## SESSION 6

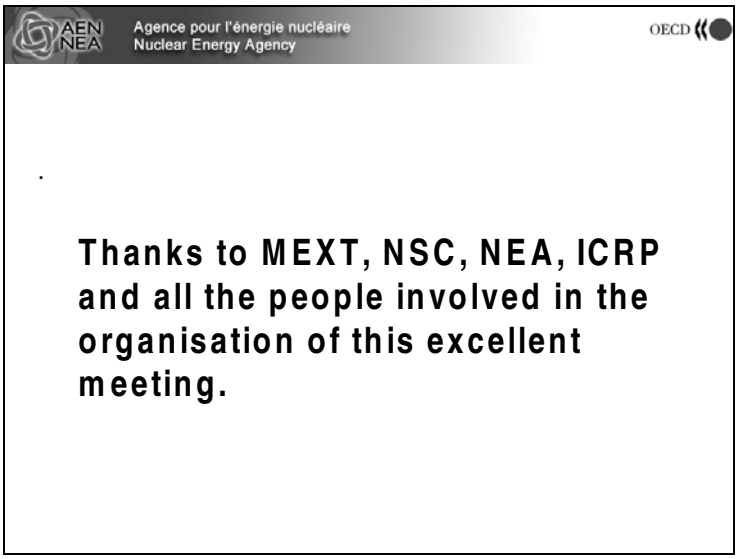
## SYNTHESIS OF THE MEETING

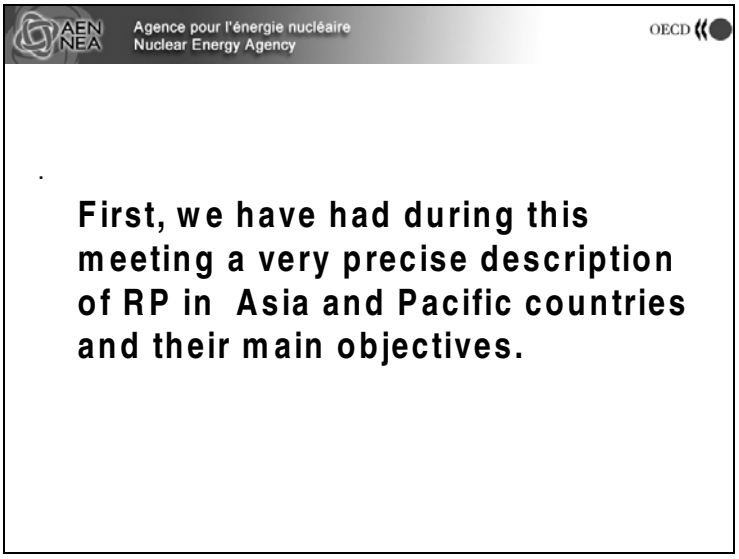
*Chair: Yasuhiro YAMAGUCHI*

Considering the contents and nature of most discussions, it can be concluded that the process of the new ICRP recommendations is moving forward considering the comments from all over the world. In addition it can be stated that the idea of new recommendations was well accepted by most participants. However, it must be noted that there are still remaining differences in regional legislative as well as cultural frameworks and these must be taken into account. An expectation was expressed that all new comments and questions should be discussed internationally.

## SUMMARY OF KEY POINTS

**Henri MÉTIVIER**
*Conference Rapporteur*



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Nuclear Energy Agency

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- The first key point is the quality of discussion.

  You have carefully read the new draft.

  The discussion was free and very useful for ICRP.

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- I fully share the point of view of our Chinese colleague: There has been a lot of progress and improvement in the drafting of the new recommendations since the last conference, including taking into account comments from the RP community.

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- Once more, we have to congratulate OECD/NEA for this very efficient brain storming.

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Key point 1

More continuity than change is appreciated.

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Key point 2

The draft clearly describes the goal of radioprotection:

Prospective
Protection

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Key point 3

Good discussion on LNT.

A lighter presentation.

A great benefit for RP and the scientific debate.

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Key point 4

Problems with the change of Wt, Wr.

ICRP 26, 60 and new draft.

Neutrons, breast.

Trust in authorities.

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Key point 5

Clear statement of the decrease of genetic risk is appreciated.

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Key point 6

Always the problem of the same name for equivalent dose and effective dose.

Moreover the equivalent dose is used for deterministic effect (lens and skin) with stochastic tools...

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Key point 7

I fully agree that the new draft is better than the former, but be careful with the wording for non-English mother tongue audiences.

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Key point 8

New definition and limits of the use of collective dose are appreciated.

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Key point 9

Definition of three types of exposure is appreciated.

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## Key point 10

**Natural exposure is recognised as a significant issue in China.**

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## Key point 11

- **Urgency for the next years or decades is the medical field, but don't forget how many lives had been saved by these intentional exposures.**

***It is important to translate in national language some ICRP-C3 publications.***

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## Other points

**Our Indonesian colleague raised an important point:**

- **Teaching of NST in primary school;**
- **Free NST training/seminars for Teachers.**

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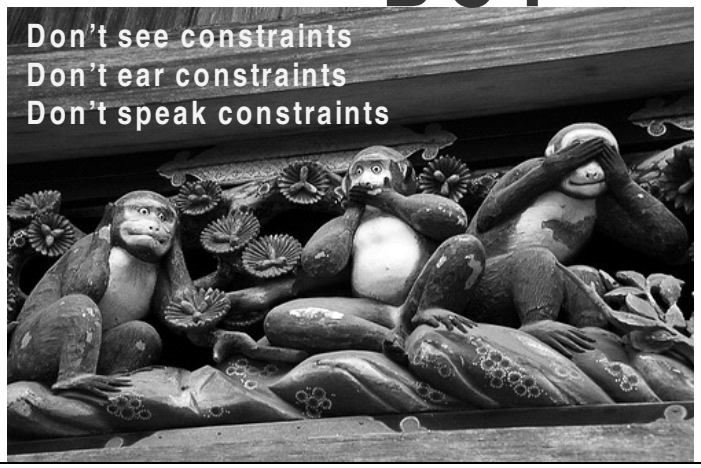
# BUT

Don't see constraints
Don't ear constraints
Don't speak constraints



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Day-to-day efforts by NPP operators is successful, ALARA well implemented in this field of activity is a good illustration that we can already use constraint without the new draft.

But if this concept is well implemented in nuclear industry, don't forget that they are other field of activities where ALARA is not usual.

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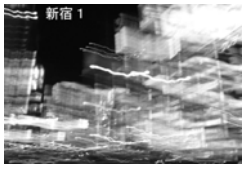


General consensus for rewriting constraint paragraphs:

- More clarity;
- More examples.

"***dose constraint is an ambition level based on experience***".

## CONCLUSION

**Lars Erik, your new draft is good, but don't stop the effort, the next one will be perfect, JHPS done half the job.**

## THE ASIAN PERSPECTIVE

**Tsutomu UEKI**
*Director of Nuclear Safety Division,*
*Science and Technology Policy Bureau, MEXT, Japan*

I would like to say thanks to all participants for fruitful discussions for two days. And I also would like to say thanks again to the ICRP for ongoing efforts to further development of the radiological protection and for the opportunity to make comments and exchange views.

The new ICRP draft recommendation, which was issued last month, is highly appreciated. Because the draft recommendation takes new scientific findings and main concepts, such as the three principles of protection, dose limit and stance to LNT, are not changed.

According to uncertainty of LNT, as Dr. Niwa explained, radiation protection contains uncertainty of dose risks, but we need to have regulation. In ICRP, C1 tries to turn uncertainty into certainly, and C4 tries to come up with best regulations even with uncertainty. Otherwise, the data of Hiroshima-Nagasaki have been useful yet for the new scientific findings. It may solve the problem of uncertainty. Thus, we recognised again the importance of the data of Hiroshima-Nagasaki.

Asian countries including Japan introduce some of the ICRP concepts into their legislation system for radiation protection. The Asian Regulatory authorities are accountable to their nations and stakeholders when they introduce a new concept to present regulations. Therefore there were many explanations and opinions about an application of ICRP recommendations to their regulation in this conference. Through the explanation, we can also discover the regulation systems of other Asian countries.

One of the main opinions was about dose constraint. In the new draft the ICRP recommendation gave a definition of a dose constraint as “a start point of optimisation”. There was an opinion that the definitions permitted many different interpretations in Asian countries and it is unclear the difference of dose constraint and dose limit. Thus, we recognised that we need to have the same understanding as each other for consistency of radiation protection. Also, other many opinions such as environmental protection, radon exposure, the roles and sharing between ICRP, IAEA and national government and the importance of risk communication were issued in this conference. Those were also remarkable opinions.

We expect that ICRP treats properly the opinions which were issued in this conference and reflect our opinions in the recommendation.

Finally, I wish, to thank Dr. Lars-Erik Holm, ICRP Chairperson, Dr. Shizuyo Kusumi, Commissioner of Nuclear Safety Commission of Japan, Dr. Yasuhito Sasaki, Vice President International University of Health and Welfare, Mr. Mason, RASSC Chairperson IAEA, Dr. Choi from Korea, Dr. Pan and Dr. Xia from China, Mr. Burns from Australia, Dr. Taryo from Indonesia, Dr. Marcus, Deputy Director-General of OECD/NEA, many distinguished guests from Asian-Pacific countries, OECD/NEA staff, secretariat of this conference, ladies and gentlemen. Thank you very much.

# IMPLICATIONS FOR ICRP DEVELOPMENTS

**Lars-Erik HOLM**
*ICRP Chair*

In the summary session, Dr. Holm expressed his thanks to all participants for their commitment and contribution to this conference. Principally he was pleased to see that participants had carefully read the new draft recommendations, and were able to contribute remarkably well in discussions in order to achieve consensus on identifying and solving problems in different countries.

He noted that that discussion of the radiation protection issues has lasted nearly 80 years, and the last eight years have been dedicated to the preparation of the current revision of the recommendations. During this process, the ICRP adopted a new approach and has tried to involve stakeholders in preparation, which has resulted in many specialists and groups around the world participating actively.

Following the Third Asian Regional Conference, the North American Regional Conference is scheduled to be held in Washington, DC, which is expected to be more policy-oriented.

Dr. Holm expressed his intention to summarise and implement comments from these conferences, and finalise the new recommendations as soon as possible.

## IMPLICATIONS FOR CRPPH DEVELOPMENTS

**Jacques LOCHARD**
*CRPPH Chair*

Dear Colleagues,

First of all, I would like to say that it was a great pleasure for me to participate in this Third Conference on the Evolution of the System of Radiological Protection. I am impressed by the quality of the presentations, the constructive criticism of the present draft document and the numerous positive proposals for improvements that have been made during these last two days.

I am quite confident that the Commission will carefully take into account these criticisms and proposals as has been proven over the last years throughout the preparation of the new recommendations, with other criticisms and proposals.

Having said that, I would like to raise briefly a few points related to the implications of this conference for future CRPPH developments. I see three main directions.

The first one is to develop a reflection on the interactions between radiological protection science and radiation protection principles. These interactions have been mentioned several times by different speakers during the Conference and this is in my view an important issue which deserves to be looked at more thoroughly in the future.

For your information, the CRPPH decided, during its last annual meeting in March 2006, to launch a series of technical workshops aiming at exploring the links between science and policy in radiological protection. This decision resulted from the discussion that followed the presentation of the work of the EGIS expert group chaired by Henri Mé tivier. The CRPPH members clearly expressed their wish to see a continuation of the work achieved so far in order to better understand how scientific findings in the fields of epidemiology and radiobiology are used to develop a system of protection responding to the expectations of a modern society.

Obviously the present conference re-enforce the interest of going into this direction and I hope that Asian experts will actively participate to the work of the Committee to ensure constructive and fruitful debates on this difficult issue, which inevitably will embrace the debate on LNT that has been several time evocated during the last two days.

The second direction, which emerged from our discussion and deserve the attention of the CRRPPH, is certainly the need for developing guidance on the practical application of dose constraints especially as far as their possible role in the regulatory process is concerned. The dose constraint concept is obviously going to play a major role in the future and the discussions during the conference have shown that misunderstanding still remain concerning their use which call for more clarification. This is certainly the role of international organisations like the CRPPH or IAEA to elaborate further

the concept on the basis of the ICRP basic recommendations and in this perspective, I think as key tools of the CRPPH, the ISOE System and the INEX Party are perfect forums to open a dialogue between radiation professionals on the use of dose constraints to protect the workforce and to protect the public during and after a nuclear accident or any radiological events.

