WNA Statement on Radon to the ICRP

July 2011

The World Nuclear Association (WNA) is pleased to provide the following 'Statement on Radon' in response to ongoing international deliberations associated with the publishing of the International Commission on Radiological Protection (ICRP) 'Statement on Radon' in November 2009. This WNA statement addresses two possible radiation protection changes arising from the ICRP statement:

1. An increase, by an approximate factor of two in the risk of lung cancer from exposure to radon progeny as derived from epidemiological studies; and

2. Moving away from the epidemiological approach to determining and adopting radon dose conversion factors based on reference biokinetic and dosimetric models.

The WNA membership comprises the full nuclear fuel cycle, from uranium mining and equipment suppliers, to generators of electricity. Our membership includes nearly 200 companies from over 30 countries, representing over 90% of the nuclear electricity generated.

Of particular relevance to the present Statement, the WNA membership covers more than 90% of world uranium mining production. The control of mine workers' exposure to radon progeny has been, and continues to be well established as part of radiological protection programmes for uranium mines and mills.

As an integral part of nuclear activities, all WNA members give due consideration to the safe management of radiation health risk to people and the environment. Sound, robust and stable science supplemented with practical knowledge and experience, underpin our approach to managing the risk from radon progeny.

The global nuclear industry is committed to offer expertise and knowledge with a view to assist with the practical implementation of this evolutionary change to the risk from radon progeny. Our suggestions in this regard are provided herein in the next following pages.

World Nuclear Association • Carlton House • 22a St. James's Square • London SW1Y 4JH • UK
Website: www.world-nuclear.org • Email: info@world-nuclear.org
Tel: +44(0)20 7451 1520 • Fax: +44(0)20 7839 1501

Incorporated in England No 1215741 • VAT Reg No GB 340 2373 93

Epidemiological studies on exposure to radon progeny and derived dose conversion factors (DCF)

The latest ICRP evaluation of epidemiological studies of lung cancer risk from radon and radon progeny indicates that the risk averaged over a population is greater by approximately a factor of two than previously estimated. It is noted that this overall average risk can be lower or higher than the average risks from individual epidemiological studies. It is also noteworthy that, given reasonable assumptions relating radon measurements to radon progeny concentrations, pooled studies of radon in homes now provide a direct estimate of risk to radon progeny without the need to rely on dosimetric extrapolations from studies of miners.

Since the risk projection models considered are all relative risk models, the determination of lung cancer risk from radon progeny is strongly dependent on the characteristics of the underlying reference populations. Among these characteristics, the confounding factor which has the most profound influence on risk estimation is the prevalence of smoking in the underlying population. In other words, except for never-smokers, the risk of lung cancer arises from the combined effect of (at least) two distinct carcinogenic agents – radon progeny and tobacco smoke – that interact synergistically. It is clear that the risk averaged over a population includes a dominant component attributable to smoking, since in the absence of smoking the risk is several times smaller. This applies also to the nominal lifetime excess absolute risk (LEAR) per unit of radon progeny exposure recommended by ICRP, which is a population-average value.

When the effect from smoking is combined with the range of risk factors reported from individual epidemiological studies, risk estimates range by more than a factor of 10. It is therefore important that the influence of smoking is properly recognised in order that appropriate judgements may be made about the need for, and nature of, any protective measures.

In assessing these developments we believe that careful consideration needs to be given to the stability and credibility of the radiation protection system. In particular, we emphasize that radiation protection at uranium mine sites is optimized and, generally speaking, doses are well below current limits. The uranium mining community has reported the significant reduction in exposure to radon progeny which has been achieved over the years through the optimization process. Given the very significant influence that smoking has on the risk from radon progeny, historical cohorts from which the risk factors are derived may not be representative of current and future populations. We also note that smoking rates are variable with a more or less generally declining trend in many places in the world and hence, so also is the underlying nominal population-based average risk from radon. It is therefore not apparent that there is a compelling case to change the DCF for exposure to radon progeny at present. At a minimum, further discussions are needed to better understand the desired level of stability in risk estimates and level of conservatism in the current approach.

Adoption of a dosimetric approach by ICRP to estimate doses from exposure to radon progeny

We have noted ICRP's intention to move from the long established epidemiological-based approach to a dosimetric-based approach for the estimation of effective dose from exposure to radon progeny. In principle, we understand the ICRP's ambition to develop a common approach for estimating, by calculation, doses from intakes of all radionuclides. We would welcome such a common approach once the dosimetric modelling for radon progeny has been robustly tested and calibrated/validated for practical implementation in real uranium mines. Otherwise, there is a real risk that its early adoption could trigger significant instability in the currently well-established system of radiation protection for uranium miners. Above all, we are concerned that a premature adoption of the dosimetric approach could lead to poor choices in optimizing the protection of miners.

It should also be noted that uranium mining is one of the very few contexts in which radon progeny doses are individually assigned to workers and are officially registered in dosimetry records. For the vast majority of (if not all) other contexts, the risk to radon progeny is addressed via the control of radon levels in ambient air – without individually assigning doses to people. In other words, for uranium mining, the accuracy of the method used to assess doses is crucial.

WNA believes that adopting a dosimetric approach for radon progeny is premature at this time and that retaining the current epidemiological-based approach continues to provide a more reliable basis for standard setting for the immediate future. We agree with the ICRP recommendation to continue using the current DCF for radon progeny while the dosimetric approach is being carefully developed and tested. Our concerns are substantiated in the following three paragraphs.

