Report of Working Group 30 on *Assessment of Marine Environmental Quality of Radiation around the North Pacific*

The 2017 business meeting of Working Group on Assessment of Marine Environmental Quality of Radiation around the North Pacific (WG 30/WG-AMR) was held in Vladivostok, Russia, from 09:00 to 18:00 on September 23, 2017. Co-Chair of the WG 30, Prof. Yusheng Zhang (China) welcomed all of the members and observers to the meeting and made the opening address. Fourteen participants, including nine WG 30 members from four member countries (except Russia and USA) attended the meeting (Annex 1).

Left: Participants of the WG 30 2017 annual meeting. Right: Participants in the meeting.

AGENDA ITEM 1
Adopting the meeting agenda

The agenda for the 2017 business meeting of the WG 30 (Annex 2) was discussed and adopted without revision by the WG members.

AGENDA ITEM 2
Overview and update of WG 30

Prof. Yusheng Zhang made a presentation entitled "Overview and update of the WG 30", giving an introduction on the progress of WG 30 since the last business meeting held during the PICES 2016 Annual Meeting in San Diego, USA.

AGENDA ITEM 3
Member country reports

Each member country of the WG 30 provided an overview of the research that they had conducted in the past year following the WG work plan.

Canada

The large discharge of radioactivity into the Pacific Ocean off Japan from the 2011 Fukushima Dai-ichi nuclear reactor accident generated considerable concern about potential impacts on marine biota in the eastern North Pacific. Time series measurements of ^{134}Cs and ^{137}Cs in seawater on Line P documented the initial arrival of the Fukushima signal by ocean current transport at a location 1500 km west of British Columbia, Canada in June, 2012, about 1.3 years after the accident. Between 2012 and 2015 the Fukushima radioactivity signal continued to increase in surface water on Line P and eventually began to level off at probable maximum values in 2016–2017 as documented by biannual monitoring surveys. Although radioactivity contamination of fish off Fukushima was initially severe, analyses of biological samples performed under the auspices of the InFORM monitoring program off British Columbia have revealed little evidence of elevated radioactivity levels in fish or other biota. These results, based on both measurements and biological modeling studies are a consequence of the low Fukushima radionuclide levels in seawater and the low biological half-lives of several months for Cs in fish. Although the ecosystem impacts off British Columbia associated with radioactivity releases from Fukushima have been minimal, the communication of these results to the public and general community acceptance of their veracity has been a challenge requiring many public lectures, scientific publications and considerable media outreach, thereby providing a cautionary note for studies of future ecosystem threats associated with grim anthropogenic drivers.

China

To improve the understanding on the transport of radioactive pollutants released from the FDNPP accident in the Northwest Pacific and their potential impact, two monitoring cruises were conducted by the Third Institute of Oceanography, SOA of China from the second half year of 2016 to the first half year of 2017. Seawater samples were collected at more than 80 stations at different depths. The biota samples were also collected in part of the stations. Radionuclides of ^{137}Cs, ^{134}Cs and ^{90}Sr were measured. By the end of June 2017, the main monitoring results were as below.

In surface water layer, ^{134}Cs signals were found in 7 stations out of 47 stations with a maximum radioactivity value of 0.76 Bq/m^3. At the depth of 100 m, ^{134}Cs signals were found in 9 stations with a maximum radioactivity value of 0.65 Bq/m^3. At the depth of 200 m, 5 stations were found containing ^{134}Cs with a maximum radioactivity value of 0.37 Bq/m^3. As for the 300-m layer, 11 stations were found with the detectable ^{134}Cs, with a maximum radioactivity value of 0.51 Bq/m^3. At the depths of 500 m and 1000 m, the numbers of stations with detectable ^{134}Cs were 5 and 7, respectively, with the maximum radioactivity level of 0.77 Bq/m^3 and 0.69 Bq/m^3. At the depths of 1500 m and 2000 m, ^{134}Cs was not detectable. As for ^{137}Cs, it was detectable at each layer above 1000-m depth. The maximum value of each depth was around 4 Bq/m^3. At the depth of 500 m, the highest ^{137}Cs value was 4.25 Bq/m^3. But at the depths of 1000 m to 2000 m, ^{137}Cs was found in some stations, with a maximum value of less than 0.5 Bq/m^3. As for the distribution of ^{90}Sr in the water column, the maximum radioactivity value of all the samples was 2 Bq/m^3. For the biota samples, activity levels of these samples were both 0.02 Bq/kg-wet, which was within the background level before FDNPP accident.