The third direction is without any doubt the continuation of the cooperation between ICRP and the CRPPH. So far this cooperation has been exemplary. We are finishing a long period during which the Committee has tried to support in the best effective way the preparation process for the recommendations through a systematic review of the successive drafts documents elaborated by the Commission. This was also a period during which the Committee tried to facilitate the dialogue between NEA members and ICRP and beyond with other key stakeholders directly involved in radiological protection. The three Asian Conferences cannot be a better example of the usefulness this dialogue played in the development of the recommendations.

I think a new period for the cooperation between CRPPH and ICRP will start soon which will focussed on the interpretation of the new recommendations and the development of advice and guidance on how to implement them in practice. This will certainly be a period as interesting as the previous one for all professionals and the CRPPH, as an open and forward looking forum, can certainly play a useful role for a rapid dissemination of the recommendations worldwide.

One of the key roles of the CRPPH is to anticipate scientific and social evolutions that may affect radiological protection in the future and, having identified such evolutions, to explore their theoretical, methodological and practical potential impacts on the professionals and organisations involved in day-to-day radiation protection. The recent contribution of CRPPH on the role of stakeholders in radiation protection is a perfect illustration of this anticipating role. The nearly decade of work devoted to this emerging issue was not an effort for nothing when looking at its place in the new recommendations and I hope that the Committee, will continue in the future, to maintain its role, together with the other international organisations, on the forefront of the evolution of radiological protection.

At this stage I would like to take the opportunity, which is offered to me today, to sincerely thank the Japanese authorities for their on-going financial support to the CRPPH over the last few years. This has been an invaluable input for the development of successful actions, among which the three Asian Conferences, and on behalf of all CRPPH members I reiterate once again my most sincere thanks.

In conclusion, I would like also thank Lars-Erik Holm, the Chairman of ICRP for his active participation in the Conference, all lecturers for their high quality presentations, all colleagues in the audience for the detailed discussions they initiated over the two days and also all of those people, including of course the interpreters, who helped in the preparation and the running of the Conference and thus directly contributed to its success.

Thank you for your attention.

## CONFERENCE SUMMARY

Based on the discussions that took place during this third forum, this summary report identifies the forum key issues. The CRPPH is grateful to the ICRP for the open discussions held during this forum and for its acceptance of the comments made by various stakeholders, including regulators, industrials and professionals This very positive discussion will be followed by another forum in North America and a final forum in Europe before the main commission acceptance of the new recommendations and their publication in 2007.

# 1. INTRODUCTION

The objectives of this third conference, following the two previous conferences held in Tokyo in October 2002 and July 2004, were to;

- Evaluate and discuss the possible implications of the ICRP draft recommendations, particularly with respect to Asian expectations and possible future application in the Asian contexts;

- Discuss how new ICRP recommendations could best serve the needs of national and international radiological protection policy makers, regulators, operators, workers and the public within the Asian context;

- Continue the open and broad dialogue between stakeholders to reach a common level of understanding of the issues at stake in the Asian context;

- Contribute to the evolution of the new system of radiation protection.

In recent years, the ICRP has launched an open process to enhance the current set of radiological protection recommendations. The ICRP has presented its new draft proposals and recommendations to the broad radiological protection community seeking a dialogue with all interested parties or stakeholders. The objective of this open process is to arrive at a new generation of ICRP recommendations that are as broadly understood and accepted as possible so they can be efficiently implemented. The ICRP published at the beginning of June 2006 the new draft recommendations on the ICRP web site (http://www.icrp.org/) for comment and is expecting a new set of comments before the publication of these new recommendations in the 2007 time frame.

The preliminary focus of the ICRP development has been on new general recommendations, which will replace Publication 60. As part of this process, the ICRP has also identified a need to clarify and update its views on the radiological protection of the environment. Both of these areas are of great interest to member countries of the Nuclear Energy Agency (NEA).

As an international committee made up of nationally nominated radiation protection authorities and technical experts, the NEA Committee on Radiation Protection and Public Health (CRPPH) has for most of its history actively followed the work of the ICRP. This interest continues as the ICRP develops its new recommendations. Shortly after the ICRP began to develop its new ideas (Roger Clarke, 1999, *J. Radiol. Prot.* 19 No 2, June 1999), the CRPPH began specific work in this area; focusing on how the system of radiological protection could be made more responsive to decision makers, regulators, practitioners and the public. Through a series of expert groups, topical session discussions with the ICRP Chair, and broad stakeholder dialogue fora, the CRPPH has developed a long series of documents discussing relevant issues, and proposing possible directions to move forward effectively. Since the appearance of the new ICRP suggestions in 1999, the CRPPH has developed and published 12 reports specifically concerning development of a new system (see References), all of which are available from the NEA's web site (www.nea.fr).

The occasion of the release of the latest draft ICRP recommendations provides the ideal timing to hold the Third Asian Regional Conference on the Evolution of the System of Radiological Protection. With the recommendations planned to be finalised in 2006 or 2007, this Conference will provide important input to the development process. In addition, CRPPH and ICRP are planning to hold North American Regional Conference (August 2006, Washington D.C.) and Third NEA/ICRP Forum (October 2006, Prague).

During this forum, the first of a series of three ICRP/NEA dialogues to discuss this latest draft, the chairman of the ICRP presented the Commission's new draft recommendations, updated after receiving a considerable number of comments during the last web consultation. This new document, very different from the previous one, largely incorporates many significant comments coming from all over the world. This latest draft is more comprehensive than previous versions, and seems more accepted by stakeholders, although the presentation of dose constraints is an exception to this broader acceptance. This new document retains its reliance on the linear non threshold (LNT) assumption, in spite of new scientific data challenging this hypothesis. A few modifications appear in weighting factors for radiation and tissues. A significant difference from previous recommendations concerns a significant reduction in genetic risk. It should be noted that genetic risks have not been statistically observed in the two generations of Hiroshima-Nagasaki bombing survivors.

There has been a lot of progress and improvement in the drafting of the new recommendations since the last conference, including taking into account many comments from the RP community.

## 2. THE NEW ICRP GENERAL RECOMMENDATIONS

The first ICRP recommendations issued in 1928 focused on the protection of the medical staff against occupational exposure. General recommendations have appeared later in 1959 (Publication 1) 1964, (Publication 6), 1966 (Publication 9), 1977 (Publication 26) and 1991 (Publication 60). Since 1991, nearly 30 different numerical restrictions on dose have appeared in a number of publications leading many users and stakeholders to confusion. A simplification was needed, and this was one of the main aims of these new recommendations, in addition to the consolidation of the general principles described in 1991.

Since ICRP Publication 60, our knowledge of radiation risk has not changed substantially. However, new results from radiological protection sciences are increasingly challenging the general concepts of the radiological protection system, although currently results are not significant enough to suggest that drastic change of the system is urgent. The system is considered as successful, there is no hurry for changes, and the Commission has wished to maintain as much stability in the new recommendations as is consistent with the new scientific information. This consistency was one of the main requirements expressed during the former consultations both in Asia (Tokyo, 2004) and in Europe (Lanzarote, 2004). There is more continuity than change!

In the new draft recommendations, most previous recommendations will remain because they work and are clear. However some previous recommendations need to be better explained, in some cases more guidance is needed, in others new recommendations need to be added because there has been a void, and in some cases new approaches are needed because understanding has evolved. The new recommendations consolidate and add to previous recommendations issued in various ICRP publications.

***The existing numerical recommendations in the policy guidance given in 1991 remain valid unless otherwise stated.***

The new recommendations maintain the fundamental principles of radiological protection and clarify how they apply to sources and individuals. The new recommendations update the radiation and tissues weighting factors and the radiation detriment, and maintain dose limits, but expand the concept of dose constraint in source-related protection to all situations.

The main change, or clarification, is the description of practices and intervention. The new recommendations retain the idea of practices and interventions, but not as a way of distinguishing between how the system will be applied. Rather, the new system adopts, for both practices and interventions, the same approach and assumes that there is no procedural difference because:

- There is some level of dose above which the regulator will demand action.
- Optimisation of protection is applied to keep exposure as low as reasonably achievable, taking into account economic and social factors.

- Once protection has been optimised, no further action to reduce doses is seen as necessary unless circumstances change.

- To achieve this, the new draft recommendations will apply to three types of exposure situations; planned, emergency and existing.

These changes result from experience of the implementation of the previous approach, and from dialogue with stakeholders mainly promoting different experience by the NEA/CRPPH.

The recommendations continue to cover controllable natural and artificial source exposure and apply to the control of sources or pathways leading to doses and individuals.

Foundation documents and building blocks will be published by the commission as the result of discussions among the different Committees of the Commission.

The quantities for radiological protection are unchanged but weighting factors for calculations are sometimes changed:

- The $W_R$ for protons decreases from a value of 5 to 2:

- The $W_R$ for neutrons is now a continuous function, and is two times less for neutron energy less than 1 MeV:

- $W_T$ for gonads drops from 0.2 to 0.08. This difference is mainly due to the change of reference for genetic risk estimate, previously extrapolated to theoretical equilibrium (many generations). Today the genetic risk is based on second generations of Hiroshima and Nagasaki survivors:

- $W_T$ for breast increases from 0.05 to 0.12:

- $W_T$ for bladder, oesophagus, liver and thyroid smoothly decrease from 0.5 to 0.4:

- News organs (brains and salivary glands) appear and the splitting rule for remainders ($W_T = 0.12 – 0.05$ in ICRP publication 60) is deleted:

The Commission has strongly clarified the use of effective dose:

- E is calculated by using reference values for a reference person or group:

- E should be used for planning in prospective situations:

- E should **not** be used for more detailed retrospective dose and risk assessments on exposure of individuals:

- E should **not** be used for epidemiological studies.

The Linear-non-threshold (LNT) hypothesis remains the hypothesis for averaging and summing up of doses, for the concept of effective dose and for the system of dose record keeping. Biological information is challenging the system, but new evolving knowledge is still insufficient to provide a new basis, or a significant change of the current basis, for protection purposes. ICRP considers that LNT is a pragmatic, realistic and conservative tool, not truth supplemented with real data.

Nominal risk coefficients for stochastic effects (% Sv-1) decreased from 6.0 to 5.5 for cancer and 1.3 to 0.2 for heritable effects for the whole exposed population, but the Commission estimates that this decrease is too small to warrant changing the current dose limit values, particularly taking into account uncertainties. Indeed the old problem of uncertainty remains, and is particularly large for low doses and dose rates. However, the Commission continues to assume that the overall risk coefficient of 0.05 $Sv^{-1}$ continues to be appropriate for purposes of radiological protection.

Although LNT remains the basis of radiological protection, the Commission accepts that specific situations with a different dose effect relationship are possible. Thresholds can exist but are not universal; the LNT remains a prospective tool.

The three principles, justification, optimisation and limitation are maintained and consolidated. In planned situations, the total dose to any individual **from all regulated sources** should not exceed the appropriate limits specified by the Commission. However the Commission reinforces the concept of Dose Constraint which is the most fundamental level of protection for the most exposed individuals **from a single source** within a type of exposure. Dose constrains are used prospectively as the starting point of the optimisation process. Numerically, the dose constraint is less than limits, and in planned, emergency or existing situations it represents the level of dose/risk where action is ***almost always*** warranted. Numerical values for dose constraints will be established at the **national level or local level** by regulators **and operators**. It is a level of ambition for operators approved by regulators; it is not a form of retrospective dose limitation.

The numerical criteria recommended by ICRP Publication 60 and thereafter can be regarded as constraints, the values fall into three defined bands: 0.01-1 mSv, 1-20 mSv, and 20-100 mSv. These three bands are explained in the text, and examples are given. For radon, ICRP's constraints are set where action is almost always warranted: 600 $Bq.m^{-3}$ for home and 1500 $Bq.m^{-3}$ at work.

In the new recommendations the Commission has more clearly defined collective dose and the limits of its uses. It is an instrument for optimisation, for comparing radiological technologies and protection procedures; it is not intended as a tool for epidemiologic risk assessment. It is not reasonable and should be avoided for computation of cancer deaths, particularly those based on collective dose involving extremely low individual exposures to large populations.

With regard to exclusion and exemption, the Commission mainly refers to several years of dialogue that various international organisations have undertaken, and suggest that they do not wish to interfere in these discussions.

The Commission is waiting for the results of Committee 5 (Protection of the Environment) before developing recommendations for protection of non-human species. The new recommendations refer today to the ICRP publication 91 (2003), which describes a framework for assessing the impact of ionising radiation on non-human species.