1. ***Issues of dosimetric model calibration/validation*** – It is unclear whether ICRP has sufficiently validated the dosimetric model for radon progeny. While there is an apparent overall agreement between the dosimetric model and the epidemiological studies, it is unclear whether this is a coincidence based on a fortuitous choice of the many parameters for the model or true agreement. We note suggestions that the dosimetric model somehow accounts for smoking through the concept of 'population weighted detriment', but we cannot see how the current physiological modelling can replicate the synergistic relationship between radon progeny and tobacco smoke, leading to a multiplicative risk. We stress that inadequately addressing smoking would cast serious doubts on using a dosimetric model.

   Regarding the aerosol characteristics of radon progeny, if one considers that the range of risks from the epidemiology studies for uranium miners from different mines is about one order of magnitude, presumably some of this variation is due to differences between mines. A crucial test of the efficacy of the radon dosimetric model would be to re-examine some of these studies with appropriate aerosol parameters and determine if some of the range of calculated radon risks is explained by the different radon aerosol conditions.

This state of affairs regarding smoking and aerosol parameters points at the need for a robust calibration/validation of the dosimetric model prior to adopting it for decision making purposes. It is possible that the related model development may also lead to improving our knowledge of the detailed parameters which underpin this risk.

2. Issues of reference conditions in uranium mines – We appreciate that the ICRP has stated that it will provide different dose coefficients for different reference domestic and workplace conditions. However, there is very little data available for modern uranium mines to provide such default conditions. There have been few measurements characterizing radon progeny aerosols in uranium mines in the last two decades. Over that same time there have been changes in mining in general and in the uranium mining industry in particular. For example, although uranium production from conventional uranium mines (open-pit or underground mines) remains dominant at the world level, *in situ* recovery mines now represent a significant and growing fraction of world production. In terms of world regions, Canada has shifted from large low-grade underground mines to a new generation of high-grade mines that are now in operation. Australia has both conventional uranium mines and *in situ* recovery mines, and mines with uranium as a by-product. New centres of uranium production have emerged in central Asia and Africa. For example, Kazakhstan is now the largest supplier of uranium in the world and most of its production is from *in situ* recovery mines. Another example is the growing production in Namibia and Niger as well as new production in Malawi. Some new mines have also been opened in the United States. Furthermore, there are a few mines left in Europe.

We emphasize that there is little or no information on the characterization of radon progeny aerosols that would reflect the significant changes that have taken place over the last two decades in uranium mining around the world. This means it is not possible to reliably establish default parameters based upon uranium mine workplaces at the current time. We also stress that the issue of characterizing workplaces would represent an even bigger challenge for other mines like coal mines, iron-ore mines, rare earth mines, etc, where radon issues are also likely to be applicable.

3. Issues of measurements of radon progeny aerosols - The lack of information on workplace conditions for current uranium production facilities points to another problem. At present, industry and regulatory agencies do not have the ability to gather this data in the immediate future. There has been little work on characterising radon progeny aerosols over the last two decades. In addition, the complexity of these measurements makes it inherently difficult to collect this data. Also, to our knowledge, there is not a standard measurement protocol for radon progeny aerosols that is widely accepted, nor reliable equipment which functions well in mine conditions. In essence, the premature adoption of a dosimetric approach would place industry, and we believe most regulators involved in uranium mining, in an awkward situation where they cannot effectively characterise the workplaces that they are responsible for. This becomes a particularly acute problem because we do not believe there is sufficient information currently available to establish reliable default parameters for the range of anticipated mine workplace conditions.

Another point to consider is the role that exposure to radon progeny has in the broader radiological protection (RP) system. In industries outside uranium mining, radon progeny exposures are usually treated as existing exposures. Radon and radon progeny concentrations are used as a trigger to decide whether the requirements for planned exposure situations should be applied. So any significant change to the estimation of radon progeny dose impacts on the broader RP system. It is unclear how the dosimetric approach would affect the above and how default parameters could be realistically applied to the wide range of exposure situations to radon progeny in workplaces and in homes of all kinds, worldwide.

In Summary

We believe that for the time being there is no compelling need to adopt a dosimetric approach for radon progeny. The results from the latest epidemiological studies provide a sound and stable basis for ensuring adequate protection of uranium miners. Prior to adopting a dosimetric approach for radon progeny, more work is needed, both by the ICRP, to further validate and improve the model, and by industry, to test the characterisation of the nature of radon aerosol properties in the various workplaces. In particular, the WNA:

- Seeks your advice on the use of the dosimetric approach to radon progeny. In particular, we would like more information on how the calibration/validation against the epidemiological approach was conducted and how the smoking confounder was considered.

- Also would like further information on what reference conditions are to be examined for uranium mines to assist in determining the relevance and application of dosimetric modelling.

- Plans to test, through a common protocol, the measurements and collection of data for the physical parameters of radon progeny aerosols. This protocol needs to be carefully developed and we would welcome input from the ICRP both on the measurement techniques and also the potential for the provision of collected data for future modelling.

In relation to the two possible ICRP changes mentioned at the beginning of this Statement, the global uranium mining industry welcomes and appreciates the opportunity for contributing to ICRP developmental work on radon. We are committed to cooperating on this matter with the ICRP and with other leading organizations such as UNSCEAR and the IAEA. In order to best achieve this goal, the global uranium industry has integrated this key function as part of the WNA uranium mining standardization working group (UMSWG). One of our group key tasks is to establish, with the help of suitable experts, a standard measurement protocol, including the required equipment to test the characterisation of the nature of radon aerosol properties in modern uranium mines. This coordinated effort through the UMSWG offers a practical way of best contributing industry expertise and experience to developing and improving a dosimetric approach for radon and its practical application.