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Background information for journalists

UNSCEAR assessment of the Fukushima-Daiichi accident

At its annual meeting in May 2011, two months after the accident at the Fukushima-Daiichi Nuclear Power Station (FDNPS) in Japan, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) agreed to carry out a scientific assessment of the levels of radiation exposure and risks to health resulting from the accident. The proposal was endorsed by the United Nations General Assembly. Subsequently 18 Member States provided 72 experts, who are now engaged in the work. Other relevant international organizations are contributing to the assessment with expertise, analysis and information.

The work so far has been focussed on collecting and reviewing the material published in the scientific literature, defining the assessment methodologies and working arrangements, and defining processes for quality assurance of the data and analysis. There are many sources of data for the Committee's evaluation; the most important of which are:

- Data from Japan from official government agencies; many are available on websites, though not in machine-readable formats; most, but not all of the information, is available in English. The Government of Japan has been requested to supply the data in electronic formats, together with supplementary information, so that the experts can more readily use the data;
- Measurements made by other United Nations Member States are being compiled and reviewed;
- Compiled and checked datasets are being made available by other United Nations organizations, including the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), the Food and Agricultural Organization of the United Nations (FAO), the International Atomic Energy Agency (IAEA), the World Health Organization (WHO) and the World Meteorological Organization (WMO); and
- Information and independent analyses published in peer-reviewed scientific journals.

Radioactive releases

Published estimates of the magnitude, composition and timing of releases to the atmosphere (the atmospheric source term) and to the marine environment (the marine source term) are being reviewed and will be used as input to the Committee's assessment of doses to members of the public and to non-human biota. Two alternative methodologies are used to estimate them:

- For each of the damaged reactors of the FDNPS, the accident progression is analysed and simulated using computer models, and the nature of the release derived;
- From monitoring data of the environment (e.g. air and soil), the magnitude, composition and timing of the releases are backtracked and reconstructed.

Present results indicate that the assessments of the atmospheric source term published by the Government of Japan[1] are plausible as initial estimates. These will be iteratively refined taking into account meteorological simulations prepared by the WMO and using environmental monitoring data provided by the CTBTO and Member States.

Analyses of the accident sequence and progression are unable to provide accurate estimates of the marine source term. Hence, the work is focussing on using local and regional environmental monitoring data to estimate the likely ranges of the releases into the Pacific Ocean.

Radiation exposure of the public

The main exposure pathways in the assessment of doses to the public are: (a) external exposure from radionuclides in the air and deposited on the ground; (b) internal exposure from inhalation of radionuclides in the air, and (c) internal exposure from the ingestion of radionuclides in marine and terrestrial foodstuffs, and water.

Radioactive isotopes of caesium and iodine are recognized as significant in terms of potential health and environmental impact after a major nuclear accident. For internal exposures, an important contribution is from the ingestion and inhalation of isotopes of iodine and caesium. In the early days after the accident, a primary concern was the exposure of children to radioactive iodine through inhalation and ingestion (radioactive iodine preferentially exposes the thyroid). In the longer term, exposure from radionuclides with long half-lives will play a dominant role. These include ^{137}Cs and ^{134}Cs, with physical half-lives of 30 years and 2 years, respectively. For the first year external exposure is expected to be the dominant pathway, with ^{134}Cs being the key radionuclide. External exposure is expected to continue to dominate in the longer term, with ^{137}Cs being the key radionuclide.

The Committee will evaluate assessments of doses to members of the public published by others, including a preliminary assessment of doses by WHO. UNSCEAR will also conduct its own scientific assessment of doses to the public living in different locations in Japan and in other countries. It will assess doses to adults and children living in different places; provide insight on the variability of doses within the population; and estimate doses to relevant organs (e.g. thyroid) for the highest exposed population groups. Dose estimation will be based on measurement data as far as possible, but models will also be used for geographical areas and time periods where no measurements were made.

Three age groups will be considered (one-year old infants, 10-year old children and adults), but consideration will also be given to the doses to the foetus and breast-fed infants in the first year after the accident.

The experts have undertaken an initial review of published papers in peer-reviewed scientific journals relevant for assessing public exposure from external irradiation, inhalation or ingestion. The papers

[1] Japan, Prime Minister of Japan and His Cabinet. Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety - The Accident at TEPCO's Fukushima Nuclear Power Stations (June 2011). Nuclear Emergency Response Headquarters, Government of Japan (2011). http://www.kantei.go.jp/foreign/kan/topics/201106/iaea_houkokusho_e.html

cover different geographical areas in Japan with the predominant focus on the most affected municipalities of the Fukushima Prefecture and some adjacent areas. The subjects considered in the papers include measurements of radionuclide concentrations in air, soil, drinking water, foodstuffs and typical meals, and dose rates.