Lastly, after these new set of consultations, the Commission plans the final adoption of these news recommendations for the end of the year 2006 or the beginning of the year 2007 for publication in 2007.

## 3. COMMENTS ON AND SUGGESTIONS FOR THE NEW RECOMMENDATIONS

For any new radiation protection recommendations to be successful, they must be welcomed and acceptable to policy makers, regulators, industries, stakeholders, scientists and radiation protection professionals. They have to enhance worker safety and health and protection of the environment, and deliver an understandable and cost effective implementable product. It is necessary to maintain stability in the policy and system of radiological protection to avoid unnecessary waste of limited resources. As the ICRP claims that the risk change being proposed is small and that risk is decreasing, it could be understood that the current regulation already protects both workers and public properly.

It is greatly appreciated that the new draft has made significant progress and improvement since the last Asian conference. Many previous criticisms have been addressed, the new draft addresses continuing concerns, and the feasibility of implementing the new draft has been greatly improved.

### 3.1 The three principles reaffirmed

Regulatory bodies (RB) of Asian and Pacific areas participating at the regional conference have well appreciated that the new recommendations represent more continuity with ICRP 60 than change. The new draft is based on and consistent with the former recommendations. New scientific findings have been introduced and the three principles of protection are not changed. Indeed, regulatory authorities are particularly concerned by justification, optimisation and dose limitation. In many countries national regulations are based on ICRP publication 60.

***Justification*** is one of the essential principles of radiological protection. ICRP reaffirms that the responsibility for judging the justification usually falls on government agencies for occupational and public exposure. Japanese regulatory bodies raised the question of whether authorities would be required to justify every situation individually, or whether broad, overall judgments would suffice for categories of radiation-related activities. Judgment of justification has been, and will be, done democratically through appropriate political/social processes. The decision-making process differs depending on the types of activity being considered.

***Optimisation.*** In Japan as in all Asian countries, the concept of ALARA has been well understood and has been implemented by each operator. The public and occupational exposures have been kept well below the dose limits, the levels controlled by laws and regulations. According to the new draft recommendations, dose constraints are "*the most fundamental level of protection"*. Indeed constraints may be a good approach to achieve "optimisation" in some cases. However, is it always necessary to introduce dose constraints into the regulation system regardless of types of exposures? Regulatory bodies are not convinced that the introduction of constraints is in all cases necessary, and think that this introduction could make the system more complicated and confusing. Operators also feel this way. The distinction between dose limits and dose constraints seems to be unclear and difficult to implement. However, the experience gained from nuclear activities can be used to establish dose constraints when designing the workplace environment. An effort of clarification is needed for the final document.

***Dose limits*** recommended by the ICRP in publication 60 have been introduced in Asian countries and have been strictly controlled by the relevant laws. Dose limits still have an important role in radiation protection. Through the implementation of the ALARA concept, doses actually received have been kept much lower than the dose limits. The values of dose limit are NOT changed, though detriment-adjusted nominal risk coefficients for cancer and hereditary effects are decreased. ICRP clearly explains that, taking into account uncertainties in risk evaluation, the decreases presented in the new recommendations are too small to justify any changes in dose limits. This, in essence increases the level of confidence in existing dose limits, and this could be explained to stakeholders.

Japanese authorities think that the role of organisations in the development and implementation of radiological protection principles should be maintained: ICRP formulates recommendations and principles, IAEA develops the BSS, which provides basic/practical model of the regulation system, and national governments establish and implement national/regional regulation systems reflecting the different situations in each country. The universality of the ICRP recommendations is an important contribution to worldwide radiological protection.

Regulatory bodies introduced the notion of risk communication in the recommendations. This communication is a part of social science which is more and more present in the radiological protection system through the involvement of stakeholders. The question of the ICRP's role in defining stakeholder involvement remains a key question.

### 3.2 Dose from radiation exposure

LNT is the foundation for the ICRP risk evaluation system, but the relation between dose — damage and detriments is probably much too naïve an approach, and has certain limitations. While risk assessment is mainly based on A-bomb survivors, risks from low doses are far from certain. Moreover, it is important to recognise the limits of epidemiological studies, in that, for example, the regional variation in cancer mortality in different Japanese prefectures is over 10%. In spite of this, because a broad, overall approach is needed for regulations and policies, the ICRP approach was endorsed by conference participants.

In radiological protection practice, one needs quantities useful for the management of exposures and regulations. The ICRP has defined a single quantity (Effective dose), specifying an "amount" of exposure and related to the probability of stochastic effects for all type of radiation exposures, both for acute and chronic exposures, and both for external and internal exposures.

One significant confusion in this system is the definition of two concepts ***Equivalent dose*** and ***Effective dose*** both using the same unit; the Sievert. Moreover the equivalent dose is applied to limit deterministic effects, such as to the lens of the eye and to skin, but uses weighting factors that have been established based on stochastic effects. As these limits are only controlled for skin, and estimated for the lens of the eye, another approach could be to simply define equivalent dose as being simply a step in the calculation of effective dose. Effective dose should be described as a double weighed concept, using the unit of Sievert, while the other dose for regulation could be the absorbed dose measured in Gray.

ICRP is not proposing a specific scheme for the treatment of doses and risks, and this simplification is sufficient only for the intended application for the limitation and management of doses.

For dose calculation the ICRP has noticeably changed some weighting factors. For the gonads, this has been a continuous trend since ICRP publication 26 (using a tissue weighting factor of 0.25), to

ICRP publication 60 (using a tissue weighting factor of 0.20), and now to the new draft recommendations (using a tissue weighting factor of 0.08). This corresponds to a continuous trend in scientific observation among the A-bomb survivors and progeny. In another case however, the evolution could be disturbing for stakeholders. For example, the tissue weighting factor for the breast has successively been 0.15 (in ICRP publication 26), 0.05 (in ICRP publication 60) and now 0.12. Neutron weighting factors for neutron energy less than 1 MeV decreased by a factor of 2 from ICRP publication 26 to ICRP publication 60 but now back to the value close to former publication 26. This "yoyo" evaluation could be misinterpreted by some stakeholders or by the "anti-ICRP" world, which have often evoked the costs of such decisions (neutrons for example). Some regulatory bodies are afraid that frequent changes of weighting factors could have a negative impact on radiation protection as well as on public trust. However, it seems reasonable for ICRP to be transparent, and not to hesitate on such decisions that are based on the latest scientific assessment of the situation. This reinforces the credibility of the institution.

Furthermore, it is anticipated that the newly recommended tissue weighting factors will have a great impact on dose assessment of not only internal exposure, but also external exposure. Because of the prospective nature of radiological protection, the Commission does not recommend re-computation of existing values with the new models and parameters (Paragraph 153). The calculation of the Occupational Intake of Radionuclide (OIR) is one of the next objectives of the new mandate, after publication of revised dosimetric models; human respiratory tract model, human alimentary tract models, systemic models and voxel phantoms calculation methodology.

Some regulatory bodies suggest performing simulation of the influences to estimate the ensuing changed in the derived, auxiliary limits and dose coefficients. It is possible that both utilities and authorities could experience problems with trust from stakeholders (workers and the public) when these changes are implemented.

To avoid this, the ICRP must clearly explain that these models are firstly developed for prospective use in protection. In these cases, parameters are default values, invariant results (dose coefficients) without uncertainties. But these modern models could also be used for retrospective purposes and in these cases, it is possible to replace default parameters by realistic parameters and the results (dose coefficients) will be really adapted to the case studied. Today, the lack of explanation sometimes leads to ambiguities.

### 3.3 Collective dose

It is generally appreciated that the concept of collective dose remains. It is also appreciated that the limits of this concept are more clearly explained, avoiding misuses as in the case of the prediction of number of deaths after the Chernobyl accident.

The new definition is considered as very important: collective dose is not intended as a tool for epidemiological risk assessment and is inappropriate to use in risk projection based on epidemiological studies. The computation of cancer deaths or hereditary effects based on collective dose, particularly those involving very small individual exposures to large populations, is not reasonable and should be avoided.

Collective dose is an instrument for optimisation, for comparing technologies and protection procedures.

The challenge now is to explain to stakeholders that their previous use of collective dose and risk prevision, mainly based on the LNT hypothesis, is not and has not been valid.

### 3.4 Definition of exposure situations

In the new recommendations three exposure situations are identified:

- Planned situations are everyday situations involving a planned operation,
- Emergency situations are unexpected situations that occur during the operation of a practice and that require urgent action,
- Existing exposure situations are exposure situations that already exist when a decision on control has to be taken, including natural background radiation and residues from previously unregulated practices.

However the new recommendations seem unclear for potential exposures. Safety culture is a concept difficult to understand for users of small sources.

### 3.5 Natural exposure

ICRP publication 60 had already considered that natural exposure, when controllable, has to be incorporated in the radiation protection system. It was a great progress, and was a key basis of the explanation to the general public that the effects of radiation do not differ between radiation of natural or man-made origin. The new recommendations reaffirm this statement. Equity between different branches of workers, who may have exposure from man-made radiation in nuclear power plants or from natural radiation in coal mine, is reinforced.

Exposure of aircrew should be classified as occupational exposure. This is already the case in many countries; Japan for example has fixed constraints at 5 mSv per year. Nevertheless this is not the main concern for natural exposures for many countries, particularly in China. Underground mining of coal and other products and underground workers in general, count for ten million workers China. This is one of the main sources of exposure for this country.

Many discussions concerned the constraints recommended for Radon-222. For some participants the level of activity 600 $Bq.m^{-3}$ for dwellings and 1500 $Bq.m^{-3}$ are too high. These comments are based on recent epidemiological studies showing statistically significant evidence of lung cancers for levels higher than 100 $Bq.m^{-3}$. Some suggested 200 $Bq.m^{-3}$ for new houses and 400 $Bq.m^{-3}$ for existing houses. ICRP wishes to keep the proposed values because uncertainties remain on epidemiological studies and because old and new approaches are used for determining these constraints values.

### 3.6 Medical exposure

In medical exposure of patients, computed tomography (CT) has become a major source of radiation. The numbers of CT facilities and examinations are constantly increasing worldwide, and several research papers have been published documenting these increases. The absorbed dose to tissues from CT can often approach or exceed the levels known to increase the probability of cancer as shown in epidemiological studies.

It is important to recognise that radiation from CT might increase cancer risk especially in children and young patients. Every effort to reduce dose while maintaining proper image quality must be made to ensure the patient's real benefit of the diagnostic X-ray examinations.

Some other, less significant needs for clarification, explanation and modification were raised during the conference. The radiosensitivity of the lens of the eye has to be explained and referenced, as well as the Commission's approach to gender differences. In addition, weighting factors and calculation methodologies have to be harmonised.

It was clearly stated that there is a significant need to encourage the translation of important documents of Committee 3 (Protection in Medicine) into many national languages for a more effective dissemination of ICRP recommendations in the medical field.

Because of the uncertainty of effects at low doses the Commission judges that it is not appropriate, for the formal purposes of public health, to calculate the hypothetical number of cases of cancer or heritable diseases that might be associated with very small radiation doses received by large numbers of people over very long periods of time (Paragraph 57). Medical practitioners hope that this important remark will be constantly announced to avoid anxiety of radiophobia about medical exposures.

Lastly risk of induction of cancer should be discussed not independently but with other major factors unrelated to radiation.

### 3.7 Environment

Regarding the new ICRP draft recommendations, it appears that the protection system for the environment and the protection on non-human species have no significant impact on regulatory authorities. Review and consultation will again be necessary if specific and practical radiation protection recommendations are developed for the environment.

Participants largely estimate that there is no hurry and that the framework for assessing the impact of ionising radiation on non-human species (ICRP Publication 91) is enough. ICRP prefers to wait for the results of the discussion of Committee 5, which was generally well appreciated.

### 3.8 Constraints

It is important again to discuss the concept of dose constraints even if this has already been discussed in previous chapters, because this is the most controversial concept in the new recommendations.

Is it always necessary to introduce dose constraints into national regulation systems regardless of types of exposures? The majority of participants are not convinced by the introduction of constraints in any case, and think that this introduction could make the system more complicated and confusing. The distinction between dose limits and dose constraints seems to be unclear and difficult to implement.

However, for the workplace, in many cases dose constraints already exist and the experience gained from such practices can be used to establish dose constraints when designing the workplace environment. Radiation protection measures have been implemented since the end of the seventies in accordance with the ALARA concept. These optimised radiation protection approaches resulted in decreases in occupational exposure.