As for marine organisms, from the 10 cruises in the last few years, it was found that the radioactivity level of marine organisms in the Northwest Pacific also decreased with time.

In addition, China has also developed a marine radioactivity assessment method with the corresponding program and an equipment for in-situ pre-concentration and monitoring. Moreover, the voxel model for squids was also studied. And six papers have been published.

This year is the last year of WG 30 program. Therefore, we have also spent much time not only to summarize our survey/monitoring results these years and write the Final Report of China, but also to compile the reports

of member countries into the first version of the WG 30 Final Report for discussion, comments and revision on it during the WG business meeting of this year.

Japan

In the past year, Japan continued to carry out the marine environmental radioactivity monitoring in coastal and off-shore areas. The monitoring results showed that the seawater radioactivity level has decreased to the range of background levels before the Fukushima accident, and none of the marine organism samples exceeded the radioactivity limit of general food in Japan. Reduction of the fishery catch caused by the FDNPP accident made the marine resources off Fukushima increase.

Korea

According to the Korean Atomic Safety Law 105, Korea Institute of Nuclear Safety (KINS) and National Fisheries Institute (NIFS) have collaborated to carry out the Marine Environmental Radioactivity Survey (MERS). In 2017 regular samplings were carried out seasonally at a total of 27 stations, and monthly or bimonthly additional samplings at a total of 6 stations in the sea regions around the Korean Peninsula. Instead of reporting results from the 2017 survey, long-term monitoring results have been reported in the 2017 meeting. Time variation of ^{137}Cs, ^{3}H, $^{239+240}$Pu and ^{90}Sr sea water concentrations over past 23 years (1994~2016) have been reported. The mean concentration values of ^{137}Cs, $^{239+240}$Pu and ^{90}Sr in the sea water are found to be 1.09~2.77 mBq/kg, 1.48~14.6 μBq/kg and 0.22~1.24 mBq/kg, respectively. Long-term variation of ^{137}Cs concentration in fish, shellfish and shellfish at 7 stations and ^{137}Cs, $^{239+240}$Pu and ^{90}Sr concentration values in bottom sediments at 16 stations have been also reported.

The Marine Radionuclide Research Group of KIOST has also secured samples of major fishery products from sea regions around the Korean Peninsula. Laboratory analysis of the collected samples has been carried out to investigate the levels of radioactivity contamination. A concentration factor data base has been constructed for major radionuclides such as ^{137}Cs, $^{239+240}$Pu and ^{90}Sr.

Transport and biological fate modeling efforts of radionuclides by KIOST over the period of Dec 2011 to 2017 have been summarized with focus on the cooperation with FIO, China and IMMSP, Ukraine. In detail, recent development of two box-based fate models as well as Eulerian and Lagrangian transport models was reported. The Eulerian transport model can consider multi-fractional sediments, two-step transfer kinetics, bioturbation effects and multiple bed layers to predict depth profiles of radioactivity in water column and bottom sediments. The Lagrangian model considers single fractional sediment, one-step transfer kinetics and single bed layer. Two box-based fate models were reported. One is POSEIDON-extended BURN ver. 1 equipped with pelagic and benthic food webs and the other is Multi-target tissue fish model ver. 1 without consideration of physiological interaction between fish organs. The model results were in good agreement with measurements.

