the way of this obvious next step. It could be an irrational belief that adding up many small numbers is likely to lead to a misleading result, or it could be that the committee membership are reluctant to have a number easily interpretable by the lay person hung around their necks. As explained by its Secretary (see [6]) UNSCEAR has a long-standing objection to using collective dose for risk assessment processes, but largely on the

grounds that very low doses reaching into the far future can be collectively misleading. This is a weak argument, but in any case the collective dose in the context of **the report** entails doses in the mSv range projected over 80 years so UNSCEAR's objection does not apply. The collective dose in terms of personSv in the context of a nuclear accident is of no conceivable value unless to compute expected detriment, as the figure has no physical significance (as, for example, collective absorbed dose in person-Gy might be) as the adsorbed dose components have been modified by weighting factors which may be subject to change in the future. The collective dose to the thyroid after Chernobyl would have been of considerable value had the sensitivity of the child's thyroid and the early appearance of the disease been understood at the time: it would have enabled the affected countries to prepare for the upcoming disease outbreak.

#### Threshold for solid cancer and leukemia<sup>\*20</sup>

UNSCEAR must be aware of the fact that the Japanese authorities are citing the following statement from the 2008 report of UNSCEAR, *“So far, neither the most informative LSS study nor any other studies have provided conclusive evidence of carcinogenic effects of radiation at smaller [than 100 mSv] doses”* (Paragraph D251), in order to justify their often repeated assertion that the risks of exposures below 100 mSv can be neglected so as to allow members of the public to live in an environment giving 20 mSv per year from external sources. This is not strictly a claim for a threshold; it is, however, misleading especially in the light of the evidence as it stands today. In **the report** the following is stated in respect of its use of LNT for solid cancer and leukemia (Paragraph E19a): *“While the Committee noted that these models had been used for radiation protection purposes [I21], it also noted that the current state of knowledge on the risk of cancer from doses of the order of 100 mSv or less was quite limited, although some but not all data were compatible with the risks of cancer from such doses not being seriously underestimated by the LNT model.”* The reference here to *“some but not all data”* is in my view disingenuous and not worthy of inclusion in a scientific document. It implies some kind of symmetry of equal weight in evidence applying to positive and negative studies. But that is not the case, since studies can give negative results due to insufficient statisti-

\*18—UNSCEAR leans on ICRP to justify not using collective dose to estimate numbers of cancer. There is a considerable degree of common membership between UNSCEAR and ICRP and thus ICRP is not an independent source.

\*19—Based on LNT, that is assuming no threshold

\*20—UNSCEAR claims that it has never advocated a threshold and that it has been misinterpreted by critics. Quite so, so there is all the more need to ensure that UNSCEAR is not misinterpreted in the future.

cal power. Therefore, provided there are no methodological flaws, positive studies (that is ones showing a significant effect) must be given greater weight and in my view the weight of evidence supporting linearity down to accumulated doses of ~10 mGy is compelling. This is the dose accumulated by a 10-year-old child subject only to the low LET component of natural background radiation.

## Summary conclusions

The response to the Fukushima accident by both the national and international authorities (especially the IAEA) has plumbed a new low in the field as judged by my experience over 40 years of professional involvement in radiological protection and nuclear emergency issues from the public health perspective. There were serious failures prior to the accident in terms of safety culture within TEPCO, from the outset to respond to the emergency at the national and international levels and finally, in my opinion, by UNSCEAR to give a scientifically credible assessment of the impact of the accident on public health. This should not be rocket science given the ~25 years that have elapsed since the Chernobyl accident and the investment over that period in preparedness capabilities for such an accident.

Clearly **the report** has entailed a substantial investment in resources and the time of many individuals, but to what extent these have been used to fit the evidence around the desired conclusions rather than, with scientific integrity, to make a reliable risk assessment, the naïve reader can only guess: my experience of working in the past with some of **the report's** contributors, the modus operandi of some UN agencies, the clear attempts to mislead in the early days of the accident and the lapses in a truly scientific approach identified above, leaves me in no doubt that **the report** is not a reliable risk assessment prepared with due scientific rigour.