ICRP addresses these concerns by suggesting that in planned situations constraints represent an ambitious level of protection based on experience. For nuclear energy production it is clearly stated by the ICRP that the system will practically not change since optimisation based on the ALARA concept

still exists. However the ICRP says that while ALARA is well implemented in the nuclear energy area, this is not true for all other sectors of exposure-causing activities.

In emergency or existing controllable exposure situations constraints represent a level of dose or risk where action to reduce dose or risk is almost always warranted. Dose constraints are set to ensure that it is not planned to exceed constraints. An effort of clarification remains needed for the final document.

The fear of users is if an assessment shows that a relevant constraint was not complied, it could be regarded as a failure of protection. ICRP once more, has to be clear on this important aspect and clearly assume that dose constraints applied only for prospective purpose in all three types of exposures. Dose constraints should not be regarded in all case as a rigid boundary. ICRP should state more clearly that exceeding the constraint would not be a regulatory infringement, and should provide guidance on what judgements can be made retrospectively in emergency and existing situations (to judge the effectiveness of protection efforts since constraints are not applicable). In its draft the ICRP illustrates the constraint concept with a definition of three bands of less than 1 mSv, 1 mSv to 20 mSv, and 20 mSv to 100 mSv. It is recommended that the explanation of these three bands should give more illustrations of the different situations.

ICRP should clearly explain the rationale for its recommended numerical values. Constraints could be a good opportunity for the ICRP or any other appropriate organisation to promote education of radiation risk. For example 1 mSv/y is the variation of natural background dose in the world and this level of dose could be explained as corresponding to a marginal increase above the natural background. Some at the conference recommended public education and information in all levels of education.

Some participants do not understand the recommendation for maximum numerical dose constraints of 0.1 and 0.3 mSv per year for the context of waste management alone, and would prefer to remove it.

Another question raised by a number of participants concerns the dose level below which the optimisation process should stop. The dose of 0.01 mV per year has been widely considered to be a good basis for exemption. Is this actually a lower boundary for optimisation?

All aspects of optimisation cannot be codified; optimisation is more an obligation of means than of results. The authority should focus on processes, procedures and judgments rather than specific outcomes. An open dialogue must be established between the authority and the operating management to ensure a successful optimisation process. Recommendations should encourage cycles of continuous review and assessment to optimise dose for practices using a single source. As such, discussions seemed to indicate that there was not a universal, *a priori*, *de facto* lower bound to optimisation.

Through general discussion, a consensus emerged that, as previously stated, the ICRP should not fix numerical values for dose constraints for specific circumstances. This should be left to appropriate processes at the national or local level. This is an important point in the discussion between Asian stakeholders and the ICRP. For example Japan has already fixed an administrative goal for aircrew exposure at 5 mSv per year.

Some conference participants suggested that dose constraints would be difficult to implement in emergency situations. They claimed that relaxation of controls (applicable for planned situations) could be permitted in an emergency situation, keeping in mind that efforts should be made to keep doses below 1 Sv in some circumstances, but below 100 mSv as the highest recommended constraint.

As such, it was requested that the ICRP should clearly explain what kind of dose constraint(s) should be used for emergency situations?

Another point in need of clarification in the final text concerns the definition of a single source. Exposure to workers is source related, but the source could be a single nuclear power plant or several nuclear power plants on one site. In the case of the public, exposure could come from several sources.

In conclusion it should be explained which concept is the most important for regulatory control under the new system, constraints or dose limits or both. Moreover if constraints are related to a single source, and if constraints become the most fundamental level of protection of exposure in future, how can we ensure that the total dose received from all possible sources will be controlled under some limit? These points are fundamental and often repeated in comments and criticisms.

Finally, it was agreed that the presentation made by the ICRP chair during the conference was very clear, and in fact much clearer than the draft recommendations themselves. As such, much of the confusion from the latest draft seems to be based on terminology and wording, not on the concepts presented.

### 3.9 General comments

Although the terms deterministic and stochastic effects have a firmly embedded use in the system of radiation protection, tissue reactions, cancer and heritable effects may be much more easily understood by the general public. As such, it seems it would be better if the previous terms were completely replaced by the new, more directly descriptive terms.

Some participants suggested that the ICRP should exercise a more discreet approach to changes, as frequent changes in the definition of terms or concepts could lead to communication problems with many different groups of stakeholders.

Generically, more attention should be paid to the language of the new recommendations, particularly keeping in mind the non-English speaking countries.

The key challenge for the new recommendations will be to demonstrate to regulators that any modification in their regulations necessary to be in full compliance with the new recommendations should be implemented. As expressed by the South Korean experts, some participants agree that once an improved draft proposal is completed, it would be worthwhile to seek the view of radiation protection practitioners (regulators and operators) on the potential, practical implications before issuing the next recommendations.

Lastly, some members of the Japan Health Physics Society (JHPS) have appreciated the enthusiastic discussions that have taken place over the past several years, but think that it is time to conclude. They have made an impressive effort at analysing the new draft and its possible implications, and have suggested some minor editorial revisions. They also suggest a significant re-ordering of the chapters (see their presentations). This suggestion should be studied by the ICRP in light of all three NEA/ICRP regional workshops.

## 4. IMPLICATIONS FOR THE CRPPH

The quality of the debate and the numerous constructive and positive proposals and criticisms encourage the CRPPH of the NEA to continue this open dialogue between the ICRP and stakeholders.

The Asian forum underlined three actions for the CRPPH:

1. The CRPPH is a useful open forum for discussion with a key role to anticipate potential challenges and dialogue with stakeholders. The Villigen meeting series and working groups such as EGIS (Expert Group on the Implementation of Radiological Protection Science) for science implication in the radiation protection system is another one? It is important to discuss interaction between science, radiological protection and social values. The CRPPH plans a series of technical workshops to discuss the interactions and relationships between science and policy. These workshops will be initiated by the EGIS working group. The CRPPH expects fruitful and positive debates.

2. It is clear that the CRPPH is a good forum for developing guidance for the implementation of the forthcoming ICRP recommendations. It could merge the perspectives of operators, regulators and professionals. The CRPPH experiences, like ISOE (Information System on Occupational Exposure) and INEX (International Nuclear Emergency Exercises), reinforce the role of this forum for this dialogue.

3. Lastly, this Asian meeting reinforces the continuation of collaboration between the ICRP and the NEA. We are at the end of the first period with the publication of the recommendations in 2007. The new period will be focused on interpretation and implementation.

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## Appendix 1

## LIST OF PARTICIPANTS

### AUSTRALIA

BURNS, Peter A.
Director
Environmental and Radiation Health Branch
Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)
Lower Plenty Road
Yallambie, Victoria 3085

Tel: +61 3 9433 2335
Fax: +61 3 9432 1835
Eml: peter.burns@arpansa.gov.au

### CHINA

LI, Xutong
Ph.D, Senior Permanent Research Fellow
Nuclear Safey and Radiation Center (SEPA)
Hongliannancun 54, Haidianqu
100088 Beijing

Tel: +86 10 82212544
Fax: +86 10 62257804
Eml: lixutong223@yahoo.com

PAN, Zi Qiang
Science and Technology Commission
China Atomic Energy Authority
P.O. Box 2102-14
100822 Beijing

Tel: +86 10 685 10 370
Fax: +86 10 685 39 375
Eml: zqpan@a-1.net.cn

XIA, Yihua
Dept of Health Physics
China Institute of Atomic Energy (CIAE)
P.O. Box 275-24
102413 Beijing

Tel: +86 (1069) 357 584
Fax: +86 (1069) 357 008
Eml: xiayh@iris.ciae.ac.cn

### FRANCE

LOCHARD, Jacques
Directeur
The Nuclear Protection Evaluation Centre (CEPN)
Expansion 10000
28, rue de la Redoute
F-92260 Fontenay-aux-Roses

Tel: +33 1 55 52 19 40
Fax: +33 1 55 52 19 21
Eml: lochard@cepn.asso.fr

MÉTIVIER, Henri
2, allé e des Hautes Futaies
F-91450 Soisy-sur-Seine

Tel: +(0)6 07 18 06 33
Eml: metivier.henri@wanadoo.fr

**INDONESIA**

TARYO, Taswanda
Director of Center for Dissemination of Nuclear and Science Technology
Indonesia National Nuclear Energy Agency (Batan)
Jalan Lebas Bulus Raya No. 49, Gedung Persaten
Jakarta Selatan 12440

Tel: +62 21 765 9401 02
Fax: +62 21 7591 3833
Eml: ptrkn@batan.go.id

**JAPAN**

AKAHANE, Keiichi
Senior Researcher
National Institute of Radiological Sciences (NIRS)
4-9-1, Anagawa, Inage-ku,
Chiba 263-8555

Tel: +81 43 206 3064
Fax: +81 43 284 0918
Eml: akahane@nirs.go.jp

AKIMOTO, Seiichi
Counselling Expert
Japan Nuclear Energy Safety Organisation (JNES)
Tokyu Reit Toronomon Bildg.
3-17-1, Toramnomon, Minato-ku
Tokyo 105-0001

Tel: +81 3 4511 1969
Fax: +81 3 4511 1998
Eml: akimoto-seiichi@jnes.go.jp

AMAYA, Takayuki
Safety Examiner, Office of Nuclear Regulation, Nuclear Safety Division
Ministry of Education, Culture, Sports and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959

Tel: +81 3 6734 4035
Fax: +81 3 6734 4037
Eml: t-amaya@mext.go.jp

ANDO, Hideki
Director of Health and Safety Department
O-Arai Research and Development Centre
Japan Atomic Energy Agency (JAEA)
4002, Narita-cho, O-arai-machi, Higashiibaraki-gun
Ibaraki 311-1393

Tel: +81 29 267 4141
(ext. 5200)
Fax: +81 266 7475
Eml: ando.hideki@jaea.go.jp

AOKI, Hideto
Advisor
Japan Nuclear Energy Safety Organization (JNES)
3-17-1, Toranomon, Minato-ku
Tokyo 105-0001

Tel: +81 3 4511 1970
Fax: +81 3 4511 1998
Eml: aoki-hideto@jnes.go.jp

AOYAMA, Shin
Deputy Director-General for Nuclear Power
NISA/METI
1-3-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8986

Tel: +81 3 3501 5801
Fax: +81 3 3580 8570
Eml: aoyama-shin@meti.go.jp

AOYAMA, Yoshiko
Chief Consultant
Japan NUS Co., Ltd.
Loop-X Bldg. 7F, 3-9-15, Kaigan, Minato-ku
Tokyo 108-0022

Tel: +81 3 5440 1865
Fax: +81 3 5440 1869
Eml: uda@janus.co.jp

ARAI, Masaji
Officer for Nuclear Safety Review
Secretariat of the Nuclear Safety Commission, Radiation Protection and Accident Management Division, Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970

Tel: +81 3 3581 9258
Fax: +81 3 3581 9839
Eml: masaji.arai@cao.go.jp

AWATSUJI, Yasuhiro
Deputy Director, Nuclear Safety Division
Ministry of Education, Culture, Sports and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959

Tel: +81 3 6734 3957
Fax: +81 3 6734 3958
Eml: yawatsu@mext.go.jp

CHIBA, Yoshinori
Business Manager, Radiation Protection Center
Hitachi, Ltd. Nuclear Power System Division
2-2, Oomika-cho, 5-chome, Hitachi-shi
Ibaraki-ken 319-1221

Tel: +81 294 55 4919
Fax: +81 294 55 9891
Eml: yoshinori.chiba.ys@hitachi.com

CHIKAMOTO, Kazuhiko
Unit Leader
Japan NUS Co., Ltd.
Loop-X Bldg. 7F, 3-9-15, Kaigan, Minato-ku
Tokyo 108-0022

Tel: +81 3 5440 1865
Fax: +81 3 5440 1869
Eml: chika@janus.co.jp

DE, Meng
Department of Nuclear Engineering and Management School of Engineering
The University of Tokyo
2-11-16, Yayoi, Bunkyo-ku
Tokyo 113-0032

Tel: +81 3 5841 2915
Fax: +81 3 3813 2010
Eml: mou@n.t.u-tokyo.ac.jp

FUCHIGAMI, Keiko
Biotechnology Safety Division
Ministry of Agriculture, Forestry and Fisheries
1-2-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8950

Tel: +81 3 3501 3780
Fax: +81 3 3502 4028
Eml:
keiko_fuchigami@nm.maff.go.jp

FUJII, Katsutoshi
Office of Radiation Regulation
Ministry of Education, Culture, Sports and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959