USA

In the past year, the USA has engaged in further outreach activities intended to better inform the public, especially now that there are finally reports of detectable ^{134}Cs in the coastal waters of USA. Most of the monitoring has arisen via the Our Radioactive Ocean project, although a smaller water survey conducted between NOAA and OSU is nearly ready to be published. Dosimetric modeling continues, evaluating the effects of tissue type, density and elemental composition on dose conversion coefficients. A new protocol for the creation of 3D dosimetric models using exclusively open-source software and realistic polygonal meshes is underway, which should allow for better representation of fine-scale structures and allow for better collaboration between the USA and other member countries on this front.

AGENDA ITEM 4
Discussion on the WG 30 Final Report

The Co-Chair of WG 30, Prof. Yusheng Zhang, introduced the current progress of the Final Report of WG 30 – according to the outline of Final Report agreed in the WG 30 2016 business meeting, most of the contents were submitted and integrated into the Final Report, while some contents (progress on radiological dose assessment model from USA, monitoring results at NW Pacific from Japan and Russia, simulation model comparison from Korea, *etc*.) were not submitted and integrated yet.

The WG 30 members agreed that the current section of "Expert Database" should be changed into "List of Contributing Scientists".
The WG members also agreed to the following time schedule for finalizing the report:

- WG members send revisions and comments to Dr. Wen Yu before Oct 20;
- Dr. Wen Yu integrates revisions and comments into the second draft of Final Report and send it to Dr. John N. Smith, Profs. Kathryn A. Higley and Yusheng Zhang before Nov 1;
- Dr. John N. Smith, Profs. Kathryn A. Higley and Yusheng Zhang send their revisions and comments to Dr. Wen Yu before Nov 15;
- Dr. Wen Yu sends the third draft of Final Report to WG members before Nov 22;
- WG members send their revisions and comments to Dr. Wen Yu before Nov 30;
- Submitting the Final Report to PICES secretariat before Dec 10.

AGENDA ITEM 5
Revision and finalisation of Brochure of WG 30

Based on the draft version of brochure of the WG 30, the following items were agreed on during the meeting:

- Information of workshops organized by WG 30 should be included.
- The TORs of WG 30 should be deleted, considering its overlapping with the mission statement of WG 30.
- The cartoon figure should be changed.
- More text should be added to give detail information about the figures.
- Any comments/revisions regarding the brochure should be sent to Dr. Wen Yu before Nov 15.

AGENDA ITEM 6
Proposal to establish a new WG on radioactivity

Since the lifespan of WG 30 will finish at the end of 2017, a proposal of establishing a new WG on the Distribution and Environmental Evolution of Radionuclides in the North Pacific was brought out by Chinese delegation.

Dr. Wen Yu gave a presentation on the above proposal at the WG business meeting. After meeting discussions on the title and duty of the new WG, no consensus was reached, but the meeting agreed to put the new WG proposal into the "Recommendations" section of the WG 30 Final Report. The meeting agreed that further comments/revisions regarding the new WG should be sent to Dr. Wen Yu before Sep 25, and a revised proposal would be presented at the MEQ business meeting on Sep 27.

WG 30 Endnote 1

WG 30 participation list

Members

Yusheng Zhang (China, Co-Chair)
In-Seong Han (Korea)
Kyung Tae Jung (Korea)
Suk Hyun Kim (Korea)
Wu Men (China)
Takami Morita (Japan)
John N. Smith (Canada)
Tomowo Watanabe (Japan)
Wen Yu (China)

Members unable to attend

China: Hongzhi Li
Korea: Young-Il Kim
Russia: Vladimir Goryachev
USA: Kathryn A. Higley

Observers

Daisuke Ambe (Japan)
Jinqiu Du (China)
Jianhua He (China)
Toyomitsu Horii (Japan)
Kyeongok Kim (Korea)
Guangshui Na (MEQ Chair)

WG 30 Endnote 2

WG 30 meeting agenda

1. Revision and adoption of the draft meeting agenda
2. Overview and update of WG 30
3. Country report presentations of member countries
4. Discussion on the WG 30 Final Report (identification of gaps, schedule and work assignments)
5. Revision and finalisation of brochure of the WG 30
6. Discussion on the proposal for the new Working Group (title, objectives, TOR, suggested membership, *etc*.)