In addition to the risk assessment aspect of **the report** it has to be borne in mind that events such as the Fukushima accident are landmark events in the history of the nuclear industry and fortunately infrequent. Therefore, they are interesting not just from the stand point of the levels and effects entailed in a particular set of circumstances, but also from the standpoint of what might have been the consequences had circumstances been different. They should act also as indicators of the potential for health and environmental damage of such accidents so that this can be weighed against the benefits of nuclear power as a means of energy produc-

tion. This is a matter of interest not only to nuclear States but also to those who might be affected by fallout originating beyond their borders. In the case of Fukushima, as far as doses out to some 200 km and beyond are concerned there were three major ameliorating factors; a) that the accident occurred in working hours; b) the wind direction and c) predominantly a lack of precipitation through the fall-out clouds over land. If the earthquake and tsunami occurred at night there would have been fewer staff on site and the disruption to transport by the earthquake would have severely limited the deployment of extra staff to the site<sup>\*21</sup>. A substantial proportion of the aeri ally released activity was blown out into the Pacific Ocean. This is evident from figure IX of **the report**. Precipitation greatly increases deposition (by a factor ~20) as was demonstrated in the Iitate area. Had the region out to some 200 km been similarly affected external doses and contamination of foodstuffs would have been proportionately increased. These three factors may well have prevented an accident involving spent fuel fires, and much higher levels of exposure over a wider area, possibly involving the need to evacuate Tokyo. The Fukushima accident could well have exceeded the collective dose from Chernobyl<sup>\*22</sup> because of the higher population density within 200 km of the reactor. UNSCEAR's view that these issues lay outside their remit is disingenuous. It would not be outside UNSCEAR's remit to comment on the role of arbitrarily determined factors that influenced levels, doses and risks, and if UNSCEAR were a responsible scientific body it would acknowledge the need of its sponsors to have that information. Indeed, it is unthinkable to me that a group of independent scientists, qualified to understand this aspect of the accident would not have drawn attention to it, given its relevance to so many States.

The UN set up UNSCEAR because of concerns about the global public health implications of the atmospheric testing of atomic weapons by a handful of Nations: today the emphasis is on the public health implications of nuclear accidents that might occur in any one of several Nations, but also have

\* 21—See: <http://www.themarknews.com/2014/08/21/should-japan-restart-its-nuclear-reactors/>

\* 22—A fallout map released by Professor Yukio Hayakawa, a Gunma University volcanologist, shows first year dose rates of 1 mSv/year or greater out to more than 100 km to east of the accident site and some 200 km to the south and north with a band of contamination about 100 km long and 20 km wide running SW to NE between 50 and 150 km from the accident site, that is outside the evacuation zone. In the event that 70% of the activity was not blown out to sea these annual dose rates would have been increased by a factor 3.

trans-boundary implications and thus affect public health in non-nuclear Nations. It is predominantly those Nations that use nuclear power that provide the expertise for UNSCEAR: the poacher and the game-keeper are one and the same. This incestuousness, it must be concluded, is at least in part responsible for **the report's** failure to qualify as a scientific document, a failure that cannot be too heavily stressed: UNSCEAR cannot credibly maintain its disconnection from the public health and policy issues associated with nuclear power and by trying to do so has done little more than produce propaganda for an industry that has contrived to have an accident that has and continues to have, without end in sight, an adverse effect on the environment and the public health in Japan and beyond. Furthermore, it may well have exacerbated the psychosocial effect, a major public health detriment after the Chernobyl accident. The United Nations should: a) commission a truly independent and comprehensive assessment of the public health and environmental implications of the Fukushima accident deploying a wider range of expertise; and b) reconsider the need in the future for UNSCEAR.

(August 2014)

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Note regarding the change: “† Editor’s note” added to p.e003 as of November 13, 2014.