Tel: +81 3 6734 4045
Fax: +81 3 6734 4048
Eml: fujikatu@mext.go.jp

FUJIMOTO, Kenzo
Director
Research Centre for Radiation Emergency Medicine
National Institute of Radiological Sciences (NIRS)
9-1, Anagawa-4, Inage-ku
Chiba 263-8555

Tel: +81 43 206 3103
Fax: +81 43 206 4094
Eml: kenzofuj@nirs.go.jp

FUJIWARA, Saeko
Department Chief
Radiation Effects Research Foundation
5-2, Hijiyama Park, Minami-ku
Hiroshima 732-0815

Tel: +81 82 261 9122
Fax: +81 82 261 3259
Eml: fujiwara@rerf.or.jp

FUKUMOTO, Masahiro
Deputy Director for Nuclear Safety Review
Secretariat of the Nuclear Safety Commission, Radiation Protection
and Accident Management Division, Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970

Tel: +81 3 3581 9259
Fax: +81 3 3581 9839
Eml:
masahiro.fukumoto@cao.go.jp

FURUTA, Sadaaki
Deputy Director
Radiation Protection Department
Nuclear Fuel Cycle Engineering Laboratories
Tokai Research and Development Center
Japan Atomic Energy Agency (JAEA)
4-33, Muramatsu, Tokai-mura, Naka-gun
Ibaraki 319-1194

Tel: +81 29 282 1111(operator)
+81 29 282 1861(direct)
Fax: +81 29 282 1873
Eml: furuta.sadaaki@jaea.go.jp

GOMI, Kunihiro
Technical Counselor
Secretariat of the Nuclear Safety Commission
Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970

Tel: +81 3 3581 9948
Fax: +81 3 3581 9837
Eml: kunihiro.gomi@cao.go.jp

HAO, Hu
Department of Nuclear Engineering and Management School of Engineering
The University of Tokyo
2-11-16, Yayoi, Bunkyo-ku
Tokyo 113-0032
Tel: +81 3 5841 2915
Fax: +81 3 3813 2010
Eml:
co-hiroshi@n.t.u-tokyo.ac.jp

HARA, Shintaro
Unit Chief for Co-ordination
Radioactive Waste Regulation Division
Nuclear and Industrial Safety Agency (NISA)
1-3-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8986
Tel: +81 3 3501 1948
Fax: +81 3 3501 6946
EML: hara-shintaro@meti.go.jp

HASHIMOTO, Makoto
Japan Atomic Energy Agency (JAEA)
4002, Narita, O-Arai
Ibaraki 311-1193
Tel: +81 29 267 4141 ext.5245
Fax: +81 29 267 4220
Eml:
hashimoto.makoto@jaea.go.jp

HATTORI, Takatoshi
Senior Research Scientist
Central Research Institute of Electric Power Industry (CRIEPI)
2-11-1, Iwado-kita, Komae-shi
Tokyo 201-8511
Tel: +81 3 3480 2111
Fax: +81 3 3480 2493
Eml:
thattori@criepi.denken.or.jp

HAYASHIDA, Yoshihisa
Senior Officer and Senior Researcher
Japan Nuclear Energy Safety Organization (JNES)
3-17-1, Toranomon, Minato-ku
Tokyo 105-0001
Tel: +81 3 4511 1953
Fax: +81 3 4511 1998
Eml:
hayashida-yoshihisa@jnes.go.jp

HAYATA, Isamu
Central Research Institute of Electric Power Industry (CRIEPI)
2-11-1, Iwado-kita, Komae-shi
Tokyo 201-8511
Tel: +81 3 3480 2111
Fax: +81 3 3480 3113
Eml:
i-hayata@criepi.denken.or.jp

HIDAKA, Tomonori
Unit Chief, Office of Radiation Regulation
Ministry of Education, Culture, Sports and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959
Tel: +81 3 6734 4045
Fax: +81 3 6734 4048
Eml: thidaka@mext.go.jp

HIGASHI, Kunio
Deputy Chair
Nuclear Safety Commission, Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 3470
Fax: +81 3 3581 3475
Eml: kunio.higashi@cao.go.jp

HIGUCHI, Kiyotaka
Deputy Chief Central Expert Officer in Industrial Health
Organization of the Ministry of Health, Labour and Welfare
1-2-2, Kasumigaseki, Chiyoda-ku
Tokyo 100-8916
Tel: +81 3 3502 6756
Fax: +81 3 3502 1598
Eml:
higuchi-kiyotaka@mhlw.go.jp

HIRANO, Shizuka
Officer for Nuclear Safety Review
Secretariat of the Nuclear Safety Commission, Radiation Protection and Accident Management Division, Cabinet office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 9258
Fax: +81 3 3581 9839
Eml: shizuka.hirano@cao.go.jp

HIROTA, Masahiro
National Institute of Radiological Science (NIRS)
4-9-1, Anagawa, Inage-ku
Chiba 263-8555
Tel: +81 43 206 3064
Fax: +81 43 284 0918
Eml: hirota@nirs.go.jp

HOMMA, Toshimitsu
Group Leader, Risk Analysis and Applications Reserch Group
Japan Atomic Energy Agency (JAEA)
2-4, Shirakata-shirane, Tokai-mura, Naka-gun
Ibaraki-ken 319-1195
Tel: +81 29 282 6862
Fax: +81 29 282 6147
Eml:
homma.toshimitsu@jaea.go.jp

HORIKAWA, Yoshihiko
General Manager
Kansai Electric Power Co., Inc.
13, Goichi, Mihama-cho, Mikata-gun
Fukui 919-1141
Tel: +81 770 32 3695
Fax: +81770 32 3698
Eml: horikawa.yoshihiko
@a4.kepco.co.jp

HOSHI, Junichi
Deputy Director
Nuclear Safety Regulatory Standards Division
Nuclear and Industrial Safety Agency (NISA)
1-3-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8986
Tel: +81-3-3501-0621
Fax: +81-3-3580-5971
Eml: hoshi-junichi@meti.go.jp

HOSONO, Makoto
Professor
Kinki University Shool of Medicine
377-2, Ohno-Higashi, Osaka-Sayama
Osaka 589-8511
Tel: +81 72 366 0221
Fax: +81 72 368 2388
Eml: principle@mac.com

ICHIJI, Takeshi
Research Scientist
Central Research Institute of Electric Power Industry (CRIEPI)
2-11-1, Iwado-kita, Komae-shi
Tokyo 201-8511

Tel: +81 3 3480 2111
Fax: +81 3 3480 2493
Eml: ichiji@criepi.denken.or.jp

IMOTO, Takeshi
Research Associate, Department of Nuclear Engineering
and Management School of Engineering
The University of Tokyo
2-11-16, Yayoi, Bunkyo-ku
Tokyo 113-0032

Tel: +81 3 5841 2915
Fax: +81 3 3813 2010
Eml: iimoto@n.t.u-tokyo.ac.jp

IZUKA, Teruyoshi
Assistant Senior Manager, Nuclear Energy Field Department
Toshiba Corporation
8, Shinsugita-cho, Isogo-ku
Yokohama 235-8523

Tel: +81 45 770 2213
Fax: +81 45 770 2174
Eml:
teruyoshi.iizuka@toshiba.co.jp

INANOBE, Katsunori
Plant Management Department
The Japan Atomic Power Company
1-1, Kanda-Mitoshiro-cho, Chiyoda-ku
Tokyo 101-0053

Tel: +81 3 4415 6125
Fax: +81 3 4415 6191
Eml:
katsunori-inanobe@japc.co.jp

INOMATA, Ichiro
Group Manager, Radiation Safety
Tokyo Electric Power Company
1-1-3, Uchisaiwai-cho, 1-chome, Chiyoda-ku
Tokyo 100-0011

Tel: +81 3 4216 4971
Fax: +81 3 4216 4967
Eml: inomata.ichiro@tepco.co.jp

INOUE, Yasunori
Unit Chief
Ministry of Health, Labour and Welfare
1-2-2, Kasumigaseki, Chiyoda-ku
Tokyo 100-8916

Tel: +81 3 3595 2171
Fax: +81 3 3503 0183
Eml:
inoue-yasunori@mhlw.go.jp

ISHIDA, Kenji
Associate Vice-President
Central Research Institute of Electric Power Industry (CRIEPI)
2-11-1, Iwado-kita, Komae-shi
Tokyo 201-8511

Tel: +81 3 3480 2111
Fax: +81 3 3480 3113
Eml: ishida@criepi.denken.or.jp

ISHIGUCHI, Tsuneo
Professor
Aichi Medical University
21 Nagakute-cho, Aichi-gun

Tel: +81 561 62 3311
Fax: +81 561 63 3268
Eml: ishiguti@aichi-med-u.ac.jp

ISHIGURE, Nobuhito
Professor
School of Health Sciences, Nagoya University
1-1-20, Minami, Daiko, Higashi-ku
Nagoya 461-8673
Tel: +81 52 719 1548
Fax: +81 52 719 1506
Eml: ishigure@met.nagoya-u.ac.jp

IWAI, Satoshi
Senior Research Advisor
Safety Policy Research Division
Mitusbishi Research Institute, Inc.
3-6, Otemachi 2-chome, Chiyoda-ku
Tokyo 100-8141
Tel: +81 3 3277 4505
Fax: +81 3 3277 3480
Eml: iwai@mri.co.jp

IWASAKI, Tamiko
5-18-7, Shinbashi, Minato-ku
Tokyo 105-0004
Tel: +81 3 5470 1986
Fax: +81 3 5470 1991
Eml: tiwa@nsra.or.jp

IWASAKI, Toshiyasu
Research Scientist
Central Research Institute of Electric Power Industry (CRIEPI)
2-11-1, Iwado-kita, Komae-shi
Tokyo 201-8511
Tel: +81 3 3480 2111
Fax: +81 3 3480 3113
Eml: iwasakit@criepi.denken.or.jp

KAI, Michiaki
Professor
Department of Health Sciences
Oita University of Nursing and Health Sciences
2944-9, Megusuno, Notsuharu, Oita-gun
Oita-ken 870-1201
Tel: +81-97 586 4435
Fax: +81-97 586 4387
Eml: kai@oita-nhs.ac.jp

KANEKO, Masahito
Managing Director
Radiation Effects Association
1-9-16, Kajicho, Chiyoda-ku
Tokyo 101-0044
Tel: +81 3 5295 1781
Fax: +81 3 5295 1486
Eml: mkaneko@rea.or.jp

KASAI, Atsushi
(Former) Director of Laboratory
Japan Atomic Energy Institute
4-B-81, Gakusha-mura, Nagawa-machi
Nagano 386-0602
Tel: +81 268 68 4153
Fax: +81 268 68 4154
Eml: kasaiat@h7.dion.ne.jp

KATAOKA, Hideya
Japan Nuclear Energy Safety Organization (JNES)
3-17-1, Toranomon, Minato-ku
Tokyo 105-0001
Tel: +81 3 4511 1814
Fax: +81 3 4511 1898
Eml: kataoka-hideya@jnes.go.jp

KATAYAMA, Shoichiro
Secretary-General
Secretariat of the Nuclear Safety Commission,
Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 0260
Fax: +81 3 3581 0260
Eml:
shoichiro.katayama@cao.go.jp

KATO, Masami
Japan Nuclear Energy Safety Organization (JNES)
3-17-1, Toranomon, Minato-ku
Tokyo 105-001
Tel: +81 3 4511 1790
Eml: kato-masami@jnes.go.jp

KATO, Takao
Director
Secretariat of the Nuclear Safety Commission
General Affairs Division, Cabinet office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 3476
Fax: +81 3 3581 9835
Eml: takao.kato@cao.go.jp

KATOH, Kazuaki
Professor Emeritus
High Energy Acelarator Research Organization (KEK)
1318-1, Tsukuba
Tsukuba 300-4352
Tel: +81 29 850 8050
Fax: +81 29 850 8050
Eml: kk-riss@nifty.com

KAWAKAMI, Hiroto
Senior Counselor
Japan Nuclear Energy Safety Organization (JNES)
3-17-1, Toranomon, Minato-ku
Tokyo 105-001
Tel: +81 3 4511 1800
Fax: +81 3 4511 1898
Eml:
Kawakami-hiroto@jnes.go.jp

KAWAKAMI, Yutaka
Technical Cousultant
Nuclear Safety Research Association
5-18-7, Shinbashi, Minato-ku
Tokyo 105-0004
Tel: +81 3 5470 1983
Fax: +81 3 5470 1989
Eml: ykawakami@nsra.or.jp