The literature search found a small number of papers relevant to the assessment of doses in countries other than Japan. Where possible, the results of UNSCEAR's assessment will be compared with these published values to check that there is consistency, or that any differences are understood.

The Fukushima Prefecture government had conducted thyroid monitoring of 1,080 children aged 15 years or younger in Iitate village, Kawamata town and Iwaki city and found no individual received a thyroid dose of more than 100 mSv[2]. The maximum thyroid dose possibly received by those children was estimated to be 35 mSv[3]. However, the date on which internal exposure began, a parameter necessary for accurate estimation of the cumulative thyroid dose, is not entirely clear. In October and November 2011, residents in Iitate village, Namie town and the Yamakiya district of Kawamata town were examined. The results of thyroid examinations using ultrasonography in a cohort of more than three hundred thousand children of the Fukushima Prefecture are expected to be made available to UNSCEAR.

The Fukushima Prefecture government initiated a survey in June 2011 in Iitate village, Namie town and the Yamakiya district of Kawamata town, where radiation levels are known to be high. The number of subjects in this survey is about 27,000. The study of the remaining Fukushima Prefecture residents started in late August 2011. It is collecting information necessary to evaluate external radiation exposure levels for all the people who were living in the Fukushima Prefecture as of 11 March 2011. The number of people to be surveyed is expected to be approximately 2 million. UNSCEAR is expected to have access to the results to scrutinize them for its own assessment.

Radiation exposure of workers

Conducting any independent dose assessments or investigating the dose assessment methodologies for workers involved in mitigation operations at the FDNPS requires comprehensive and precise information on the internal and external monitoring regime that was implemented.

An initial literature review has been undertaken to identify papers relevant to assessment of doses to workers received from internal and external exposure. The literature search found a small number of relevant documents that address doses likely to be received by Tokyo Electric Power Company (TEPCO) workers and contractors. As of 31 January 2012, a total of 20,115 workers had been involved in the mitigation activities, of whom about 17 per cent were TEPCO workers and 83 per cent were contractors. About 66 per cent of the workforce received doses equal to or below 10 mSv. Six TEPCO workers received effective doses over 250 mSv, with most of the dose due to intakes of ^{131}I, ^{134}Cs and ^{137}Cs. There

[2] Nuclear Safety Commission of Japan. The results of thyroid radiation dosimetry among children in Fukushima Prefecture, Siryo 4–3, May 12, 2011.

[3] Tashiro, S. Thyroid dosimetry of Fukushima children. Emergency Forum of Japan Pediatrics Society on the Tasks of Pediatricians facing this Disaster, April 17, 2011.

were 167 workers (87 per cent from TEPCO) who received effective doses higher than 100 mSv. Presently there are no data available in the open literature about thyroid dose estimates.

The Government of Japan is compiling information on doses received by workers in other categories (for example, self-defence forces, policemen, firemen, and municipal employees) for the Committee's review.

The work to be carried out over the next months is intended to achieve two aims: (a) to validate the results of the internal dose assessments reported by the Japanese authorities for the 12 workers with the highest assessed internal doses; and (b) to validate the methodologies used for internal dose assessments for workers exposed at lower levels for a representative sample of cases covering TEPCO workers, contractors, emergency services workers and so on.

Currently available information shows that worker deaths and injuries were a result of physical trauma, cardiovascular stress and heat stress, associated with the tsunami or the damage mitigation activities at the site. One reported acute leukaemia death cannot be attributed to radiation exposure from the accident owing to the short time between the exposures and the death.

Although there were several workers whose skin was irradiated by contamination, there were no reported or clinically observable effects. Accordingly, from the currently available literature, there has been no evidence of acute radiation injury in any of the workers.

Effects on plants and animals

Similar to humans, non-human biota can be exposed internally to radionuclides taken up from the environment, and externally from radiation sources in their habitat. The Committee has reviewed the effects of radiation exposure on non-human biota and published the data in its UNSCEAR 1996 and 2008 Reports. Those reports reviewed findings of experimental studies and field experiments, but also observations of effects in the natural environment following the Chernobyl accident.

To date, there are only a few published assessments of exposure of non-human biota to radiation resulting from the accident. These show somewhat contrasting results. The highest exposures of wildlife appear to be associated with the marine environment. This substantiates the need for the Committee to undertake its independent assessment.

Initial agreement has been reached on the methodology for conducting the environmental impact assessment. Preference will be given to using radionuclide concentrations in plants and animals, measured over time and geographical area from the first day of the accident. In the absence of such data, computer models will be applied to simulate doses to indicative species of plants and animals.

Analysis of any irradiation effects will be conducted using published direct observations (if available) and evaluated from the dose assessments and past studies.