KAWASAKI, Masatsugu
Japan Atomic Energy Agency (JAEA)
2-4, Shirakata-shirane, Tokai-mura, Naka-gun
Ibaraki 319-1195
Tel: +81 29 282 5183
Fax: +81 29 282 5183
Eml:
kawasaki.masatsugu@jaea.go.jp

KAWATA, Yosuke
Mitsubishi Materials Corporatin
1-297, Kitabukuro-tyo, Ohmiya-ku
Saitama-shi
Saitama-ken 330-8508
Tel: +81 48 641 5696
Fax: +81 48 641 5654
Eml: kawata@mmc.co.jp

KIKUCHI, Toru
Radiation Protection Supervisor
Jichi Medical School
3311-1, Yakuchiji, Shimotuke-chi
Tochigi 329-0498
Tel: +81 285 58 7062
Fax: +81 285 40 8481
Eml: tkikuchi@jichi.ac.jp

KIMURA, Masanori
Risk Analysis and Applications Research Group
Nuclear Safety Research Center
Japan Atomic Energy Agency (JAEA)
Tokai-mura 2-4, Naka-gun
Ibaraki 319-1195
Tel: +81 29 282 5459
Fax: +81 29 282 6147
Eml:
kimura.masanori@jaea.go.jp

KIRYU, Yasuo
Director for Radiation Protection Policy
Ministry of Education, Culture, Sports, Science and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959
Tel: +81 3 6734 4045
Fax: +81 3 6734 4048
Eml: ykiryu@mext.go.jp

KIUCHI, Shigeaki
Planning Manager
Radiation Effects Association
1-9-16, Kaji-cho, Chiyoda-ku,
Tokyo 101-0044
Tel: +81 3 5295 1483
Fax: +81 3 5295 1486
Eml: kiuchi@rea.or.jp

KO, Susumu
Postdoctral fellow
National Institute of Radiological Sciences (NIRS)
4-9-1, Anagawa, Inage-ku
Chiba 263-8555
Tel: +81 43 206 3064
Fax: +81 43 284 0918
Eml: ssmko@nirs.go.jp

KOBAYASHI, Hirohide
General Manager
Japan Atomic Energy Agency (JAEA)
Nuclear Fuel Cycle Engineering Laboratories
Radiation Protection Department
4-33, Tokai-mura, Naka-gun
Ibaraki 319-1194
Tel: +81 29 282 1111
Fax: +81 29 282 9966
Eml:
kobayashi.hirohide@jaea.go.jp

KOBAYASHI, Sadayoshi
Deputy Director
Radiation Effects Association
Maruishi-Daini B1dg.
1-9-16, Kaji-cho, Chiyoda-ku
Tokyo 101-0044
Tel: + 81 3 5295 1492
Fax: + 81 3 5295 1485
Eml: skobaya@rea.or.jp

KODAMA, Kazunori
Chief Scientist, Chief, Department of Epidemiology
Radiation Effects Research Foundation
5-2, Hijiyama Park, Minami-ku
Hiroshima 732-0815
Tel: +81 82 261 4723
Fax: +81 82 262 9768
Eml: kodama@rerf.or.jp

KOMORI, Akio
Director
Nucler Power Plant Management Department (TEPCO)
1-3, Uchisaiwai-cho, 1-chome, Chiyoda-ku
Tokyo 100-8560
Tel: +81 3 4216 1111 (4801)
Eml: komori.akio@tepco.co.jp

KOSAKO, Toshiso
Professor
Nuclear Professional School, Post-graduate Course, School of Engineering, University of Tokyo
2-22, Shirakata-shirane, Tokai-mura
Ibaraki
Tel: +81 29 287 8441
Fax: +81 29 287 8438
Eml: kosako@nuclear.jp

KUBA, Michiyoshi
Managing Director
Radiation Effects Association
1-9-16, Kaji-cho, Chiyoda-ku
Tokyo 101-0044
Tel: +81 3 5295 1781
Fax: +81 3 5295 1486
Eml: mkuba@numo.or.jp

KUNIYOSHI, Hiroshi
Director
Secretariat of the Nuclear Safety Commission, Radiation Protection and Accident Management Division, Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 3478
Fax: +81 3 3581 9839
Eml: hiroshi.kuniyoshi@cao.go.jp

KUROKI, Noriko
Research and Planning Department
Nuclear Safety Research Association
5-18-7, Shinbashi, Minato-ku
Tokyo 105-0004
Tel: +81 3 5470 1986
Fax: +81 3 5470 1991
Eml: kuroki@nsra.or.jp

KUROTAKI, Katsumi
General Manager
Radiation Effects Association,
Maruishi-Daini Bldg 5F
1-9-16, Kaji-cho, Chiyoda-ku
Tokyo 101-0044
Tel: +81 3 5295 1484
Fax: +81 3 5295 1485
Eml: kurotaki@rea.or.jp

KUSAMA, Keiji
Manager, Radiation Protection Section
Japan Radioisotope Association
28-45, Honkomagome, 2-chome, Bunkyo-ku
Tokyo 113-8941

Tel: +81 3 5395 8084
Fax: +81 3 5395 8054
Eml: kusama@jrias.or.jp

KUSUMI, Shizuyo
Commissioner
Nuclear Safety Commission, Cabinet office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970

Tel: +81 3 3581 3470
Fax: +81 3 3581 3475
Eml: shizuyo.kusumi@cao.go.jp

MARUYAMA, Takashi
Ph.D /Honorary Scientist
National Institute of Radiological Sciences (NIRS)
9-1, Anagawa-4, Inage-ku
Chiba 263-8555

Tel: +81 43 206 3064
Fax: +81 43 284 0918
Eml: t_maru@fml.nirs.go.jp

MATSUDAIRA, Hiromichi
Advisor
Radiation Effects Association
Maruishi-Daini Bldg. 5F
1-9-16, Kaji-cho, Chiyoda-ku
Tokyo 101-0044

Tel: +81 471 58 1409
Fax: +81 471 58 1409
Eml: koshoji@ka2.koalanet.ne.jp

MIKAJIRI, Motohiko
General Manager
Radiation Effects Association
Maruishi-Daini Bldg. 5F
1-9-16, Kaji-cho, Chiyoda-ku
Tokyo 101-0044

Tel: +81 3 5295 1498
Fax: +81 3 5295 1485
Eml: mikajiri@rea.or.jp

MISUMI, Takashi
Managing Director
Radiation Effects Association
1-9-16, Kaji-cho, Chiyoda-ku
Tokyo 101-0044

Tel: +81 3 5295 1783
Fax: +81 3 5295 1485
Eml: tmisumi@rea.or.jp

MITANI, Shunji
Counseling Expert
Japan Nuclear Energy Safety Organization (JNES)
3-17-1, Toranomon, Minato-ku
Tokyo 105-001

Tel: +81 3 4511 1957
Fax: +81 3 4511 1998
Eml: mitani-shinji@jnes.go.jp

MIYAMARU, Kunio
General Manager
Nuclear Power Division
Tokyo Electric Power Environmental Engineering Co.
6-14, 4-chome, Shibaura, Minato-ku
Tokyo

Tel: +81 3 4511 7650
Fax: +81 3 3452 4730
Eml:
miyamaru-k@mail.tee-kk.co.jp

MIYAWAKI, Yutaka
Official for Subsequent Regulation Review
Secretariat of the Nuclear Safety Commission
Subsequent Regulation Review Division, Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970

Tel: +81 3 3581 9842
Fax: +81 3 3581 9837
Eml:
yutaka.miyawaki@cao.go.jp

MIYAZAKI, Shinichiro
Manager
Kansai Electric Power Co.
3-6-16, Nakanoshima, Kita-ku
Osaka 530-8270

Tel: +81 80 5303 7740
Fax: +81 6 6443 2659
Eml: miyazaki.shinichiro
@e5.kepco.co.jp

MIZUNO, Shoichi
Researcher
Tokyo Metropolitan Institute of Gerontology
35-2, Sakae-cho, Itabashi-ku
Tokyo 173-0015

Tel: +81 3 3964 3241.Ext 3153
Fax: +81 3 3579 4776
Eml: smizuno@tmig.or.jp

MORIMYOU, Mitsuoki
Research Councilor
Radiation Effects Association
Maruishi-Daini Bldg. 5F
1-9-16, Kaji-cho, Chiyoda-ku
Tokyo 101-0044

Tel: +81 3 5295 1484
Fax: +81 3 5295 1485
Eml: morimyou@rea.or.jp

MUKAIDA, Naoki
Radiation Safety Nuclear Power Engineering,
Quality and Safety Management
Tokyo Electric Power Company
1-3, Uchisaiwai-cho, 1-chome, Chiyoda-ku
Tokyo 100-8560

Tel: +81 3 4216 4975(direct)
+81 3 4216 1111
Fax: +81 3 4216 4967
Eml: mukaida.naoki@tepco.co.jp

MURAKAMI, Hiroyuki
Japan Atomic Energy Agency (JAEA)
2-4, Shirakata, Tokai-mura,
Ibaraki 319-1195

Tel: +81 29 282 5876
Fax: +81 29 282 6063
Eml:
murakami.hiroyuki@jaea.go.jp

MURAKAMI, Takashi
Kyushu Electric Power Co., Inc.
2-1-82, Watanabe-dori, Chuo-ku
Fukuoka 810-8720

Tel: +81-092-726-1558
Eml: takashi_c_murakami
@kyuden.ne.jp

MUTO, Sakae
Deputy Chief Nuclear Officer
Tokyo Electric Power Company
1-3, Uchisaiwai-cho, 1-chome, Chiyoda-ku
Tokyo 100-0011

Tel: +81 3 4216 1111
Fax: +81 3 3596 8538
Eml: muto.sakae@tepco.co.jp

NAGATAKI, Shigenobu
Executive Director
Japan Radioisotope Association
2-28-45, Honkomagome, Bunkyo-ku
Tokyo 113-8941

Tel: +81 3 5395 8021
Fax: +81 3 5395 8051
Eml: nagataki@jrias.or.jp

NAKAGAMI, Motonori
Manager
Chubu Electric Power Co., Inc.
1, Toshin-cho, Higashi-ku
Nagoya 461-8680

Tel: +81 70 6588 9731
Fax: +81 52 973 3176
Eml: nakagami.motonori
@chuden.co.jp

NAKAGIRI, Shigeru
Commissioner
Nuclear Safety Commission, Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970

Tel: +81 3 3581 3470
Fax: +81 3 3581 3475
Eml: shigeru.nakagiri@cao.go.jp

NAKAI, Kunihiro
JGC Corporation
2-3-1, Minato Mirai, Nishi-ku
Yokohama 220-6001

Tel: +81 45 682 8385
Fax: +81 45 682 8812
Eml: nakai.kunihiro@jgc.co.jp

NAKAMURA, Koichiro
Director
Nuclear Safety Regulatory Standards Division
Nuclear and Industrial Safety Agency (METI)
1-3-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8986

Tel: +81 3 3501 0621
Fax: +81 3 3580-5971
Eml:
nakamura-koichiro1@meti.go.jp

NAKAMURA, Takashi
Professor Emeritus and Visiting Professor
Cyclotron and Radioisotope Centre
Tohoku University
6-3, Aoba, Aramaki, Aobaku, Sendai
Miyagi 980-8578

Tel: +81 22 795 7800
Fax: +81 22 795 3485
Eml:
nakamura@cyric.tohoku.ac.jp

NIWA, Ohtsura
Professor
Radiation Biology Centre, Kyoto University
Yoshida Konoe-cho, Sakyo-ku
Kyoto 606-8501

Tel: +81 75 753 7563
Fax: +81 75 753 7564
Eml:
oniwa@house.rbc.kyoto-u.ac.jp

NOGUCHI, Hiroshi
Deputy Director, Safety Administration Department
Japan Atomic Energy Agency (JAEA)
Muramatsu 4-49, Tokai-mura, Naka-gun
Ibaraki-ken 319-1184

Tel: +81 29 282 1122
Fax: +81 29 282 4921
Eml: noguchi.hiroshi@jaea.go.jp

NOMURA, Masashi
Radiological & Environmental Protection Group Manager
Japan Atomic Power Company
Mitoshiro Bldg.
1-1, Kanda-Mitoshiro-Cho, Chiyoda-ku
Tokyo 101-0053

Tel: +81 3 4415 6121
Fax: +81 3 4415 6191
Eml:
masashi-nomura@japc.co.jp

NUMAKUNAI, Takao
General Advisor
Institute of Radiation Measurements
2-4, Shirakata Shirane, Tokai-mura, Naka-gun
Ibaraki-ken 319-1184

Tel: +81 29 282 5546
Fax: +81 29 283 2157
Eml: t.numakunai@irm.or.jp

ODA, Keiji
Professor, Division of Environmental Energy Science
Faculty of Maritime Sciences, Kobe University
5-1-1, Fukaeminami-machi, Higashinada-ku
Kobe-shi
Hyogo-ken 658-0022

Tel: +81 78 431 6304
Fax: +81 78 431 6304
Eml: oda@maritime.kobe-u.ac.jp

ODA, Kimihiko
Director-General
Science and Technology Policy Bureau
Ministry of Education, Culture, Sports, Sciences and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959

Tel: +81 6734 4000
Fax: +81 6734 4008
Eml: koda@mext.go.jp

OGISO, Zen-ichi
Principal Staff
Japan Nuclear Energy Safety Organization (JNES)
3-17-1, Toranomon, Minato-ku
Tokyo 105-0001

Tel: +81 3 4511 1710
Fax: +81 3 4511 1898
Eml: ogiso-zenichi@jnes.go.jp

OGIU, Toshiaki
M.D., Ph.D., Guest Researcher
National Institute of Radiological Sciences (NIRS)
4-9-1, Anagawa, Inage-ku
Chiba 263-8555
Tel: +81 3 5295 1489
Fax: +81 3 5295 1485
Eml: ogiu@rea.or.jp

OHKURA, Takehisa
Japan Atomic Energy Agency (JAEA)
2-4, Shirakata-shirane, Tokai-mura, Naka-gun
Ibaraki-ken 319-1195
Tel: +81 29 282 6351
Eml: ohkura.takehisa@jaea.go.jp

OHNO, Kazuko
Instructor,
Aichi Medical University Hospital
Nagakute-cho 21, Aichi-gun
Aichi-ken
Tel: +81 561 62 3311
Eml:
kakochan@aichi-med-u.ac.jp

OISHI, Tetsuya
Japan Atomic Energy Agency (JAEA)
2-4, Shirakata-shirane, Tokai-mura, Naka-gun
Ibaraki-ken 319-1195
Tel: +81 29 282 5196
Fax: +81 29 282 5197
Eml: ohishi.tetsuya@jaea.go.jp

OKUBO, Toshiteru
Chairman
Radiation Effects Research Foundation
5-2, Hijiyama Park, Minami-ku
Hiroshima 732-0815
Tel: +81 82 261 3131
Fax: +81 82 263 7279
Eml: okubo@rerf.or.jp

PINAK, Miroslav
Eng., Ph.D./Principal Scientist
Japan Atomic Energy Agency (JAEA)
2-4, Shirakata-shirane, Tokai-mura, Naka-gun
Ibaraki-ken 319-1195
Tel: +81 29 284 3739
Fax: +81 29 282 6768
Eml: miroslav.pinak@jaea.go.jp

SAIGUSA, Shin
Technical Counsellor
Secretariat of the Nuclear Safety Commission
Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 9258
Fax: +81 3 3581 9839
Eml: shin.saigusa@cao.go.jp

SAKAI, Kazuo
Director, Research Centre for Radiation Protection
National Institute of Radiological Sciences (NIRS)
4-9-1, Anagawa, Inage-ku
Chiba 263-8555
Tel: +81 43 206 6290
Fax: +81 43 206 4134
Eml: kazsakai@nirs.go.jp

SAKAI, Yasuhito
Vice-President, Professor of Graduate School
2600-1, Kita-Kanemaru, Otawara City
Tochigi 324-8501
Tel: +81 287 24 3000
Fax: +81 287 24 3120
Eml: ysasaki@iuhw.ac.jp

SATO, Shunsuke
Unit Chief
Ministry of Education, Culture, Sports, Sciences and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959
Tel: +81 3 6734 4161
Fax: +81 3 6734 4162
Eml: ssato@mext.go.jp

SATO, Kaoru
Scientist
Japan Atomic Energy Agency (JAEA)
2-4, Shirakata-Shirane, Tokai-mura, Naka-gun
Ibaraki 319-1195
Tel: +81 29 282 5195
Fax: +81 29 282 6768
Eml: sato.kaoru@jaea.go.jp

SATO, Hideharu
General Manager
Research and Planning Department
Nuclear Safety Research Association
5-18-7, Shinbashi, Minato-ku
Tokyo 105-0004
Tel: +81 03 5470 1986
Fax: +81 3 5470 1991
Eml: hsato@nsra.or.jp

SHIBATA, Masahiro
Director, Office of International Relations
Nuclear Safety Division, Science and Technology Policy Bureau (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959
Tel: +81 3 6734 3901
Fax: +81 3 6734 4027
Eml: shibata@mext.go.jp

SHIGEIRI, Yoshiharu
Deputy Director
Secretariat of the Nuclear Safety Commission
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 0021(ext 44777)
Fax: +81 3 3581 9839
Eml:
yoshiharu.shigeiri@cao.go.jp

SHIGEMATSU, Itsuzo
Consultant Emeritus
Radiation Effects Research Foundation
5-2, Hijiyama Park, Minami-ku
Hiroshima 732-0815
Tel: +81 3 5729 1855
Fax: +81 3 5729 1855
Eml: ishibe@rerf.or.jp

SHIOTSUKI, Keiko
Manager, Training Section
Japan Radioisotope Association
28-45, Honkomagome, 2-chome, Bunkyou-ku
Tokyo 113-8941
Tel: +81 3 5395 8083
Fax: +81 3 5395 8053
Eml: shiotsuki@jrias.or.jp

SODA, Kunihisa
Commissioner
Nuclear Safety Commission, Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 3470
Fax: +81 3 3581 3475
Eml: kunihisa.soda@cao.go.jp

SOHN, Sang-Kyeong
The University of Tokyo
Yayoi, Bunkyo-ku
Tokyo
Tel: +81 3 5841 2905
Eml:
sang-kyeong@n.t.u-tokyo.ac.jp

SUGIURA, Nobuyuki
Associate Professor
Kinki University
3-4-1, Kowakae, Higashi-Osaka
Osaka 577-8502
Tel: +81 6 6721 2332 ext.4429
Fax: +81 6 6721 3743
Eml: nsugiura@kindai.ac.jp

SUZUKI, Gen
Director
Department Environment. Health
National Institute of Public Health
2-3-6, Minami, Wako city
Saitama 351-0197
Tel: +81 48 458 6254
Fax: +81 48 458 6255
Eml: gsuzuki@niph.go.jp

SUZUKI, Kyu
The Kansai Electric Power Co., Inc.
8 Yokota 13, Goichi, Mihama-cho, Mikata-gun
Fukui 919-1141
Tel: +81 770 32 3696
Fax: +81 770 32 3698
Eml:
suzuki.kyuu@d5.kepco.co.jp

SUZUKI, Atsuyuki
Committee Chairperson
Nuclear Safety Commission, Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 3470
Fax: +81 3 3581 3475
Eml: atsuyuki.suzuki@cao.go.jp

SUZUKI, Akira
Manager of Safety Technology Office
Japan Nuclear Fuel Limited
4-108, Okitsuke, Obuchi, Rokkasho-mura
Aomori-ken 039-3212
Tel: +81 175 71 2392
Fax: +81 175 71 2071
Eml: akira.suzuki@jnfl.co.jp

SUZUKI, Yasuyuki
Specialist Atomic Energy, Nuclear Safety Division
Science and Technology Policy Bureau
Ministry of Education, Culture, Sports and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959
Tel: +81 3 6734 4161
Fax: +81 3 6734 4162
Eml: yasuszk@mext.go.jp

TACHIKAWA, Hirokazu
Nuclear Safety Research Association
5-18-7, Shinbashi, Minato-ku
Tokyo 105-0004

Tel: +81 3 5470 1986
Fax: +81 3 5470 1991
Eml: tachikawa@nsra.or.jp

TADA, Junichiro
Safety Officer
Spring-8, 1-1 Khoto, Sayo-mura, Sayo-gun
Hyogo-ken 679-5198

Tel: +81 791 0874
Fax: +81 791 0932
Eml: tada@spring8.or.jp

TAKAHASHI, Fumiaki
Japan Atomic Energy Agency (JAEA)
Shirakata 2-4, Tokai-mura
Ibaraki-ken 319-1195

Tel: +81 29 282 5803
Fax: +81 29 282 6768
Eml:
takahashi.fumiaki@jaea.go.jp

TAKANO, Atsuko
International Affairs and Research Department
Nuclear Safety Research Association
5-18-7, Shinbashi, Minato-ku
Tokyo 105-0004

Tel: +81 3 5470 1983
Fax: +81 3 5470 1989
Eml: takano@nsra.or.jp

TAKASAKI, Koji
Deputy General Manager
Japan Atomic Energy Agency (JAEA)
4-33, Muramatsu, Tokai-mura, Naka-gun
Ibaraki 319-1194

Tel: +81 29 282 1111
Fax: +81 29 282 2033
Eml: takasaki.koji@jaea.go.jp

TAKEDA, Norimasa
Deputy Director
Secretariat of the Nuclear Safety Commission, Radiation Protection and Accident Management Division, Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970

Tel: +81 3 3581 9256
Fax: +81 3 3581 9839
Eml: norimasa.takeda@cao.go.jp

TATENO, Yukio
4-11-2, Sodegaura, Narasino-shi
Chiba 275-0021

Tel: +81 47 453 2475
Fax: +81 47 453 0256
Eml: yukio.tateno@nifty.com

TATSUMI, Kouichi
Director, Institute of Radiation Epidemiology
Radiological Effects
Maruishi-Daini Bldg. 5F
1-9-16, Kaji-cho, Chiyoda-ku
Tokyo 101-0044

Tel: +81 3 5295 1491
Fax: +81 3 5295 1485
Eml: tatsumi@rea.or.jp

TOYOSHIMA, Naoyuki
Manager, Radiation Protection Group
Nuclear Power Operation Department
Kyushu Electric Power Co., Inc.
2-1-82, Watanabe-dori, Chuo-ku
Fukuoka 817-8720
Tel: +81 92 726 1558
Eml:
naoyuki_toyoshima@kyuden.co.jp

UEKI, Tsutomu
Director, Nuclear Safety Division
Science and Technology Policy Bureau
Ministry of Education, Culture, Sports and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959
Tel: +81 3 6734 3900
Fax: +81 3 6734 4027
Eml: ueki@mext.go.jp

UMEZAWA, Hirokazu
Technical Counsellor
Secretariat of the Nuclear Safety Commission
Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 9259
Fax: +81 3 3581 9839
Eml:
hirokazu.umezawa@cao.go.jp

URABE, Itsumasa
Fukuyama University
Gakuen-cho 1, Fukuyama-shi
Hiroshima 729-0292
Tel: +81 84 936 2112 ex.4142
Fax: +81 84 936 2023
Eml:
urabe@fuee.fukuyama-u.ac.jp

WADA, Shigeyuki
Senior officer
Japan Nuclear Energy Safety Organization (JNES)
3-17-1, Toranomon, Minato-ku
Tokyo 105-001
Tel: +81 3 4511 1966
Fax: +81 3 4511 1998
Eml: wada-shigeyuki@jnes.go.jp

WAGATSUMA, Makoto
Japan Nuclear Fuel Limited
4-108, Aza Okitsuke, Oaza Obuchi, Rokkasho-mura, Kamikita-gun
Aomori-ken 039-3212
Tel: +81 175 71 2000
Eml:
makoto.wagatsuma@jnfl.co.jp

WAKASUGI, Kazuhiko
Technical Counsellor
Secretariat of the Nuclear Safety Commission
Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970
Tel: +81 3 3581 9842
Fax: +81 3 3581 9837
Eml:
kazuhiro.wakasugi@cao.go.jp

YAMAGUCHI, Ichiro
Senior Research Officer
National Institute of Public Health
2-3-6, Minami, Wako city
Saitama 351-0197

Tel: +81 48 458 6259
Fax: +81 48 458 6270
Eml: drhyama@niph.go.jp

YAMAGUCHI, Yasuhiro
Deputy Director
Department of Radiation Protection
Japan Atomic Energy Agency (JAEA)
Tokai-mura, Naka-gun
Ibaraki 319-1195

Tel: +81 29 282 5205
Fax: +81 29 282 6063
Eml:
yamaguchi.yasuhiro@jaea.go.jp

YAMAMOTO, Masafumi
Chief Project Manager, Safety Requirement Research Project
Radioactive Waste Management Funding and Research Centre
15 Mori Bldg.
2-8-10, Toranomon, Minato-ku
Tokyo 105-0001

Tel: +81 3 3504 1537
Fax: +81 3 3504 1297
Eml: m_yama@rwmc.or.jp

YAMAMOTO, Hideaki
Japan Atomic Energy Agency (JAEA)
Tokai-mura, Naka-gun
Ibaraki-ken 319-1195

Tel: +81 29 282 6459
Fax: +81 29 282 6063
Eml:
yamamoto.hideaki@jaea.go.jp

YAMANAKA, Takeshi
Senior Researcher, Safety Standard Division
Japan Nuclear Energy Safety Organization (JNES)
Tokyu Reit Toranomon Bldg.
3-17-1, Toranomon, Minato-ku
Tokyo 105-0001

Tel: +81 3 4511 1804
Fax: +81 3 4511 1898
Eml:
yamanaka-takeshi@jnes.go.jp

YAMASOTO, Koutaro
Japan Atomic Energy Agency (JAEA)
Tokai-mura, Naka-gun
Ibaraki 319-1195

Tel: +81 29 282 5183
Fax: +81 29 282 5183
Eml:
yamasoto.kotaro@jaea.go.jp

YASUDA, Takashi
The Kansai Electric Power Co., Inc.
8 Yokota, 13 Goichi, Mihama-cho, Mikata-gun
Fukui 919-1141

Tel: +81 770 32 3697
Fax: +81 770 32 3698
Eml:
yasuda.takashi@d3.kepco.co.jp

YODA, Norihiko
Director-General
Tokyo Quarantine Station
Ministry of Health, Labour and Welfare
2-56, Aomi, Koto-ku
Tokyo 135-0064

Tel: +81 3 3599 1511
Fax: +81 3 5530 2151
Eml:
yoda-norihiko@keneki.go.jp

YOKOYAMA, Hayaichi
Associate Vice-President, Director
Nuclear Technology Research Laboratory
Central Research Institute of Electric Power Industry (CRIEPI)
2-11-1, Iwado-kita, Komae-shi
Tokyo 201-8511

Tel: +81 334802111 ext: 0942
Fax: + 81 3 3480 7950
Eml:
hayaichi@criepi.denken.or.jp

YONEHARA, Hidenori
Team Leader
National Institute of Radiological Sciences (NIRS)
4-9-1, Anagawa, Inage-ku
Chiba 263-8555

Tel: +81 43 206 3099
Fax: +81 43 206 4097
Eml: yonehara@nirs.go.jp

YONEKURA, Yoshiharu
President
National Institute of Radiation Sciences (NIRS)
4-9-1, Anagawa, Inage-ku
Chiba 263-8555

Tel: +81 43 206 3000
Fax: +81 43 206 3271
Eml: yonekura@nirs.go.jp

YOSHIDA, Kazuo
Central Research Institute of Electric Power Industry (CRIEPI)
2-11-1, Iwado-kita, Komae-shi
Tokyo 201-8511

Tel: +81 3 3480 2111 ext.1330
Eml: kazu@criepi.denken.or.jp

YOSHIZAWA, Michio
General Manager
Japan Atomic Energy Agency (JAEA)
Shirakata-Shirane 2-4, Tokai, Naka-gun
Ibaraki 319-1195

Tel: +81 29 282 5200
Fax: +81 29 282 6063
Eml:
yoshizawa.michio@jaea.go.jp

**KOREA (REPUBLIC OF)**

CHOI, Ho-Sin
Director
Radiation Safety Regulation Division
Korea Institute of Nuclear Safety (KINS)
P.O. Box 114
Yuseong
Daejeon 305-600

Tel: +82 42 868 0289
Fax: +82 42 862 3680
Eml: hschoi@kins.re.kr

JUNG, Kyu-Hwan
Senior Researcher, Principal Engineer
Radiation & Waste Safety Evaluation Department of KINS
Korea Institute of Nuclear Safety
19 Guseong-dong, Yuseong
Taejeon 305-338

Tel: +82 42 868 0658
+82 42 868 0061
Fax: 042 868 0531
Eml: jkhwan@kins.re.kr

LEE, Jaiki
Hanyang University
Nuclear Engineering Department
17 Hangdang, Seongdong
Seoul

Tel: +82 2 2220 0466
Fax: +82 2 2292 9855
Eml: jklee@rrl.hanyang.ac.kr

LIM, Byoung-chan
Manager
Radiation Health Research Institute
388-1 Sangmun-dong, Dobong-gu
Seoul

Tel: +82 2 3499 6612
Fax: +82 2 3499 6699
Eml: imbycha@khnp.co.kr

## INTERNATIONAL ORGANISATIONS

### INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

MASON, Ches
Radiation Safety Section
Division of Radiation and Waste Safety
Department of Nuclear Safety
IAEA
Wagramerstrasse 5, P.O. Box 100
A-1400 Vienna

Tel: +43 1 2060 22719 or 22736
Fax: +43 1 20607
Eml: c.mason@iaea.org

### INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP)

HOLM, Lars-Eric
Director-General
Swedish Radiation Protection Authority
SE-171 16 Stockholm

Tel: +46 8 72 97 110
Fax: +46 8 72 97 108
Eml: lars.erik.holm@ssi.se

### OECD NUCLEAR ENERGY AGENCY (OECD/NEA)

Le Seine-St. Germain
12, Boulevard des Îles
F-92130 Issy-les-Moulineaux
France

MARCUS, Gail H.
Deputy Director-General

Tel: +33 (0)1 45 24 10 02
Fax: +33 (0)1 45 24 11 10
Eml: gail.marcus@oecd.org

RIOTTE, Hans
Head
Radiation Protection and Waste Management Division
Tel: +33(0)1 45 24 10 40
Fax: +33(0)1 45 24 11 10
Eml: hans.riotte@oecd.org

LAZO, Edward
Principal Administrator
Radiation Protection and Waste Management Division
Tel: +33 (0)1 45 24 10 42
Fax: +33 (0)1 45 24 11 10
Eml: lazo@nea.fr

ICHIHARA, Yoshiko
Radiation Protection and Waste Management Division
Tel: +33 (0)1 45 24 11 41
Fax: +33 (0)1 45 24 11 45
Eml: :
yoshiko.ichihara@oecd.org

**WORLD NUCLEAR ASSOCIATION (WNA)**

SAINT-PIERRE, Sylvain
Director for Environment and Radiological Protection
World Nuclear Association
Carlton House
22a St. James's Square
London, W4 1EN
Tel: +44(0)20 7451 1539
Fax: +44(0)20 7839 1501
Eml:
saintpierre@world-nuclear.org

## Appendix 2

## LIST OF SPEAKERS

### AUSTRALIA

BURNS, Peter A.
Director
Environmental & Radiation Health Branch
Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)
Lower Plenty Road
Yallambie, Victoria 3085

Tel: +61 3 9433 2335
Fax: +61 3 9432 1835
Eml: peter.burns@arpansa.gov.au

### CHINA

PAN, Zi Qiang
Science and Technology Commission
China Atomic Energy Authority
P.O. Box 2102-14
100822 Beijing

Tel: +86 10 685 10 370
Fax: +86 10 685 39 375
Eml: zqpan@a-1.net.cn

XIA, Yihua
Deparment of Health Physics
China Institute of Atomic Energy (CIAE)
P.O. Box 275-24
102413 Beijing

Tel: +86 (1069) 357 584
Fax: +86 (1069) 357 008
Eml: xiayh@iris.ciae.ac.cn

### INDONESIA

TARYO, Taswanda
Director of Center for Dissemination of Nuclear and Science Technology
Indonesia National Nuclear Energy Agency (Batan)
Jalan Lebas Bulus Raya No. 49, Gedung Persaten,
Jakarta Selatan 12440

Tel: +62 21 765 9401 02
Fax: +62 21 7591 3833
Eml: ptrkn@batan.go.id

### JAPAN

ISHIGUCHI, Tsuneo
Professor
Aichi Medical University
21 Nagakute-cho, Aichi-gun

Tel: +81 561 62 3311
Fax: +81 561 63 3268
Eml: ishiguti@aichi-med-u.ac.jp

ISHIGURE, Nobuhito
Professor
School of Health Sciences, Nagoya University
1-1-20, Minami Daiko, Higashi-ku
Nagoya 461-8673

Tel: +81 52 719 1548
Fax: +81 52 719 1506
Eml:
ishigure@met.nagoya-u.ac.jp

KAI, Michiaki
Professor
Department of Health Sciences
Oita University of Nursing and Health Sciences
2944-9, Megusuno, Notsuharu, Oita-gun
Oita-ken 870-1201

Tel: +81-97 586 4435
Fax: +81-97 586 4387
Eml: kai@oita-nhs.ac.jp

KIRYU, Yasuo
Director for Radiation Protection Policy
Ministry of Education, Culture, Sports, Science and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959

Tel: +81 3 6734 4045
Fax: +81 3 6734 4048
Eml: ykiryu@mext.go.jp

KOSAKO, Toshiso
Professor
Nuclear Professional School, Post-graduate Course, School of Engineering
University of Tokyo
2-22, Shirakata-shirane, Tokai-mura
Ibaraki

Tel: +81 29 287 8441
Fax: +81 29 287 8438
Eml: kosako@nuclear.jp

KUNIYOSHI, Hiroshi
Director
Secretariat of the Nuclear Safety Commission, Radiation Protection
and Accident Management Division, Cabinet Office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970

Tel: +81 3 3581 3478
Fax: +81 3 3581 9839
Eml:
hiroshi.kuniyoshi@cao.go.jp

KUSUMI, Shizuyo
Commissioner
Nuclear Safety Commission, Cabinet office
3-1-1, Kasumigaseki, Chiyoda-ku
Tokyo 100-8970

Tel: +81 3 3581 3470
Fax: +81 3 3581 3475
Eml: shizuyo.kusumi@cao.go.jp

MUTO, Sakae
Deputy Chief Nuclear Officer
Tokyo Electric Power Company
1-3, Uchisaiwai-cho, 1-chome, Chiyoda-ku
Tokyo 100-0011

Tel: +81 3 4216 1111
Fax: +81 3 3596 8538
Eml: muto.sakae@tepco.co.jp

NIWA, Ohtsura
Professor
Radiation Biology Centre, Kyoto University
Yoshida Konoe-cho, Sakyo-ku
Kyoto 606-8501

Tel: +81 75 753 7563
Fax: +81 75 753 7564
Eml:
oniwa@house.rbc.kyoto-u.ac.jp

ODA, Keiji
Professor, Division of Environmental Energy Science,
Faculty of Maritime Sciences, Kobe University
5-1-1, Fukaeminami-machi, Higashinada-ku
Kobe-shi,
Hyogo-ken 658-0022

Tel: +81 78 431 6304
Fax: +81 78 431 6304
Eml: oda@maritime.kobe-u.ac.jp

ODA, Kimihiko
Director-General
Science and Technology Policy Bureau
Ministry of Education, Culture, Sports, Sciences and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959

Tel: +81 6734 4000
Fax: +81 6734 4008
Eml: koda@mext.go.jp

UEKI, Tsutomu
Director
Nuclear Safety Division
Science and Technology Policy Bureau
Ministry of Education, Culture, Sports, Sciences and Technology (MEXT)
2-5-1, Marunouchi, Chiyoda-ku
Tokyo 100-8959

Tel: +81 3 6734 3900
Fax: +81 3 6734 4027
Eml: ueki@mext.go.jp

**KOREA (REPUBLIC OF)**

CHOI, Ho-Sin
Director
Radiation Safety Regulation Division
Korea Institute of Nuclear Safety (KINS)
P.O. Box 114, Yuseong
Daejeon 305-600

Tel: +82 42 868 0289
Fax: +82 42 862 3680
Eml: hschoi@kins.re.kr

**INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)**

MASON, Ches
Radiation Safety Section
Division of Radiation and Waste Safety
Department of Nuclear Safety
IAEA
Wagramerstrasse 5, P.O. Box 100
A-1400 Vienna

Tel: +43 1 2060 22719 or 22736
Fax: +43 1 20607
Eml: c.mason@iaea.org

**INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP)**

HOLM, Lars-Eric
Director General
Swedish Radiation Protection Authority
SE-171 16 Stockholm

Tel : +46 8 72 97 110
Fax : +46 8 72 97 108
Eml : lars.erik.holm@ssi.se

**OECD NUCLEAR ENERGY AGENCY (OECD/NEA)**

MARCUS, Gail H.
Deputy Director-General

Tel: +33 (0)1 45 24 10 02
Fax: +33 (0)1 45 24 11 10
Eml: gail.marcus@oecd.org

**TABLE OF CONTENTS**